OPTIMISATION OF CEMENT MOVEMENT IN INDIA

RATIONALISATION OF COMMODITY FLOWS

Cement Industry - A case study in rationalisation of inter-regional flows with special reference to problems of production and consumption.

SHAKTI KAK

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CENTRE FOR THE STUDY OF REGIONAL DEVELOPMENT
SCHOOL OF SOCIAL SCIENCES
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PREFACE

Increasing importance of cement for the developmental activities and the inequalities in spatial pattern of distribution of the main centres of production and consumption makes the inter-regional flow of cement more prominent. Emergence of large supply centres, on the one hand, and of large demand centres, on the other hand, give further impetus to the movement of cement from supply centres to demand centres. So a rationalised pattern of movement between these is important for making the maximum use of available limited resources.

The study is concerned with the spatial pattern of production and consumption centres, and the pattern of links between these. A further attempt has been made to find a normative pattern of links so as to find the gap existing between the actual and the normative pattern.

The study in depth involving data on the basis of individual plant location and areas of raw material resources is based essentially on the report on cement industry by Dr.L.S.Bhat and the commodity flow studies of the Joint Technical Group on Transport. Within the limitations of time and the design of the study as an exercise in the application of selected techniques of spatial analysis, it is hoped that this study has brought out some important clues as to the pattern of industrial location, commodity flows and the need for rationalising the linkage and flow pattern during the stages of regional economic development.

This study has benefitted from my training at the Centre for Studies of Regional Development. I am grateful to Prof.Moonis Raza and the faculty for their encouragement and stimulation in the preparation of this work. I would like to mention particularly the contribution made by Dr.Ishwari Prasad and Dr.L.S.Bhat in my understanding of the subject.

CHAPTER - 1

INTRODUCTION

The increasing importance of inter-regional flows brought into prominence several lacunas of the traditional trade theory which was criticised by its virtual neglect of the space aspects of economic activity. In order to fill up this gap, theories in location have been formulated and modified from time to time[1]. The synthesis of these two theories assumes a set of regions about which resources, technologies and tastes about a commodity are given and is effectively achieved by introducing programming techniques. In this formulation space is treated explicitly and linear programming is applied as a tool of analysis to achieve the results. This formulation can further be specified as minimum transportation effort problem.

A study of the problem of transportation effort assumes greater importance in under developed countries as they start the processof industrialisation. This is because modern industrial complexes often have to gather its component materials from great distances. Their markets are also

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1. See:
   1. Losch.A.(1954),"The Economics of Location"
   2. Isard,W.,(1956),"Location and Space Economy"
   3. Hoover,E.M, (1963),"The Location of Economic Activity"
   4. Isard,W.,(1960),"Methods of Regional Analysis: An Introduction to Regional Science".
2. Ghosh.A.,(1965) " Efficiency in Location and Inter-Regional flows". P.2.

far more dispersed. This problem,therefore, can be studied under two aspects - the static and the dynamic. These can also be termed as long-run approaches and short run approaches.

The static approach assumes the regional requirements and capacities as constant. In the short run, no change can be brought in these and the optimality, therefore, can be achieved as a system of distribution which minimises the total cost of the commodity, the cost being inclusive of transport. Hence, emphasis is laid on the regionalisation and the increased efficiency of movement. This can be achieved by finding out the ideal flow pattern that minimises total costs backed by direct control of distribution to achieve it.

The dynamic approach leads us to go a little deeper into the problem of regional economic growth over time. Here, the aim is to find out the optimum locational pattern in future such that the cost is minimised to the consumer of the product. In this case, the costs are minimised by dealing with transportation from "functional vantage point"[3]. The location of supply points at the geographically suitable places, saves much of cross hauls

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3."Transportation-Science,Technology and Development" .Unites States's Papers prepared for the U.N.Conference on the application of Science and Technology for the benefits of less developed countries. P.1.

and traffic movements.

Objectives:

The present study is an attempt to find the optimal pattern of flow with regional capacities and requirements as given. It becomes essential to study the problem of minimising costs through the optimum pattern of movement because of limited availability of resources in terms of railway capacity. Recently, it has been felt that in some areas eement could not be moved and in others, cement factories had to work 'under capacity' due to shortage of railway wagons and track capacity. It is important, therefore, to find out normative plan which minimises the overall cost of moving cement. In this study, cement has been taken as a commodity whose flow can be minimised.

Cement has been particularly chosen for study because of its importance in the developmental activities. In a developing economy, an increase in income leads to an increased expenditure on the construction work, i.e. construction both for residential and industrial activities. Secondly, the production centres for cement are located at a few places near the raw materials while the demand centres are scattered in all parts of the country. This makes it a necessity to move cement economically from production centres to consumption centres.

The nature of the cement industry being weight losing, it is advantageous to establish cement plants near the raw material sources. Therefore, areas of raw material concentration provide a basis for the analysis of alternative. locations of cement plants. In the Indian situation, availability of limestone reserves is a determining factor for the location of the cement plants. Often this raises a problem of carrying cement from the production centres to demand centres. An efficient and economical mode of transportation is important under these conditions.

Approach to the Problem:

Keeping in view the above mentioned objective the following procedure was adopted for the study of cement in order to study the normative pattern of movement. Cement industry has been viewed under a historical perspective finding the changes in production pattern, consumption pattern and therefore, in the pattern of movement over a period of time. A study of the pattern of production and that of consumption gives an insight in the movement pattern of a commodity. Therefore, all these are studied in depth for the final analysis of optimal flow.

The study has been carried mainly at two stages. In the first stage, an optimal pattern of movement for cement in terms of kilometres have been worked out. In the second stage, these kilometres in actual flow & the optimal flow pattern have been converted into the freight charges and found out the difference between the two.

Data Base:

The basic data for this study is the supply of cement, demand for cement and the transportation cost of each movement to determine the supply function, the demand function and the distances between the originating and destination points. Data for movement of cement from production centres to consumption centres or from factories to district headquarters have been taken. However, due to non-availability of total flow-data at district level, only the free sale movement of cement is considered. This constitutes more than 50% of the total movement. Therefore, the conclusions arrived at can be generalised because this movement represents a larger share of the total movement.

The data have been obtained from the publications of Cement Controller, J.T.G.reports and other publications[4].

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4. i) "Cement Production and Despatches" 1968 to 1971.
   ii) "Cement" (1966) Joint Technical Report.

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The flow data studied for optimising the pattern of movement is of 1971-72. The technique used to obtain an optimum pattern of flow isthrough the transportation model of linear programming. The freight rates were derived by fitting the regression function. Since cement is a bulk commodity and is carried mainly by railways, the optimization is done for this mode of movement only.

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contd...

4. iii) "Cement" Quarterly Journal of the Cement Manufacturers' Association.

iv) Bhat & Mathur (1967)," Cement Industry - A case study in National and Regional Perspective - 1976".

CHAPTER - II

PRODUCTION AND CONSUMPTION PATTERN OF CEMENT

The location of supply and demand units of a commodity determines the extent and the mode of transportation needed to move it from the former to the latter. The location of supply units can be either near to the raw material sources or near the consumption centres. Both the situations require different type of transport. This chapter, therefore, is an attempt to study the pattern of supply units, on the one hand, and that of demand units, on the other.

Sometimes the social, economic and political factors seem to have a considerable amount of influence on the pattern of specialisation and concentration of economic activities in a region [1]. In some cases, firms tend to cluster in a belt in an area endowed with resources required by an industry or it might have a

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1. The emergence of cement industry in India has been somewhat on the same lines. The first cement factory set up in Madras in 1904 was the result of the policies of British Govt. of developing the port areas.

consumer market situated there[2]. However, the maximum profit location for a plant is the one where transport costs are minimised[3]. It becomes more important when the freight/total cost ratio is high and when this ratio varies widely between different sites[4]. Transport costs become more important when the industries have a raw material oriented base or the weight losing characteristics. The raw materials lose weight during conversion to finished products. Besides this, in some cases, overall transport cost varies more widely than other costs at alternative sites and the transport rate on the raw materials exceeds the rate on the final product.

Cement industry too is raw material oriented. Its weight loosing characteristic makes it essential that it is located closer to the raw materials required to produce cement. We find that in India, chief factors responsible for the location of cement industry has been the raw material availability which traditionally consisted of limestone. It is estimated that one tonne of cement requires about 1.4 to 1.6 tonnes of limestone,

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2. For further detail, See
   i) Losch, A.," Economics of Locations"
   ii) Nourse, H.O.," Regional Economics"
   iii) Richardson, H.W., " Regional Economics"
3. This holds true under the assumption that other costs—processing costs and the demand factor-are constant.
4. Richardson H.W. Op. cit. P.42.

0.34 tonnes of coal, 0.04 tonnes of gypsum, 0.0018 tonnes of clay and 0.0037 tonnes of bauxite[5]. The dominance of limestone as the basic raw material explains the location of factories near them. In India, a cement factory is generally located within a radius of 50 to 60 Kms of the limestone deposits. Only in a few cases, the quarries are at a distance larger than that.

Limestone Reserves in India.

Importance of limestone reserves as a location factor for cement industry, makes it essential to have an idea of the limestone reserves. Rich reserves of limestone occur mainly in the Vindhyan, Cuddapah and the Archaen system of rocks and as such the reserves are concentrated in the 32 tracks forming broad regions of reserves which are potential areas of cement production[6]. From the point of view of limestone reserves, the Kurnool-Cuddapah area of Andhra Pradesh, is richest among the 32 areas. It contains about 11984 million tonnes or 41% of the total limestone reserves of India. Close to this area lies another important area of Northern Mysore (reserves 1100 m.tonnes) which in its eastern parts is,

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5. Bhat & Mathur "Cement Industry - A case Study" 1967. P.10.

6. Bhat & Mathur: op cit P.11.

in fact, an extension of the Kurnool Cuddapah series. A little towards the north in Danndakarnya (Baster) area of Madhya Pradesh (reserves - 800 m.tonnes) Yeotmal - Chanda area of Maharashtra (reserves - 400 m.tonnes) and Eastern Gujarat footbill area (reserves -825 m.tonnes)are a few important limestone deposits. Other areas worth mentioning are: Khasi and Jaintia hills in Assam (reserves 1041 m.tonnes), Rewa Jabalpur area in Madhya Pradesh (2492 m.tonnes) and Uttarkhand in U.P. (reserves - 606 m.tonnes). These eight areas together contribute 22848 m.tonnes or 90% of the total estimated reserves of limestone.

Curiously enough, till 1965, these areas were much less developed in respect of cement production (contributing only 17% of the total cement capacity in 1965-66) than the Chota Nagpur plateau of Bihar, Arravali region of Rajasthan, Saurashtra coast of Gujarat and the Madras platean which together possessed only 877 m.tonnes or 3.2% of the limestone reserves and yet contributed to 53% of the total capacity. During the period 1966-71, rapid development of these areas was envisaged which led to the emergence of certain areas to meet the demand for cement of the neighbouring areas.

Growth of Cement Industry.

A chronological study of growth of cement industry shows that by 1951 there were 21 factories of different sizes ranging from 42000 tonnes to 350,000 tonnes capacity per annum. Table 1 exhibits that in 1951 certain states had obvious clusters of cement plants. Southern region had the largest number of cement plants. Andhra Pradesh,Kerala, Tamil Nadu and Mysore had 8 units with 1213 thousand tonnes of capacity and 1048 thousand tonnes of production out of the total 21 factories, 3449 thousand tonnes of capacity and 3165 thousand tonnes of production. States like J & K, Himachal Pradesh West Bengal, U.P., Orissa, Maharashtra and Assam did not have a cement plant so, the cement production was fairly concentrated in few areas with the southern region dominating the map of the cement industry.

A decade later, however, the cement industry started developing rapidly. By 1961, the total supply of cement industry rose to 9.47 million tonnes per annum. Out of the six new factories, there were located in and around the Chota Nagpur Plateau which began to emerge as one of the core areas of cement production. The other three factories were located sporadically near the limestone sources in Rajasthan, Gujarat and Mysore. Among these new factories, the factory at Sindri (Table 2) was basedon the fertiliser sludge instead of limestone as the basic raw material. Besides the setting up of new plants, there was expansion of the existing units.

Seven units which underwent substantial expansion contributed about 3.21 m.tonnes or 71% of the additional capacity of the new factories. Three units were set up in Andhra Pradesh making use of the limestone reserves of Adilabad and Krishna Godavari interfluxe area and the remaining in the states of Bihar, Madhya Pradesh, Gujarat and Madras. With the opening of three new factories and with the expansion of other four units, this period marked the emergence of the second core area of cement production in the Kurnool-Cuddapah system of limestone bearing rock in the Godavari troughs, Rayalseema and northern Mysore.

The significant achievement of this period were the manufacture of white cement at Kottayam and Porbandar and of slag cement at Chaibasa. The Chaibasa factory which was using limestone as the basic raw material started using blast furnace slag in addition to limestone. Out of the total capacity of 488000 tonnes per annum, the slag cement of this factory was 170000 tonnes.

By 1971, the cement industry has developed over a wider area. There is a substantial expansion in the Saurashtra region complexes of Bombay, Poona and in the Baroda-Ahmedabad areas. The north-eastern platean has assumed further importance partly as a result of infilling within the Chota Nagpur Plateau and partly by the setting up of new factories in eastern Madhya Pradesh and northern Orissa. The third important core o f production has emerged in the Madras Platean where the limestone deposits occur in the Archaen Crystalline rocks. In 1970-71, the total number of units has increased to 51, the capacity is 18950 thousand tonnes and the production is 15393 thousand tonnes. States like Assam, J & K and Mahrashtra also have a cement plant.[7]

Increase in Cement Production.

The overall increase in the cement production is shown in the following table:-

Cement Production In India - 1965 - 1971[8].

Year	Productions(Tonnes)
1965	10577612
1966	1157517
1967	11302379
1968	11943373
1969	13624206
1970	13956047
1971	14931533

7. Bhat & Mathur op. cit. P.13-15.

8. Cement Production and Despatches Cement Controllers' Office - 1971.

The total increase of cement has been from 10.57 million tons in 1965 to 14.93 million tonnes in 1971. Between 1968-69, the industry registered maximum growth (14.2%) while between 1969-70, it was marginal (2.4%) and between 1970-71, there was again a net increase of 1 million tonnes (6.7%).

A study of the development of the cement industry in India shows that it has been expanding rapidly over the years and the sharp features that have emerged are the growth of three core areas, i.e., the area under Chota Nagpur Platean, the second is the northern Mysore and parts of Andhra Pradesh. The third core area is the Madras Platean. The cement produced in all these units can be broadly divided into five types : (1) grey-portland cement, (2) Portland blast furnace slag cement, (3) White cement, (4) Hydro-phobic cement and (5) Oil well and rapid hardening cement[9].

Alongwith the factor of raw material availability, the other factors influencing the location of a unit are (i) technological change and (ii) licensing policies of the government.

<u>Technological Change:</u> Changes in technology also influence the location of some of the plants. Recently cement is

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9. Cement-Commodity Transport Studies, Joint Technical Group for Transport Planning, Planning Commission 1966 P.24.

being manufactured from the fertiliser sludge and blast furnace slag also. Since a huge amount of waste products get accumulated near the fertiliser plants, the cement factories have been started to absorb these. The factory at Sindri in Bihar is based on the fertiliser sludge instead of Limestone. Also, the Chaibasa factory, which was using limestone as the basic raw material started using blast furnace slag from TISCO in addition to limestone.

Development in technology has made possible the split location method of production. Clinker produced at Sikka factory is transported to Bombay for its final grinding with gypsum. A plant has been set up at Sewree in Greater Bombay for grinding purposes. Another method adopted is the dry process and making cement.

Licensing Policies of the Government: The government policy is also responsible for the dispersal of cement factories in India. The aim of the government is to have a balanced regional growth, which necessitates the setting up of basic industries in every state. As a result we find that cement industries have been set up in J & K and Assam.

A close scrutiny of Table 1 and 3 shows that the cement production in 1971 is concentrated in large quantities at few places only. Most of the production is concentrated in Bihar and Tamil Nadu area. This implies that greater transportation is needed to move cement from these originating points. However, the situation is eased by a dispersed location of cement. Small plants have emerged in every state, thus reducing the distances over which cement was previously being carried. Though sometimes there have been situations leading to a reduction in the total productivity and total production of cement industry but generally the both have been rising in the last few years. Cement industry has been emerging with a definite character and pattern. The major production areas are concentrated at few places while every state has a small cement plant. This type of pattern creates the problem of adequate transport at these places with huge production.

Consumption Pattern of Cement:

Cement comes next to steel in importance as construction material. It is the most versatile in the developmental activities of an economy. Hence the consumption of cement is an indicator of the pace of development of a region. Cement is consumed in all construction activities, the most prominent one being industrial complexes, irrigation projects and other multi-storey complexes in big cities. It has always been found that with a rise in per capita income cement consumption too goes high. Along with this, the higher the industrial activity the greater the consumption of cement. That explains the rapid development of cement industry in India. However, if the per capita consumption of cement in India is compared with that of other developed countries, we find that India is lagging far behind these countries. India has got the lowest per capita consumption figures as compared to other such countries like U.S.A., U.K. , Switzerland etc.[9] The difference is more than ten times. However, over last few years the consumption of cement is increasing with the growth in service and tertiary sector. Such cities like Delhi, Bombay, Kanpur etc. are high cement consuming areas because of high level of tertiary activities. However, there is no uniformity in the consumption of cement in all the states in India.

If we look at the statewise consumption of figures, we find that there is a wide disparity in the consumption of various states. Some states and ~~central areas~~ union territories have a very high consumption of cement while others have a low consumption. This disparity in consumption shows the disparity in the rate of economic activity in such states.

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9. " Cement" Quarterly Journal of the Cement Manufacturers' Association Vol.5 Jan 1972.

TABLE - A

States	Average per capita consumption 1968-71	Coefficient of variation	Per capita consumption in 1971
Punjab	48.92	24.8	53.88
Gujarat	47.66	10.4	51.33
Haryana	41.83	4. 2	48.34
Maharashtra	32.97	8. 2	37.24
Tamil Nadu	31.83	4. 5	33.86

The above table shows the consumption in the states that are industrially developed. Even in this category, Punjab is the state that consumes highest amount of cement. However, Punjab has the highest coefficient of variation which shows that there has been highest relative variation[10] in Punjab as far as cement is concerned. In Tamil Nadu and Maharashtra though the average cement consumption is lower than Punjab but the consumption has been more consistent.

The reason for this can be that Punjab had undertaken

10. Relative variation or coefficient of variation is given by

$$C.V. = \frac{\frac{(x-\bar{x})^2}{n}}{x} \quad \text{or} \quad \frac{\frac{\frac{x^2}{n} - (\frac{\bar{x}}{n})^2}{n}}{x}$$

where x denotes consumption of cement in a particular state in different years

$\bar{x}$ denotes the mean consumption of cement
n denotes the number of years.

See Kenney & Keeping " Mathematics of Statistics" P.84.

large irrigation projects which increased its consumption for last few years. Following table gives the second category of the consumption of cement.

TABLE - B

States	Average per capita consumption between 1968-71	Coefficient of variation %	Per capita consumption in 1971.
Mysore	25.88	6.5	29.79
Nagaland	23.76	18.5	19.37
Kerala	23.22	14.2	28.19
West Bengal	22.83	11.8	18.96
Andhra Pradesh	22.59	10.6	26.38
J & K	21.71	23.9	25.78

Comparing the figures above with the previous table we find that there is a huge gap in the per capital consumption of these states as compared to Punjab, Maharashtra Gujarat and Tamil Nadu

TABLE - C

States	Average per capita consumption between 1968-71	Coefficient of variation %	Per capita consumption in 1971
1	2	3	4
Rajasthan	18.11	6.5	17.80
Uttar Pradesh	17.89	2.3	17.75

1	2	3	4
Assam	17.44	12.04	15.75
Bihar	17.40	4.5	16.26
Himachal Pradesh	17.29	10.2	13.43
Madhya Pradesh	13.22	10.5	15.05
Orissa	13.76	5.8	15.13
Manipur	12.16	33.7	6.54
N.E.F.A.	10.67	34.6	4.49
Tripura	8.07	55.7	3.85

TABLE - D

Union Territories	Average per capita consumption 1968-71	Coefficient of variation %	Per Capita consumption 1971
Chandigarh	229.55	87.8	284.04
Delhi	115.52	21.8	256.73
Pendicherry	42.74	9.1	46.70
Andaman & Nicobar.	42.50	92.4	18.26

All the four tables given above give us a picture of the consumption pattern in different states. Table C gives us the general picture in India where consumption of cement is very low, though these states have been comparatively more consistent in the consumption of cement. This implies that construction activity have been consistent in these states though it has remained at a low level.

Table D shows that the union territories like Delhi & Chandigarh have unusually high consumption. They have a high coefficient of variation also. The sprat of economic activity in these areas gives rise to multi-storey complexes for residential and service activities. Pondicherry and Andaman and Nicobar have comparatively high consumption of cement though in the case of latter it is highly inconsistent. The reason for high consumption of cement in recent years has been the increasing effort of the Govt.to invest more in the industrial and service sectors of these areas.

An analysis of the whole picture presented above shows that industrialised states of India have higher consumption as compared to others. Union Territories like Delhi and Chandigarh too have a very high consumption due to their rising importance as big cities.

A study of the consumption and production pattern, therefore, gives us an idea about the cement producing states and the cement consuming centres. States like

Tamil Nadu , Andhra Pradesh, Bihar and Madhya Pradesh meet the demand of many other states along with their own. Certain high consumption centres like Chandigarh, Delhi etc. do not produce any cement while Bihar consumes at a low level though its production is very high.

Table No.4 gives an elaborate picture of the states that are deficit or surplus. It gives us an idea of the total production and requirements of various states. Considering deficit and surplus areas, it becomes essential to study the pattern of movement of cement.

CHAPTER - III

PATTERN OF MOVEMENT OF CEMENT

An analysis of the production pattern of cement in the previous chapter reveals that there are some surplus and some deficit areas of production. Along with this, the rapid industrialisation has created a higher demand for cement, which involves a movement from surplus to deficit areas. A glance at Tables 1 and 3 reveals that production pattern has become dispersed in 1971 as compared to 1951. However, the demand for cement has increased so fast that the cement plants established in different states are not able to cater to their full needs. In the following pages, therefore, an analysis of the pattern of movement of cement has been done.

Cement factories despatch at least 90% of their production implying that as the factories expand and as the new units are established the need for transport becomes more important.[1] Table 4 gives us the figures of cement despatches over last few years. We find that amount of cement moved has increased over last few years. In such a situation both road and rail transport assure critical role.

Relative Share of Road and Rail in Carrying Cement

The burden of increase in internal freight traffic

1."Cement Production and Despatches" Publication Office of the Cement Controller P.39.

since the First Five Year Plan has fallen mainly on the railways and on the road transport[2]. In case of cement also, road and rail transport are emerging as main carriers. Cement being a bulky commodity, its movement from the production centres to the consuming centres involves considerable expenditure on transportation. So, the cement industry in the country uses all available modes of transport for maintaining an even flow of cement despatches throughout the country. In spite of the dominant position of railways in the transport of cement, road transport plays an important role in carrying cement to areas not served by the railway network and in areas affected by wagon shortage. The relative importance of road transport can be judged from the break-up of despatches shown in the following Table as shown in the next page

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2. Looking at the overall national picture during 1950-51 and 1964-65, we find that railway freight traffic increased nearly two and a half times and traffic by road has increased almost five times. The share of road transport in the total traffic carried by rail and road transport together has increased from about 11% in 1950-51 to about 23% in 1964-65.

3. The modes of transport used for carrying cement are mainly railways and roadways and coastal ships in some areas.

Break up of Despatches[4].

Percentage Despatches by Road as Compared to total Despatches During 1962-1969

Period	Total Despatches	Despatches by road	%
1962	8124	1923	23.7
1963	8774	2092	23.8
1964	9142	2186	23.9
1965	10033	2206	22.0
1966	10698	1130	19.8
1967	10656	2154	20.2
1968	11211	2244	20.0
1969	9578	1932	20.1
1970	13821	2565	19.1
1971	14825	3031	24.7

The table given above shows that during 1962-65, the share of road transport for carrying cement increased. The reason for this could be the increased pressure on railways due to increasing industrial activity, thus creating bottlenecks wagon shortages etc. At present

4. "Cement" Quarterly Journal of the Cement Manufacturer's Association Vol.III Jan/April 1970.

the share of the road transport is stationary at 20%. After 1965, with the slackening of pressure on rail transport facilities, the dependence on road transport decreased. Although a dispersed locational pattern of cement units has a tendency to increase greater use of road transport because of many favourablefactors[5], the overall total despatches and percentage despatches declined.

The seasonal pattern of road transportation indicates that usually the share of road transport is higher during the second and third quarters of the year which coincided with the increased pressure on the railway system due to the movement of agricultural produce and weather conditions.

The bulk of the cement production, however, is transported by railways. For instance, during 1968-69, more than 10 million tonnes of cement was hauled by railways in 350,000 broad gauge wagons and 250,000 metre gauge wagons. Cement being a low bulk commodity is

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5. The flexibility of road transport is the most favourable factor in its support. Motor vehicles can supply services over public highways between any two points. The operating units are small, each unit requiring a relatively small investment of capital. The industry thus has a much greater adaptability to varying conditions and is also able to adapt equipment and type of services to the particular needs of the shippers.

preferably moved by railways. A comparison of cement with other low rated commodities shows that their share in the rail transportation is going up in absolute terms. Low rated commodities are charged lower rates by railways because of their national importance. The importance of railways in transporting these goods is indicated in the following table.

Comparison of Rail Movement of Some Commodities with their Production.

Commodity		50-51	55-56	60-61	66-67
Coal	Production	32825	38821	52620	70536
	Movement	30911	35888	50396	65793
	%	(94.2)	(92.4)	(95.8)	(93.3)
Iron & Steel	Production	1881	2929	5490	7950
	Movement	2750	5713	7588	9776
	%	(146.2)	(126.8)	(138.2)	(123.0)
Cement	Production	2655	4559	7844	11053
	Movement	2471	4022	6548	8892
	%	(93.1)	(88.2)	(83.5)	(80.4)

1. It includes imports also.

Source: Ministry of Railways, Directorate of Statistics and Economics.

The above table shows the increase in the rail transportation of low rated goods. This increase[6] can be explained by the nature of such commodities. The reason for this is that such commodities are bulky and have to be transported in huge quantities over long distance for which rail transportation is a better and cheaper mode of transport[7].

Cement Production, Rail movement and Average Load

'000 Tonnes

Year	Cement production.	Total qty moved	Rail movement (originating tonnes)	Rail movement as % of total movement	Average* lead kilometres.
1960-61	7844	7873	6548	83.2	372
1962-63	8587	8600	6851	79.2	400
1965-66	10578	10588	8649	81.7	456
1967-68	11308	11290	9353	82.8	484
1968-69	11943	11836	9397	79.1	527
1969-70	13912	13821	10590	75.1	535
1970-71	14904	14824	10918	73.9	585

Source: Ministry of Railways

* Figures are for broad gauge only.

6. Since the beginning of the Second Five Year Plan, the low rated freight has been taking larger share as compared to high rated commodities. The rail earnings from low rated freight have increased about 9% and earnings from high rated traffic have decreased by about 9% between 1956-57, and 1964-65.

7. For bulky goods, railways are an efficient mode of transport because of large scale economics. The (contd..

The above table shows that sizable amount of cement is moved by railways. The production of cement has increased from 7844 thousand tonnes in 1960-61 to 14904 in 1970-71. In other words, the production of cement has doubled during last decade. The quantity moved by railways has increased from 6548 thousand to 9397 thousand tonnes. In terms of percentage, we find that the production of cement has doubled and the quantity moved by railways has increased by about 60% as compared to 1960-61 figures. In terms of inter-model allocation, rail share throughout the period varies between 73% and 83% of the total quantity moved.

We find that in terms of percentages there are fluctuations in the quantity moved by rail. In terms of absolute figures, however, there has been a steady growth in the share of railway in the transportation of cement. The fluctuations in the rail movement of cement can be attributed to the freight pool arrangement[8], seasonal pressure on railways and weather conditions.

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greater the volume of traffic on railways, the lower will be the unit cost. The railway can transport full wagon loads of goodsover long distances at unusually low costs.

8. According to the present freight pool arrangement the freight paid is Rs.34.15 per tonne irrespective of the distance over which cement is moved. So, the short haulage is preferred by road transport because of its flexibility.

The transportation of cement by railway is, however, increasing in absolute terms. Railways are considered efficient for the transportation of bulk commodities because of large scale economics, surety of delivery and the amount of movement involved. In the case of deterioration of cement due to weather conditions also necessitates the use of railways than roads.

The uniformity of freight charges in railways transportation further encourages the use of railways for long and bulky haulage[9]. However, the tendency for long haulage is restricted to some extent by the distribution control operated by the cement controller. Control over cement distribution involves a simple mechanism. Each factory is given a definite market to sell its product[10]. The factory concerned has the full freedom to sell any quantity (unless otherwise specifically directed by the cement controller) without seeking prior permission from this organisation. Each producer can build his network of stockists within the marketing zone and plan his movement according to the needs of the region. The rate of growth under

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9. Uniformity of railway freight charges irrespective of distance implies that the short distance consumers of cement are discriminated against the long distance consumers. In the latter situations, therefore, railway transportation is preferred while in the former case road transportation is considered economical.

10. The cement distribution control mechanism operates only on a part of cement movement called stockist category (cont.)

free sale has been varying from 5 to 15 percent per annum depending upon the economic activity in each state.

The determination of market for each factory leaves limited choice to a producer. He can supply to different places within a limited area. This avoids a lot of cross hauls and long movements.

Till 1971, however, existence of new factories made it necessary that the market for each factory be again determined. With the expansion of the old units and the emergence of new units it become essential that markets be properly allocated to these units to rationalise movements to conserve the transport capacity and to avoid cross movements. The railways too desired some changes in the marketing zone so as to facilitate the maximum utilisation of the railways rolling stock. An elaborate list of the marketing zone of each factory is given in a publication of the cement Controller[11].

The marketing zones determine the pattern of movement of cement. Each factory is allocated a specified

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or freesale category. Under this category each producer has been despatching his commodity to the extent of 60 to 70 percent of the production. The second category is known as the reserved cate gory which caters to 30% to 40% of the total production. Under this category come the indendors under the government and public sector undertakings and classified industries which consume cement regularly and in large quantities.

11. Cement Production and Despatches,1971, Office of the Cement Controller, p.200.

market. This rationalises the movement of cement. In 1960-61, when south was one of major producers of cement, the movement of cement was sometimes as long as between Tamil Nadu and Assam. Factories in south supplied cement to Assam. However, with the dispersed growth of cement industry such a pattern of movement has changed and shorter hauls are made necessary by the distribution control. Inspite of the rationalised movement pattern there has been a steady rise in the average movement of cement traffic because of increasing demand.

The rise in the average movement of cement traffic, therefore, can be attributed to the imbalance between the demand and supply in different regions. Although production units for cement are being established in every region, the production in these units is not sufficient to meet total demand. Increasing activity in large sector involves large demand for cement. Growing investment in irrigation works, other public facilities like hospitals, schools etc. and other industrial complexes require huge amount of cement. Hence an increase in the average lead of cement. The following table gives the pattern of the railway movement according to distance zones during 1965-66 and 1970-71[12].

12. Bhat & Mathur (1967): P.64.

Movement of Cement Over Different Distances

Distance	1965-66 Qty (in million tonnes)	%	1970-71 Qty(in million tonnes	%
Upto				
500 Kms	6.77	76.6	10.92	73.4
500-750 Kms	0.84	9.5	1.86	12.8
750-1000 "	0.64	7.2	1.23	8.3
Over 1000 "	0.60	6.7	0.87	5.5
Total	8.85	100.0	14.88	100.0

The above table shows that out of total movement of cement of 8.85(million tonnes) over different distance ranges, about 6.7 million tonnes or 76.6% involved movement within a distance of 500 Kms., while the remaining 2.08 million tonnes or 23.4% moved over distances above 500 kms. In 1970-71, however, the movement between 500-750 kms increased to 12.8% as compared to 9.5% in 1965-66. In the same way there has been an increase in the cement moved over the distance range of 750-1000 Kms. Curiously enough, the movement of cement over the distance range of 500 kms. and less has diminished to 73.4% in 1970-71 from 76.6% in 1965-66.

This decline in the short distance movement of cement can be because of telescopic nature of freight rates. Besides this, the freight pool arrangement, as mentioned earlier, also affects the long term movement by railways. This explains the rise in the long distance movement of cement and a decline in the short distance movement of cement.

The pattern of movement of cement is further revealed when we find that (Table 4) Bihar the leading producer of cement not only satisfies its own demand but despatches cement to its neighbours like West Bengal, Orissa and a large quantity to Assam which wholly depends upon Bihar to meet its requirements. The factory at Cherrapunji in Assam meets only a little portion of the total demand of Assam. The factories at Churk in eastern U.P. and the Rajgangpur in northern Orissa despatch some of their cement to centres in north Bihar and South Bihar respectively. Factories at Khalari and Satna areas of Madhya Pradesh supply cement to U.P. while western M.P. gets its supplies from Chittorgarh in Rajasthan. Rajasthan, which is another big producer of cement, supplies to its neighbouring states- Punjab, U.P., Delhi and Madhya Pradesh. But some parts of Rajasthan receive cement from factories in Sikka and Dwarka in Gujarat.

Andhra Pradesh supplies some of its cement to Maharashtra and Mysore. Western Maharashtra's requirements are mostly met by factories in Gujarat and northern Mysore.

Nagpur region of Maharashtra is dependent on supplies from Durg district of Madhya Pradesh - its nearest neighbour.

Most of the cement factories are situated in the heart of the southern Peninsula and are equidistant from the eastern and western coasts. Their supplies are, therefore, radially distributed in Kerala, Mysore and Tamil Nadu.

A study of movement pattern of cement reveals some of its important characteristics.

Firstly, it shows that the percentageof despatches of cement by road is steadily going up. There has been also a large increase in the absolute figures of movement by road. Secondly, cement being a bulk and low rated commodity is mainly transported by railways. Thirdly the cement despatches by railways are increasing in absolute figures but in terms of percentage there has been some decline. Fourthly, we find that there is an increase in the long distance movement of cement by railways and a decline in the short distance movement. An analysis of this shows that it is the freight pool and the telescopic railways charges that are mainly responsible for this. Lastly, we get a picture of the surplus and the deficit areas in which we find that Bihar, Tamil Nadu and Rajasthan, with Madhya Pradesh emerging, as the main suppliers of cement.

CHAPTER - IV

ANALYSIS OF FLOW PATTERN - ACTUAL AND OPTIMAL

After analysing the patterns of production, consumption and movement, it becomes interesting to investigate further as to what is the optimum pattern of movement of cement. In the previous chapters, we have reached the conclusion that with the dispersed location of units, the long movements and cross hauls have been reduced to a great extent. However, the demand for cement has risen considerably, making it essential that it be supplied at reasonable transport rates. In the short run, this can be achieved by adopting a commodity flow in which maximum use is made of all the resources thus minimising the costs to the extent possible. In the following pages, therefore, an attempt is made to arrive at a pattern of movement in which distances are minimised. The study has been carried in two steps. First, the optimum flow of cement was arrived at by minimising the net tonne kilometres travelled to carry cement. The second step involved finding out the cost of the optimal flow and the actual flow in terms of freight charges.

The set of assumptions to carry out the study is that the capacity and demand factors are taken as constants. The supply is determined on the basis of despatches from the producing units and the demand is determined on the basis of despatches to various centres. No importance is attached to the cost of production. When the cost of production is assumed to be given, it is the transportation costs that have to be minimised. Only the movement from factories to demand centres is considered.

Only the substitutable type of cement has been taken into consideration. Such types as white and oil well hardening have not been included. So, the factories like Shahabad, Porbandar, Kottayam and Cherrapunji have been left from the study.

Consumption centres have been analysed regionwise, based on the planning regions delineated by the Planning Commission[1]. Production centres have been aggregated together on the basis of geographical locations to reduce the number of origins along with the number of destinations to manageable extent.(Table No.5)

This chapter has been divided into two sub sections. The first section gives the methodology used to arrive at the solution. And the second section gives the analysis of the study.

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1. Planning Commission has divided India into 42 micro-regions depending upon its natural conditions and resources potentials which requires special planning for development. For further details, See: Sen Gupta and Sdasyuk (1961)"Economic Regionalization of India, Problems and Approaches" Census of India.

PART -I

Methodology:

To reduce the dimensions of the problem to a manageable extent , the number of consumption centres was reduced to 41 demand centres (Appendix A) instead of 365 districts (though the study at district level would have been more informative). For planning purposes, India has been divided into seven macro regions. These are - (i) The North Eastern region, (ii), the eastern region, (iii) the north-central region, (iv) the central region (v) the north-western region, (vi) the western region, (vii) the southern region. The north eastern region conforms to the states of Assam and Nagaland and the Union Territories of N.E.F.A., Manipur and Tripura; the eastern region comprises of West Bengal, Bihar and Orissa states; the north central coincides with U.P and the central region with Madhya Pradesh; the Western region comprises of Maharashtra and Gujarat; the north western region includes Rajasthan, Punjab, Haryana, J & K and the Union Territories of Goa, Pondicherry, Yanam, Andaman and Nicobar islands and Laccadive, Minicoy and Aminidiv islands - Each region is different from others in its natural conditions and resource potentials demanding special planning for development.

The demand for these demand centres has been taken on the basis of total despatches to these centres. Each demand region constitutes ~~of~~ a number of districts and the total sum of despatches to these districts form the total demand of that region. In the same manner the total despatches from the factories aggregated together give the total supply from those aggregated factories.

The central point in these regions is calculated by taking consumption figure of each district in the particular region and by measuring the x and y coordinates of the districts. This is derived from

$$\bar{x} = \frac{\sum x_i \quad c_i}{c_i},$$

$$\bar{y} = \frac{\sum y_i \quad c_i}{c_i}$$

where $(\bar{x}, \bar{y})$ are the coordinates of the mean centre of the demand region, (x_i, y_i) are the coordinates of ith district and c_i is the consumption of cement in the ith district. The values of $(\bar{x}, \bar{y})$ for all the regions have been obtained from this formula. Thus, the central points for all the regions were determined by computing the values of $(\bar{x}, \bar{y})$. This method of finding the central points is relistic because it is the extent of consumption that determines its point.

The central point for factories was also computed like this. The production of different factories was aggregated to find the centroid or the central point.

The distances from these production centres to consumption centres were measured from the railway maps. The movement data used in the analysis is not the total movement data. Because of non-availability of district wise data for total movement only freesale despatches from factories to consumption centres was put. Though this puts a limitation to the study, the conclusions arrived at are valid and can be generalised since this represents between 50 - 55% of the total movement (Table No.6).

Technique of Finding an Optimal Solution:

The mathematical tools available so long for finding an optimal flow was the maxima ad minima approach of calculus. While the method of maxima and minimawas often used for the purpose of solving a problem formally as a theoretical exercise, the requirement of continuous function with a known form and having derivatives was for practical purposes much more difficult to achieve[2]. The difficulty associated with defining continuous differentiable functions prevents the actual application of this approach in most cases.

2. Ghosh A.(1965) "Efficiency in Location and Interregional Flows". P.23.

The recent development of linear programming techniques has, however, provided a computational tool for tackling such maxima and minima problems where the maximising and minimising functions and the constraints are linear, the variables considered atttain only non-negative values and the restraining equations can be formed as equalities or inequalities[3]. The general framework of the problem in linear programming can be stated as follows:

$$\text{Minimise (Maximise)} \sum_i \sum_j c_{ij}\, x_{ij}$$

subject to

$$\sum_j a_{ij}\, x_{ij} \leq k_i$$

$$\sum_i a_{ij}\, x_{ij} \geq r_i$$

$$r_{ij} \geq 0$$

Making use of the above formulation, a transportation problem can be solved by simplex algorithm. This defines a linear programming problem with mixed type of constraints (supply and demand constraints), since some of the inequalities will be of "less than or equal to" type and the rest of the "greater than or equal to type. Using the simplex method is, however, inefficient, since for the transportation problem the dimension of the linear programming problem increases rapidly. Thus for a

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3. Loomba (1962) N.Paul "Linear Programming".

problem of 10 origins and 41 destinations, we obtain $10 + 41 = 51$ inequalities with 10×41 410 structural variables (the unknowns). The total number of data to be stored, therefore, ifthe problem is solved by a computer, is $51 \times 410 = 20910$. The transportation model of linear programming is considered better for problems which for few dimensions is best solved with pen and pencil (because it entails the manipulation of only no. of destinations x no. of origin points).

Transportation model of linear programming has therefore been used to solve the problem of optimum regional flow. This technique is applied to obtain an optimum spatial delivery system for a product which originates in several centres and has to be distributed to several destinations. The problem may be formally stated as follows:

Let the jth regional demand or requirement be denoted by r_j and the capacity of the ith centre of production by k_i, if x_{ij} denotes as before the delivery from the ith to jth region and c_{ij} is its associated cost, then

$$\text{Minimise } \sum_i \sum_j c_{ij} x_{ij}$$

subject to

$$\sum_j x_{ij} \leq x_i$$

$$\sum_i x_{ij} \geq r_j$$

4. Dantzig, B.(1963) "Linear Programming and Extensions"

This can be explained by the following example. Suppose there are three supply units and four demand unit, we can identify the supply units as O_1, O_2 and O_3 and the demand units as D_1, D_2, D_3 and D_4. The relevant data on plant capacities, destination requirements and shipping costs for individual shipping routes are recorded.

	DESTINATIONS D_1	D_2	D_3	D_4	Origin capacity per time period
O_1	c_{11} x_{11}	c_{12} x_{12}	c_{13} x_{13}	c_{14} x_{14}	b_1
O_2	c_{21} x_{21}	c_{22} x_{22}	c_{23} x_{23}	c_{24} x_{24}	b_2
O_3	c_{31} x_{31}	c_{32} x_{32}	c_{33} x_{33}	c_{34} x_{34}	b_3
Destination requirement per time period	d_1	d_2	d_3	d_4	

The transportation model like the general linear programming model consists of three components, First we have to formulate a linear objective function which is to be minimised. This function represents the total shipping cost of all the goods to be sent from origins to the destinations. Second, out of seven linear structural constraints of the above problem three (one for each row) will give the relationship between the origin capacities and the goods to be received by different destinations. These are called capacity constraints.

Requirement constraints are the four constraints in each column which satisfy the relationship between the destination requirement and the goods to be shipped from different origins.

Thirdly we can specify a set of non-negativity constraints for the structural variables x_{ij}. They state that no negative shipment is permitted. The general correspondence between a typical linear programming problem is thus complete.

The three component parts of a transportation problem can be written in the following way:-

Minimise

$$F(x) = c_{11}x_{11} + c_{12}x_{12} + c_{13}x_{13} + c_{14}x_{14} + c_{21}x_{21} + c_{22}x_{22} + c_{23}x_{23} + c_{24}x_{24} + c_{31}x_{31} + c_{32}x_{32} + c_{33}x_{33} + c_{34}x_{34}$$

subject to

$$x_{11} + x_{12} + x_{13} + x_{14} = b_1$$

$$x_{21} + x_{22} + x_{23} + x_{24} = b_2$$

$$x_{31} + x_{32} + x_{33} + x_{34} = b_3$$

$$
\begin{aligned}
x_{11} + x_{21} + x_{31} &= d_1 \\
x_{12} + x_{22} + x_{32} &= d_2 \\
x_{13} + x_{23} + x_{33} &= d_3 \\
x_{14} + x_{24} + x_{34} &= d_4
\end{aligned}
$$

where

$$x_{ij} \geqslant 0 \; ; \quad i = 1,2,3 \; ; \quad j = 1,2,3,4.$$

This transportation problem can be solved by three steps. The first step involves making the initial shipping assignment in such a manner that a basic feasible solution is obtained. This means that m+n -1 cells of the transportation matrix are used for shipping purposes. In the second step we determine the implied cost associated with the empty cells. The third step involves determining a new and better basic feasible solution.

An initial basic feasible solution is obtained with the number of filled up cells equal to m+n-1. The initial optimum solution can be obtained by North-West Corner or by the minimum cost cell method. The second and third steps can be carried out by stepping stone method or by the modified distribution method. The difference between the two is that the former principle is carried out by taking small loops and in the latter only one large loop is made after finding the implied cost of empty cells. The optimal flow pattern obtained by applying this technique in the present study is given in the cells. The optimal flow computed in this manner is given in table no.9.

At a later stage, the freight charges of the actual flow & the optimal flow were obtained to find the extent to which the freight cost rates could be reduced keeping in view the telescopic nature of railway rates. The freight rates for some of the representative distances are given below

Distance in Kms.	Rates per tonne.
100	11.70
200	17.00
300	21.90
500	30.80
750	41.20
1000	51.00
1500	68.00
2000	84.10
2500	96.00

Source: Ministry of Railways

A glance at the rate structure suggests that as the distance increases, the rates increase but at a decreasing rate. This implies that the relationship between distance and its freight charges is non-linear. Thus a function to reflect a non-linear relationship between the rates and the distances is postulated as:

$$Y = ax^b \qquad 0 < b < 1 \quad \ldots(1)$$

where

Y = transport rates in Rs. per tonne.

x = distance is kilometres.

Taking logarithms equation(1) is written as

$$\log Y = \log a + b \log x \quad \ldots\ldots\ldots\ldots\ldots(2)$$

which is a linear function in log. Using the data givèn above, the fitted least square regression of log Y on log x will then be

$$\log Y = 1.6871 + \underset{(0.173)}{0.6734} \log x \quad \ldots\ldots(3)$$

$$R^2 = 0.99$$

The standard errors of the regression coefficnets are given in brackets[5]. Using equation(3) and the data on rail mileage, the transport distances between two regional points have been estimated and are given in Table No.7.

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5. Johnston J.(1960) " Econometric Mèthods" McGraw Hill Book Co.Ltd. P.48.

PART - II

Given the regional demarcations and the methodology as mentioned above, the present study includes (1) a demand function for each of the 41 regions; (2) a structure of transportation costs between all possible pairs of regions and (3) and a supply function for 10 originating centres. The supply and demand functions are determined on the basis of freesale despatches from production centres to demand centres and the transportation costs is determined on the basis of distances between the production and the consumption centres.

Salient Features of the Movement Pattern of Cement:

A study of cement movement given in Table No reveals some interesting facts. It gives us an overall picture of the supply to and demand of various regions which, to some extent, gives us an idea of despatches in cement consumption. It further givesus an idea of the development of tertiary and service sectors of the particular region.

Table 6 showing the despatches from various originating centres in 1971 shows that largest amount of cement originates in South from Ammasandra (417522 tonnes), Sankandurg (447443 tonnes) and Dalmiapuram (504702 tonnes) while in the northern region it originates from Sawai Madhopur (713032 tonnes), Chaibasa (454582 tonnes) and Kymore (586911 tonnes). This implies that

that these originating centres need efficient and adequate transport to move cement to consuming centres.

On the consumption side, largest amount of cement was consumed by Tamil Nadu (1392 thousand tonnes), Andhra Pradesh (1145 thousand tonnes), U.P.(1570 thousand tonnes) Gujarat (1370 tonnes) Maharashtra (1874 thousand tonnes), West Bengal (542 thousand tonnes) and Punjab (724 thousand tonnes) comes in next order. Among these states, Tamil Nadu and Andhra Pradesh produce sufficient cement to satisfy their demand. But U.P. , Maharashtra and some other small states do not produce significant amount of cement.

A more elaborate idea of the cement consumption and production can be had from Table No. 4 . We find that the eastern,western and southern zones are surplus in the production of cement while only north zone is a deficit zone to the extent of 1786 thousand tonnes. Among the states Maharashtra in 1971 had a deficit of 1410 thousand tonnes, West Bengal 843 thousand tonnes, Punjab 726 thousand tonnes, Delhi 634 thousand tonnes and Kerala 561 thousand tonnes.

Among the surplus states in 1971, Madhya Pradesh had a surplus of 1504 thousand tonnes, Tamil Nadu1406 thousand tonnes, Bihar 684 thousand tonnes, Mysore 664 thousand tonnes, and Andhra Pradesh 468 thousand tonnes. The other surplus states are Orissa (329 thousand tonnes), Gujarat (296 thousand tonnes), Haryana (74 thousand tonnes).

To mention zone-wise we find that west zone had a surplus of 317 thousand tonnes, east zone had 32 thousand tonnes, and south zone had 1934 thousand tonnes.

This gives us an overall picture of the linkage pattern at state level. At state level we find that Maharashtra, West Bengal, Delhi, Punjab, Chandigarh, Kerala, Himachal Pradesh are the deficit states while Tamil Nadu, Madhya Pradesh, Bihar, Orissa, Gujarat, Andhra Pradesh, Mysore and Haryana are the surplus. Under such conditions a linkage pattern emerges in which these surplus states supply cement to deficit states and the strength of the links depends upon the extent of the surplus.

By studying the data of cement consumption, we get an insight into the development of tertiary and service sector of these states. Table No.4 gives us an idea of the consumption level of cement in 1971 in different states. Maharashtra (1875000 tonnes) Tamil Nadu (1392000), Gujarat (1370000 tonnes) Andhra Pradesh

(1145000 tonnes) have the highest level of cement consumption. These states with higher cement consumption have big irrigation projects, industrial complexes and multistorey complexes. These states have such industrial towns like Bombay, Poona, Madras and Bangalore etc.

The states like West Bengal (843000 tonnes), Mysore (872000 tonnes), Punjab (726000 tonnes), Delhi (634000 tonnes) also consume high levels of cement. Thus we find that large quantity of cement is consumed in these industrial towns which is further confirmed by a survey made by Govt.of India in 1965. The survey reveals that most industrialised states in the country are those mentioned above, together accounting for 64% of the factories reporting data, 66% of the productive capital employed ,72% of the employment, 76% of the values of output and 77% of the value added by manufacture. The report further discloses that these states are high supply and demand potentials for all agricultural and industrial goods because of their industrial development and higher per capita income.

The other side of the picture shows that cement consumption is low in Orissa (332000 tonnes), Assam (251000 tonnes) and Jammu and Kashmir (119000 tonnes). These are the states with less-developed tertiary and service sector. In 1965, the industrial activity in these states accounted for 36% of the reporting units, 34% of the productive capital employed, 28% of the total employment, 24% of the value of output and 23% of the value added by manufacture.

Thus, an analysis of the data reveals that there are few concentrated large cement units which cater to most of the demand. The small units satisfy the local demands and send despatches to short distances only. The concentration of cement units is mostly in south Bihar, Madhya Pradesh and Tamil Nadu, though other states too have a cement plant.

A glance at Table No. 8 shows that cement producing units in Bihar (Ashoka,Rohtas,Japla, Khalari, Sindri, Satna, Dall, Banjari and Churk) together supply cement to 15 demand regions comprising of districts in Assam, West Bengal, Orissa, Eastern Madhya Pradesh and some places in central Maharashtra. The highest quantity is sent to lower, eastern and western ganga plain which includes the districts like Hooghly, Howrah, Kanpur, Lucknow, Meerut, Varanasi, Allahabad etc.

The following table gives an idea of the total supply from these units.

Producing units	Qty Despatched in tonnes.
1. Rohtas,Ashoka,Japla,Khalari, Sindri,Satna,Dalla, Banjari, Churk.	1193300

Producing units	Qty Despatched in tonnes
2. Chaibasa, Mandhar, Jamul, Rajgangpur, Bargarh.	854700
3. Bhupendra, Dalmia Dadri	245400
4. Lakheri, Madhopur, Bammore.	403500
5. Chittorgarh, Udaipur.	238800
6. Sevalia, Ahmedabad, Sikka, Dwarka, Ranavav	812600
7. Chanda, Ranagundam, Mancherial, Sewree.	468700
8. Wadi, Macherla, Bugginapalli, Vijawada, Kistna, Bagalkot.	924600
9. Bhadravati, Ammasandra.	168600
10. Sankaridurg, Karur, Madukkarai, Dalmiapuram Alangulam, Tulukapatti. Talaiyuthu.	1311600
Total	6621800

This supply from these units is sent to various places, sometimes in very small amounts. These linkages, are not always economical. Sometimes, very small amount is sent over long distances which is obvious from the table No. 8 .

An estimate of total tonne kilometres was, therefore, made in the actual flow pattern and compared with the net tonne kilometres travelled under the optimal flow pattern. The optimal flow has given us a new consumption area for each producing unit. The supplies to these centres is made at reduced kilometres.

Comparison of the actual and optimal flow pattern.

1. In the actual movement of cement we find that producing units like Rohtas, Ashoka, Japla, Khalari and Banjari in western Bihar, Churk and Dalla in eastern U.P and Sindri from eastern Bihar supply cement to areas in Assam, West Bengal, large parts of U.P and Madhya Pradesh. The quantity supplied was about 284000 tonnes in some cases and in others it varied between 1500 and 1300 tonnes. However, in the optimal flow, the linkage pattern established givesus a different type of movement. The above mentioned factories supplied to 15 consuming regions in the actual flow pattern. The number of linkages has been reduced to 6 consuming regions like western and eastern Madhya Pradesh, western and eastern Ganges plain and some parts of Bihar, west Bengal and Orissa. The amount supplied varies between 16300 tonnes to 333400 tonnes.

2. The producing units like Chaibasa in South Bihar, Rajgangpur and Bargarh in Western Orissa, Mandhar and Jamul in Madhya Pradesh supplied cement to Assam, West Bengal, Orissa and Bihar, Jammu and Kashmir and even to some parts of Maharashtra. The quantities supplied are sometimes as low as 700 or 800 tonnes. In the optimal plan, the number of linkages has been reduced to 11 as compared to 25 in the actual flow.

The linkage pattern in the optimal is that producing units supply cement to Assam in larger amounts thus satisfying their whole demand.

3. In the case of producing units of Bhupendra and Dalmia-Dadri, total supply was 24500 tonnes. This supply was directed towards 9 demand regions consisted of districts of western ganga plain of U.P, Punjab, Rajasthan and the Bombay region. In the case of some links the supply is as less as 300 or 400 tonnes while the highest amount supplied is 194000 tonnes. In the optimal flow, however, the total number of linkages is reduced to two. The quantity supplied in one case is 240200 tonnes and in the other 5200 tonnes. The linkages are established to the districts Punjab and Haryana and the Himachal Pradesh and Jammu area of Jammu and Kashmir state.

4. The producing units of Lakheri, Sawai Madhopur in Rajasthan and Banmore in Madhya Pradesh supply to 14 demand regions consisting of some districts of Bihar and Orissa, U.P., Punjab, Haryana and Rajasthan. In the optimal flow pattern, the number of linkages is reduced to 5. The demand regions supplied are districts of U.P., Himachal Pradesh, eastern Rajasthan and Delhi. The amount supplied varies between 11900 tonnes to 165300 tonnes. (Table No. 9)

5. Chittorgarh and Udaipur in Rajasthan supplied to 9 demand regions of U.P., Rajasthan, Delhi and Punjab. In the optimal flow pattern, the number of linkages is reduced to 3 and the places supplied are Punjab plain, Delhi and western Rajasthan.

6. The producing units of Sevalia, Ahmedabad, Sikka, Dwarka and Ranavav in Gujarat supply a total amount of 811000 tonnes. The number of demand regions to which it caters is 8. It supplies to western Madhya Pradesh, Punjab, Haryana, Delhi and western Rajasthan and Gujarat. In the optimal flow, the places served by these factories are Western Rajasthan and the Gujarat area.

7. In the case of Chanda in Maharashtra and Mancherial and Ramagundam in Andhra Pradesh, the demand units served are Western and Central Madhya Pradesh, Punjab, Haryana, Maharashtra and some areas of Gujarat and Andhra Pradesh. In the optimal plan, however, the pattern of linkages is different. In the optimal flow the places served are Delhi, Eastern Maharashtra and Andhra Pradesh.

8. The producing units of Macherla, Kistna, Vijaywada, Buggmapalli in Central and Western Andhra Pradesh and Wadi and Bagalkot in Mysore served Maharashtra, Andhra Pradesh and Tamil Nadu, some areas of Kerala. Small amounts are sent to as distant places as Delhi, Orissa

and Kashmir. In the optimal flow, the places serves are Bombay area, some of the Maharashtra districts and a part of Gujarat area.

9. In the case of the producing units of Bhadravati and Ammasandra in Mysore, the places served are Punjab and Haryana districts, Maharashtra,Mysore, Kerala and some districts of Tamil Nadu. In the optimal plan the places served are the coastal part of Maharashtra, Himachal Pradesh and some districts of Tamil Nadu.

10. The producing units of Sankaridurg, Karur, Madukkarai, Dalmiapuram, Alangulam, Tulukapatti and Talaiyuthu in Tamil Nadu served Punjab and Haryana,Delhi,Himachal Pradesh, Orissa, Bihar Maharashtra,Tamil Nadu, Kerala Andhra Pradesh. In the optimal flow the long haulages have been reduced and the places served are some of the districts of Orissa, Punjab and Haryana, Huge quantities are supplied to Tamil Nadu, Andhra Pradesh and Kerala.

The optimal plan, therefore, gives us a pattern of linkages in which the long haulages are reduced. If, sometimes to satisfy the demand factors, long haulages have to be maintained, the supply is considerably reduced. Maximum quantity is sent on short distances. A total reduction in the tonne kilometres travelled by these units are given below. The percentage difference between the optimal and actual flow give us an idea of the saving done by adopting the optimal flow.(Tables 10 & 11)

Producing Units	Distances over which cement is carried from these units		% difference between the Actual & Optimal flow.
	Actual	Optimal	
1. Rohtas, Ashoka, Japla, Khalari, Sindri, Satna Dalla, Banjari, Churk.	11842000	9866600	16.68
2. Chaibasa, Mandhar, Jamul, Rajgangpur, Baragarh.	12153200	9236300	24.82
3. Bhupendra, Dalmia-Dadri.	935800	746600	21.22
4. Lakheri, Madhopur, Banmore.	2744200	2131100	22.34
5. Chittorgarh, Udaipur.	2057200	1600200	22.21.
6. Senalia, Ahmedabad, Sikka, Dwarka, Ranavav	3781300	3096300	18.12
7. Chanda, Ramagundam, Mancherial, Sewree.	3630400	2085600	42.55
8. Wadi, Macherla, Bugginapalli, Vijaywada, Kistna, Bagalkot.	7641900	6500000	14.94
9. Bhadravati, Ammasandra.	1787800	1099400	38.51
10. Sankaridurg, Karur, Madhukkarai, Dalmiapuram, Alangulam, Tulukapatti Talaiyuthu.	18864200	17589000	6.76
Total	63838000	53851100	15.64

In the above table, we find that there has been a total reduction of 15.64% in the net tonne kilometres travelled in the optimal plan.

The variations in the tonne kilometres covered by supplies from different units is between 6.76% to 42.55%. So, the optimal plan gives us a normative pattern of flow for cement, which, if adopted, will reduce the tonne kilometres covered considerably.

Difference of freight charges in the actual and optimal flow.

A clearer idea of the differences between the optimal flow and the actual flow is further made by converting the tonne kilometres into freight charges by railway. Although there is a freight pool arrangement for cement decrease in freight rates in some case will also bring down the pooled prices. The following table gives an idea of the reduction in freight charges if the optimal flow is adopted.

Producing centres from which commodity is moved	Freight charged for moving cement (in Rs.)		% difference
	Actual flow	Optimal flow	
1.Rohtas,Ashoka,Japla, Khalari,Sindri,Satna, Dalla,Banjari,Churk.	592381.64	523981.04	11.60
2.Chaibasa,Mandhar,Jamul, Rajgangpur,Bargarh.	468684.86	394207.56	15.90
3.Bhupendra,Dalmia-dadri	64140 .37	56310 .02	12.30

contd...

Producing centres from which commodity is moved.	Freight charged for moving cement (in Rs.) Actual flow	Optimal flow	% difference
5. Chittorgarh, Udaipur.	108454.78	92433.54	14.30
6. Sevalia, Ahmedabad, Sikka, Dwarka, Ranavav.	240036.73	306676.67	22.00
7. Chanda, Ramagundam, Mancherial, Sewree.	341951.90	125254.97	63.40
8. Wadi, Macherla, Bugginapalli, Vijaywada, Kistna ---- Bagalkot.	404760.48	253464.14	37.40
9. Bhadravati, Ammasandra	356982.69	64222. 42	82.10
10. Sankaridurg, Karur, Madukkarai, Dalmiapuram, Alangulam, Tulukapatti, Talaiyuthu.	753202.90	752546.91	.20
Total	3482353.10	2702163.92	21.67

The above table shows that there will be a decrease in the freight charges paid if the optimal flow is adopted. There is a reduction of about 22% in the optimal flow as compared to the actual flow. We can see the difference between the freight charges of actual flow and that of optimal flow. In Table No. 7 an elaborate idea is given of the freight rates paid over different hauls. And Table Nos. 12 & 13 gives us the total freight rates charged for different amount of cement moved.

CONCLUSION

The present study was undertaken to analyse the spatial variation in the production patterns in the movement of cement and finally, to obtain a pattern of movement which would involve the minimisation of distance covered to carry cement. Availability of limited sources make it essential that a pattern of linkages, which minimises the distances, should be established. With production patterns and consumption patterns as given in the short run, it is the linkage pattern, which can be made efficient for utilising the resources to the maximum. Cement has pooled prices and the marketing zones for each producing unit is determined by the cement controller. In such conditions, therefore, it is only the pattern of movement between these producing centres can be made efficient in the short run. The main findings of the study are summarized below.

1. In case of cement, there has been a distinct shift in the spatial pattern of production with the increasing industrialization and the resulting economic growth. During 1950-56, the cement industry was located sporadically near the limestone reserves. Due to lack of overall planning strategy-both sectoral and regional-the locational pattern was not optimal. Moreover in the

initial stages the locational divisions are guided by least cost principle particularly of production. However, by 1971, the locational pattern of cement industry has acquired a distinct spatial pattern. There have emerged certain core areas of production, e.g., central and western regions[1] . Generally, emergence of more than one core area and the homogeneous nature of a commodity reduces intra-regional flow. However, in case of cement, the demand has risen so fast that both the intra-regional and inter-regional flows have grown in magnitude. With increasing economic activity, cement assumes a greater importance for use in developmental programmes. In developing economies, a rise in income often leads to an increase in the expenditure on construction activities, especially for residential purposes.

2. The pattern of production and supply is always dynamic and the differential pattern of demand owing to the differences in the patterns and levels of regional development bring out complex patterns of inter-regional transactions.

3. The cement industry being mostly raw-material oriented, we find a pattern of location of cement industry

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1. Gidadhubli and Bhat (1971) "Economic Regions and Regional Flows, A case study in the flow patterns and trends in the selected commodities in India".

in which factories are close to limestone quarries. Only in case of a few plants like Dalmia Dadri in Haryana, Kottayam in Kerala, Sindri in Bihar and Dwarka in Gujarat the raw-material used is different, and these therefore are not located close to limestone mines.

4. The locational pattern of cement industry has changed over last two decades. Previously it was the sourthern region that dominated the map of cement industry. However, recently the central region, including Madhya Pradesh and Bihar are emerging as the main suppliers.

5. The consumption pattern indicates that the states of Maharashtra and West Bengal and the union territories of Delhi and Chandigarh consume cement in large amount. These states which are highly industrialized have a developed tertiary and service sector.

This pattern of consumption and production determine the pattern of movement of cement. Cement is transported from surplus to deficit states. Sometimes, several factories are concentrated in one region like Bihar and Madhya Pradesh. In such cases, to meet the demand the supply from such regions is sent on long hauls.

A study of production pattern, consumption pattern and distribution pattern has given an idea of the pattern of links. With the former three situations as constant, only the linkage pattern can be made more efficient. In this study an attempt was made to see how far the linkage pattern be rationlized so as to reduce the distance covered.

6. In the rationalized linkage pattern, the long haulage is reduced. Factories in North Bihar previously used to supply cement to Assam, but in the rationlized flow pattern the factories in South Bihar supply cement to Assam. In the same manner long haulage from factories, in the North to places in the South is reduced.

7. This study in the locational pattern of production, supply and inter-regional flows should be regarded only as a first step in assessing the extent of anomaly that is likely to be present in inter-regional transactions. The principle is that in the long run, economic regionalization brings about a reduction in long haulage of goods. This study has approached the problem only from a sectoral point of view. Similar studies of important commodities involving long haulage would be of value in further testing the results of this study. For example, what is considered as an eptimal flow pattern or linkages between regions may not be practicable in all the situations because of the possibilities of transport bottlenecks along the same routes which

are involved in inter-regional flow of several commodities. The pattern of flows along different routes would be complementary for this purpose even though the distance calculation makes use of the routewise flow.

APPENDIX - A

PLANNING REGIONS OF INDIA

MACRO REGIONS	MICRO REGIONS	DISTRICTS
1. North-Eastern Region	a) Upper Brahmaputra Valley.	**Assam Districts** Lakhimpur. Sibsagar, Darrang
	b) Lower Brahmaputra Valley	Nowgong. Kamrup, Goalpara.
	c) Mineralised Platean	Garo Hills and United Khasi and Jaintia Hills
	d) Eastern and Northern Hills and Basins.	United Mikir and North Cachar Hills and Mizo Hills and Cachardistrict and Nagaland. Union Territories - Manipur, Tripura and NEFA.
2. Eastern Regions	a) Calcutta Hooghly Area.	**West Bengal Districts** The whole of Calcutta and Howrah. 24 Parganas and Hooghly districts inparts.
	b) Damodar Valley area.	Bankura, Burdwan, Hooghly and Howrah districts in parts. **Bihar Districts-** [illegible], Dhanbad, Hazaribagh.
	Chota Nagpur and Northern. c) Orissa Plateau.	**Bihar Districts** - Ranchi Palamau, Gaya, Shahbad, Singhbhum, Santhal Paraganas and Southern part of Monghyr. **Orissa Districts-** Sundargarh, Keonjhar, Mayurbhanj, Dhenkanal, Sambalpur. **West Bengal Districts-** Purulia.
	Southern Hills and Plateans of Orissa	**Orissa Districts-** Bolangir, Boudh Khondmals, Kalahandi, Ganjam and Koraput.
	d) Lower Ganga Plains e) Including deltas and coastal areas.	**Bihar Districts-** Champaran Saranand Patna, Muzaffarpur Dharbanga, Monghyr, Bhagalpur, Saharsa and Purnea districts.

MACRO REGIONS	MICRO REGIONS	DISTRICTS
		<u>West Bengal Districts-</u> Jalpaiguri (excluding Duars areas), Cooch Behar, West Dinajpur, Malda, Murshidabad, Nadia, 24 Par ganas, Howrash (excluding industrial Hooghly region), Birbhum, Midnapur.
		<u>Orissa Districts-</u> Balasore,, Cuttack and Puri.
	Darjeeling Hills and Duars area/ Sikkim.	<u>West Bengal Districts -</u> Darjeeling and Northern fringe of Jalpaiguri district (Duars area) and Sikkim)
3. Northern Region	a) Norther Himalayan Area.	<u>Uttar Pradesh Districts</u> Tehri Garhwal, Garhwal, Almora, Dehradun Nainital, Uttar Kashi, Chamoli and Pithoragarh.
	b) Western Ganga Plain	<u>Uttar Pradesh Districts-</u> Saharanpur, Muzaffarnagar, Bijnor, Meerut Bulandshahr, Shahjahanpur, Kheri, Sitapur Hardoi, Moradabad, Rampur, Bareilly, Pilibhit, Lucknow, Unnao Kanpur Fatehpur, Banda, Hamirpur, Jhansi, Jalaun, Etawah, Mainpuri Ferrukhabad, Etah, Budaun, Mathura, Agra and Aligarh.
	c) Eastern Ganga plain	<u>Uttar Pradesh Districts-</u> Bahraich, Gonda, Basti, Gorakhpur, Deoria, Bhallia, Azamgarh, Faizabad, Bara-Banki Rae-Bareli Sultanpur, Pratapgarh, Jaunpur, Ghazipur, Varansi, Mirzapur and Allahabad.

MACRO REGIONS	MICRO REGIONS	DISTRICTS
4.Central Regions	a) Eastern Madhya Pradesh.	Madhya Pradesh Districts Durg, Raipur, Balaghat, Mandya, Bilaspur, Raigarh Surguja, Shahdol.
	b) Western Madhya Pradesh.	Betul, Hoshangabad, East and west Nimar, Dhar, Jhabua, Indore, Dewas, Sehore, Raisen, Narsimhapur, Sagar, Vidisha, Guna, Shivpuri, Morena, Gwalior, Bhind, Dalia, Rajgarh, Shajapur, Ujjain, Rattlam and Mandsaur.
	c) Bastar Area	Bastar.
	c) Central Madhya Pradesh.	Tikamgarh, Chhatarpur Panna, Satna, Rewa, Jabalpur, Damoh, Chhindwara, Seoni, Sidhi.
5. North Western Region	a) Punjab.Plain	Punjab and Haryana Dist. Rohtak, Gurgaon, Mahender garh, Hissar, Bhatinda Sangrur, Karnal, Ambala, Patiala, Ludhiana, Jullundur Ferozpur, Amritsar, Kapurthala, Hoshiarpur, Gurdaspur.
	b) Delhi.	Delhi Union Territory (Delhi Metropolitan City and its surrounding rural areas).
	c) Western Raj.	Rajasthan Districts. Ganganagar, Bikaner, Jaisal mer, Barmer, Jalor, Pali, Nagaur, Jodhpur, Churu, Sirohi.
	d) Eastern Raj.	Rajasthan Distrits- Alwar, Bharatpur, Sawai, Madhopur, Jaipur, Torjk,

MACRO REGIONS	MACRO REGIONS	DISTRICTS
		Sikar, Jhunjhunu, Ajmer, Bhilwara, Bundi, Kota, Jhalawa Chitorgarh, Udipur, Dungarpur and Bhanswara.
	e) Himalayan Hills including 'Dun' areas.	Jammu and Kashmir excluding Kashmir Valley and its surrounding hills and Himabal Padesh Distt. - Chamba, Bilaspur, Mandi Mahasu, Sirmur, Kinnaur, Kangra, Lahaul and Spiti and Simla.
	f) Kashmir Valley and its surrounding hills.	Jammu and Kashmir Distt. Srinagar, Anantnag and Baramulla.
6. Western Region	a) Bombay city and its conurbation Area.	Maharashtra Distt. Maharashtra Distt-Greater Bombay and Thana.
	b) The intervening area along the railway between Bombay and Nagpur	Maharashtra Distt.-Nasik Jalgaon, Dhulia, Buldhana, Akola, Amravali, Wardha, and Nagpur.
	c) Coastal part of Maharashtra South of Bombay City.	Maharashtra Distt. Kolaba and Ratnagiri.
	d) Western Maharshtra mainly w.Ghat and Platean Area.	Maharashtra Distt.- Poona (north) Satara, Sangli, Kolhapur and Sholapur.
	e) Eastern Maharashtra	Maharashtra Distt. Bhandara, Chanda, and Yeotmal.
	f) Central Maharashtra	Maharashtra Distt. Ahmednagar, Aurangabad, Osmanabad, Parbhani, Nanded and Bhir.

MACRO REGION	MICRO REGIONS	DISTRICTS
	g) Gujarat Plains	Gujarat Distts. Ahmedabad ,Kaira,Sabar kantha,Panchmahals, Baroda,Broach,Surat and Dangs;Daman and Diu Dadra and Nagar Haveli Union Territory.
	h) Saurashtra	Gujarat Distts. Jamnagar,Bhernagar, Junagadh,Rajkot,Amreli, Mehsana,Banaskantha and Diu Union Territory
	i) Kutch	Gujarat Distt. Kutch.
7.Southern Region	a)Coastal Plain of Andhra Prad.	Andhra Pradesh Distts. East.Godavari,West Godavari Krishna,Srikakulam, Visakhapatnam,Guntur and Nellore.
	b) Telangana Area	Andhra Pradesh Distts. Adilabad,Nizamabad,Karimnagar,Medak.Warangal Hyderabad,Mahbubnagar Nalgonda and Khammam.
	c) Rayalaseema Area	Andhra Pradesh Distts. Chittor,Anantpur, Cuddapah and Kurnool.
	d) South Central Industrial Area	Madras Distts. Madras North Arcot, Chingleput, Salem, South Arcot, Coimbatore,Madurai and Tiruchirapalli.
		Mysore Distts.- Bangalore,Kolar,Mysore and Mandya.
	e) South Eastern Coast	Madras Distts.
		Thanjavar,Ramanathapuram, and Tiruneveli Distts excluding Hill margins.

MACRO REGIONS	MICRO REGIONS	DISTRICTS
	f) Annimalai, Cardamom and Nilgiri Hills	Mysore Distts. Coorg, Hill part of Mysore. Madras Distts. Nilgiri Hillpart of Madaurai, Hill part of Tirunelveli and Hill part of Kanya Kumari. Kerala Distts. Hill part of Trichur, Ernakulam, Kottayam, Quilon and Trivandrum.
	g) Western Coast	Kerala Distt.s . Part of Trivandrum Quilon, Kottayam, Trichur, Ernakulam and almost whole of Alleppey, Kozhikode, Palghat and Cannanore. Mysore Distts. Coastal part of North Kanara, and South Kanara, KanyaKumari Distts. of Madras the western half of the union territory Goa and Mahe,
	h) Mained and Western ghat Area.	Mysore Distt. -Chikmagalur, Shimoga, East part of south Kanara and W. Coorg. union territory east part of Goa.
	i) Maidan Area	Mysore Distt. Bidar, Gulbarga, Bijapur, Belgaum, Dharwar, Raichur, Bellary, Chitradurga and Tumkur.
	j) Island	Andaman and Nicobar Island Laccadiv, Minicoy and Amindivi Islands.

Source -

Sen Gupta and Sdasyuk,

"Economic Regionalization of India, Problems and Approaches" Census of India 1961.

Appendix B

TABLE NO. 1

Statewise Distribution of Cement Factories in India - 1951.

(Capacity and Production in '000 tonnes)

States	1950-51			1955-56			1960-61			1965-66			1970-71		
	No.	Capacity	Production	No.	Capacity	Production	No.	Capacity	Production	No.	Capacity	Production	No.	Capacity	Production
Andhra Pradesh	2	189	147	2	189	210	5	960	729	5	1213	1092	6	1926	1613
Assam	-	-	-	-	-	-	-	-	-	1	84	76	1	84	75
Bihar	5	922	833	6	1116	820	7	1914	1422	7	2114	1903	7	2408	1600
Gujarat	3	337	294	4	692	647	5	1109	994	5	1901	1712	6	2447	1666
Kerala	1	51	47	1	51	56	1	51	53	1	51	46	1	51	40
Madhya Pradesh	2	410	424	2	410	442	3	894	781	4	1829	1646	5	2730	2130
Tamil Nadu	3	647	631	3	635	709	4	1233	1186	6	1958	1762	7	3412	2798
Maharashtra	-	-	-	-	-	-	-	-	-	-	-	-	2	400	465
Mysore	2	326	223	3	560	435	3	877	758	4	1103	993	5	1677	1536
Orissa	-	-	-	1	165	193	1	371	373	2	771	694	2	797	661
Punjab	2	342	305	2	370	348	2	645	640	2	645	681	2	545	496
Rajasthan	1	225	261	2	525	536	2	1184	1091	3	1385	1247	4	1966	1399
Uttar Pradesh	-	-	-	1	231	175	1	235	217	1	475	428	2	907	426
West Bengal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jammu & Kashmir	-	-	-	-	-	-	-	-	-	1	20	18	1	-	1058
Himachal Pradesh	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	21	3449	3165	27	4944	4571	34	9474	8244	42	13549	12197	51	18950	15393

Source : 1. Ministry of Industrial Development
2. Bhat & Mathur "Cement Industry - A case Study" 1967

TABLE - 2

CEMENT FACTORIES USING RAW MATERIALS OTHER THAN LIMESTONE

Sl. No.	Location	Period of establish ment	Materials used	Prod. in Tonnes 1971.
1.	Dalmia Dadri	Pre 1951	Kankar	197010
2.	Kottayam	Pre "	Sea-shell	39546
3.	Dwarka.	" "	Sea-sand	282885
4.	Bhadravati.	" "	Blast-Furnace slag.	91123
5.	Sindri	1951-56	Fertilizer sludge	260384
6.	Chaibasa	1956-61	Blast Furnace slag.	454000
7.	Jamul	1961-66	"	741300

Source:

Col.3,4 Bhat & Mathur "Cement Industry - A case study" 1967 P.1963.

Col.5. - " Cement Production and Despatches" Office of the Cement Controller 1971.

TABLE - 3

PRODUCTION OF CEMENT - 1950 - 1971

(In '000 tonnes)

Sl. No.		1950-51	1960-61	1969-70	1970-71	1971-72
1.	Banmore	65	63	73	68	63
2.	Bhupendra	-	-	314	308	299
3.	Chaibasa	204	276	362	447	454
4.	Chanda	-	-	-	101	255
5.	Dwarka	162	252	312	294	283
6.	Jamul	-	-	741	749	741
7.	Khalari	75	113	113	110	87
8.	Kistna	87	253	199	223	209
9.	Kymore	359	474	603	530	590
10.	Lakheri	261	336	339	299	256
11.	Madukkarai	282	293	332	364	321
12.	Mancherial	-	182	294	282	297
13.	Porbandar	31	13	182	153	168
14.	Sevalia	-	181	221	184	216
15.	Shahbad	165	498	486	487	517
16.	Sindri	-	277	284	299	260
17.	Wadi	-	-	205	286	310
18.	Alangulam	-	-	-	76	275
19.	Bhadravati	58	80	83	80	91
20.	Cherrapunji	-	-	69	55	74
21.	Bargarh	-	-	202	243	264
22.	Churk	-	217	390	353	342.
23.	Dalla	-	-	-	-	84
24.	Mardhar	-	-	-	52	183

TABLE - 3 (Contd...)

Sl. No.		1950-51	1960-61	1969-70	1970-71	1971-72
25.	Bagalkot	-	180	201	218	202
26.	Dalmia-Dadri	56	175	208	214	197
27.	Ashoka	-	137	162	164	190
28.	Rohtas	266	291	309	315	326
29.	Dalmiapuram	240	406	524	503	512
30.	Japla	254	204	195	144	33
31.	Rajgangpur	-	373	454	384	398
32.	Sawai-Madhopur	-	755	887	780	709
33.	Ammasandra	-	-	303	387	415
34.	Chittorgarh	-	-	254	235	252
35.	Ramagundam	-	68	165	247	295
36.	Satna	-	244	591	593	553
37	Sankaridurg.	-	-	484	428	451
38.	Talaiyuthu	109	450	514	659	826
39.	Macherla.	-	78	176	204	231
40.	Vijayawada.	60	150	192	189	306
41.	Bugginapalli.	-	-	343	313	374
42.	Banjari	34	124	262	272	249
43.	Karur	-	-	193	200	241
44.	Kottayam.	47	53	43	42	39
45.	Ranavav	-	168	449	400	415
46.	Sikka	101	380	462	517	519
47.	Sewree	-	-	160	166	210
48.	Ahmedabad	-	--	54	61	64

TABLE - 3 (contd...)

Sl. No.		50-51	60-61	69-70	70-71	71-72
49	Tulukapatti	-	37	192	201	172
50	Udaipur	-	-	-	32	182

Source Col: 2,3 - Bhat & Mathur "Cement Industry, A case study" 1967 P.54.

Col.4,5,6 - " Cement Production & Despatches" Publication, office of the Cement Controller for 1969, 1970, 1971.

TABLE - 4

PRODUCTION & REQUIREMENT OF CEMENT - 1971

'000 tonnes

State	Production	Total consumption	Deficit	Surplus
West Zone				
Gujarat	1666	1370	-	296
Maharashtra	465	1875	1410	-
Madhya Pradesh	2131	627	-	1504
Goa, Daman & Diu	-	72	72	-
Dadra and Nagar Haveli	4262	3945	-	317
East Zone				
Assam	74	251	177	-
Bihar	1600	916	-	684
Orissa	661	332	-	329
West Bengal	-	843	843	-
Manipur	-	7	7	-
Nagaland	-	10	10	-
N.E.F.A.	-	2	2	-
Tripura.	-	6	6	-
Total East	2335	2367	-	32
North Zone				
Chandigarh	-	73	73	-
Delhi	-	634	634	-
Haryana.	496	482	-	14
Himachal Pradesh	-	46	46	-
Punjab	-	726	726	-

contd.

State	Production	Total consumption	Deficit	Surplus '000 tonnes
Rajasthan	1399	458	-	941
U.P.	426	1569	1143	-
J & K	-	119	119	-
Total North	2321	4107	1786	-
South Zone				
Andhra Pradesh	1613	1145	-	468
Tamil Nadu	2798	1392	-	1406
Mysore	1536	872	-	664
Kerala	39	600	561	-
Pondicherry	-	22	22	-
Andeman & Nicobar	-	21	21	-
Laccadnes	-	-	-	-
Total South	5986	4052	-	1934
Grand Total:	14904	14471	533	-

Source: Publication " Cement Production and Despatches, 1971"
Cement Controller.

TABLE - 5

Factories Aggregated Together to Form One Producing Unit

		Production in 1971 (Tonnes)	Production in 1970 (Tonnes)
ONE			
1	Rohtas	325885	314680
2	Ashoka	190005	164167
3	Japla	33218	143590
4	Khalari	87220	109940
5	Sindri	260384	298803
6	Satna	553484	593366
7	Dalla	884267	-
8	Banjari	248905	272426
9	Churk	341937	353507
TWO			
1	Charbasa	454000	447120
2	Mandhar	182537	52424
3	Jamul	741300	749350
4	Rajgangpur	397657	383554
5	Bargarh	263558	243057
THREE			
1	Bhupendra	298607	306165
2	Dalmia Dadri	197010	214198
FOUR			
1	Lakheri	255800	299000
2	Madhopur	709689	780083
3	Banmore	63200	67600

TABLE -5

contd..

FIVE		
1 Chittorgarh	251525	234593
2 Udaipur	182359	31658
SIX		
1 Sevalia	215995	183756
2 Ahmedabad	64499	60710
3 Sikka	519408	516839
4 Dwarka	282885	294425
5 Ranavav	415542	4000418
SEVEN		
1 Chanda	254000	447120
2 Ranagundam	294930	247120
3 Mancherial	296885	281650
EIGHT		
1 Kurkunta	310405	286011
2 Wadi	231355	2037712
3 Macherla	374555	313454
4 Bugginapalli	206088	189260
5 Vijaywada	208958	223420
6 Kistna	202375	218175
7 Bagalkot		

TABLE -5 contd...

NINE				
	1	Bhadravati	91123	80323
	2	Amanasandra	414759	386606
TEN				
	1	Sankaridurg	451018	428359
	2	Karur	2411296	200407
	3	Madukkarai	320970	363790
	4	Dalmiapuram	5212085	503538
	5	Alangulam	275022	76127
	6	Tulukapatti	171700	200900
	7	Talaiynthu	825741	659551

Source: "Cement Production and Despatches" - 1971 and 1970.

TABLE - 6

Total and Freesale Despatches From Producing Units (in Tonnes) 1971

	Despatches	Freesale Despatches	% of Freesale Despatches to total Despatches
1	2	3	4
1. Banmore	62937	39000	61.97
2. Bhupendra	296347	142000	47.92
3. Chaibasa	454582	221000	48.62
4. Chanda	249668	167000	66.89
5. Dwarka	281254	175000	62.22
6. Jamul	741599	419000	56.50
7. Khalari	88205	33000	37.41
8. Kistna	204336	165000	80.75
9. Kymore	586911	305000	51.97
10. Lakheri	254511	163000	64.04
11. Madukkarai	321897	249000	77.35
12. Mancherial	291906	191000	65.43
13. Porbandar	168478	152000	90.22
14. Senalia	216583	163000	75.26
15. Shahabad	517555	287000	55.45
16. Sindri	265102	133000	50.17
17. Wadi	313225	206000	65.77
18. Alangulam	274979	63000	22.91
19. Bhadravali	89441	52000	58.14
20. Bargash	265422	105000	39.56
21. Cherrapunji	73107	50000	68.39
22. Churk	348717	199000	57.07

TABLE-6 Contd...

1		2	3	4
23	Dalla	67849	67000	98.75
24.	Mandhar	183760	305000	165.54
25.	Bagalkot	203619	130000	63.84
26.	Dalmia Dadri	195433	102000	52.19
27.	Ashoka	187897	126000	67.06
28.	Rohtas	303867	204000	67.13
29.	Dalmiapuram	504702	386000	76.48
30.	Japla	39389	34000	86.32
31.	Rajgangpur	390108	167000	42.81
32.	Samai Madhopur	713032	300000	42.07
33.	Ammasandra	417522	247000	59.16
34.	Chittorgarh	249348	151000	60.56
35.	Ramagundan	286775	145000	50.56
36.	Satna	553462	318000	57.46
37.	Sankaridurg	447443	267000	59.67
38.	Talaiyuthu	826417	405000	49.01
39.	Macherla	230123	129000	56.06
40.	Vijaywada	206471	115000	55.70
41.	Bugginapalli	375329	232000	61.81
42.	Banjari	248750	175000	70.35
43.	Karur	239631	95000	39.64
44.	Kottayam	39450	33000	83.65
45.	Ranavav	42256	306000	72.47
46.	Sikka	511780	228000	44.55
47.	Sewree	208632	146000	69.98
48.	Ahmedabad	64259	39000	62.44
49.	Tulukapatti	172161	124000	72.03
50.	Udaipur	180325	118000	65.44
	Total	14836552	8610000	58.03

Source- Col.2,3 -
" Cement Production and Despatches" - 1971.

TABLE - 7

Estimates of Railway Freight Charges Over Different Distances

Distances in Kms.	Freight Rates per tonne.	Distances in Kms.	Freight rates per tonne
100	10.81	2500	93.30
200	17.21	2600	96.22
300	27.40	2700	99.26
400	32.01	2800	101.00
500	22.75	2900	104.01
600	36.24	3000	107.94
700	39.80	3100	108.89
800	43.65	3200	110.66
900	47.16	3300	112.38
1000	50.96	3400	115.93
1100	54.22	3500	117.74
1200	57.70	3600	121.45
1300	60.43	3700	122.00
1400	63.31	3800	123.40
1500	67.37	3900	127.24
1600	69.50	4000	129.00
1700	72.81	4100	131.22
1800	76.28	4200	133.30
1900	77.46	4300	135.37
2000	81.15	4400	137.46
2100	83.69	4800	146.29
2200	86.35		
2300	88.10		
2400	91.87		

TABLE NO. 8

Actual flow of Cement - 1971

Flow in '00 tonnes
*Distances in '00 Kms.

	Upper Brahmaputra Valley	Lower Brahmputra Valley	Mineralised plateau	Eastern & Northern Hills and Basins	Calcutta Hoogly area	Damodar Valley area	Chhota Nagpur and Northern plateau	Southern hills and plateaus of Orrisa	Lower Ganga plain including deltas & Coastal areas.
	1	2	3	4	5	6	7	8	9
1. a) Rohtas, b) Ashoka, c) Churk d) Japla, e) Khalari, f) Sindri g) Satna, h) Dalla, i) Banjari	(29) 79	(24) 18	(26) -	(29) 15	(18) 713	(15) 866	(11) 1300	(15) -	(11) 2553
2. a) Chaibasa, b) Mandhar c) Jamul, d) Rajgangpur e) Bargarh	(26) 190	(20) 146	(22) -	(26) 70	(11) 220	(10) 408	(7) 822	(11) 135	(12) 1236
3. a) Bhupendra, b) Dalmia Dadri	(39) -	(34) -	(36) -	(39) -	(34) -	(33) -	(34) -	(31) -	(36) -
4. a) Lakheri, b) Madhopur, c) Banmore	(34) -	(28) -	(30) -	(34) -	(24) -	(22) -	(25) -	(22) 8	(25) -
5. a) Chittorgarh, b) Udaipur	(36) -	(31) -	(33) -	(36) -	(27) -	(24) -	(28) -	(25) -	(28) -
6. a) SSenalia, b) Ahmedabad c) Sikka, d) Dwarka, e) Ranavav	(42) -	(36) -	(38) -	(42) -	(32) -	(30) -	(33) -	(32) -	(34) -
7. a) Chanda, b) Ramagundam, c) Mancherial	(34) -	(28) -	(30) -	(34) -	(17) -	(15) -	(16) -	(18) -	(18) -
8. a) Kurkunta, b) Wadi, c) Marcherla, d) Buggirapallia, e) Vijaymada, f) Kistna, g) Bagalkot	(41) -	(35) -	(37) -	(41) -	(36) -	(23) -	(20) -	(26) 152	(25) 178
9. a) Bhadravati, b) Ammasandra	(45) -	(39) -	(41) -	(45) -	(32) -	(29) -	(29) -	(24) -	(32) -
10. A) Sankaridurg, b) Karur, c) Madukkarai, d) Dalmiapuram, e) Alungulam, f) Tulukapatti g) Talaiyuthu	(54) -	(49) -	(51) -	(54) -	(41) 330	(39) -	(36) -	(27) 42	(41) 17
TOTAL	269	227	-	85	1267	1274	2122	337	3984

* Distances are given in brackets.

contd...

	Darjeeling Hills & Dnar areas	Northern Himalayan areas	Western Ganga Plain	Eastern Ganga Plain	Eastern Madhya Pradesh	Western Madhya Pradesh	Bastar area	Central Madhya pradesh.	Punjab Plain	Delhi	Western Rajasthan	Eastern Rajasthan	Himalayan Hills including Dun areas
	10	11	12	13	14	15	16	17	18	19	20	21	22
1.	(17) 72	(22) 266	(8) 2840	(5) 2907	(6) 18	(6) 144	(8) -	(3) 80	(16) -	(13) -	(15) -	(11) -	(17) -
2.	(17) 12	(29) 273	(16) 985	(13) 71	(1) 720	(12) 780	(4) 34	(6) 80	(23) 730	(27) 800	(21) -	(17) -	(24) 20
3.	(39) -	(8) 4	(11) 90	(18) -	(20) -	(13) -	(24) -	(18) -	(3) 1940	(5) 201	(5) 3	(6) 90	(5) 91
4.	(31) -	(7) 3	(5) 742	(11) 233	(13) -	(4) 331	(18) -	(10) 2	(8) 1230	(5) 1020	(6) 251	(2) 60	(9) 61
5.	(34) -	(10) 9	(9) 235	(14) 430	(17) 3	(7) 32	(21) -	(9) -	(8) 1040	(5) 161	(6) 420	(2) -	(6) -
6.	(37) -	(19) -	(18) -	(26) -	(23) -	(13) 18	(27) -	(20) -	(18) -	(15) 123	(13) 133	(12) -	(19) -
7.	(22) -	(22) -	(18) -	(14) -	(6) -	(12) 3	(10) -	(8) 1	(24) 154	(21) -	(20) -	(17) -	(25) -
8.	(30) -	(27) -	(23) -	(22) -	(14) -	(16) -	(10) -	(15) -	(28) -	(25) -	(25) -	(22) -	(23) -
9.	(36) -	(41) -	(36) -	(30) -	(23) -	(26) -	(23) -	(23) -	(32) 273	(29) 6	(29) -	(26) -	(27) 8
10.	(47) -	(46) -	(41) -	(43) -	(30) -	(32) -	(25) -	(35) -	(40) 400	(38) 100	(40) -	(37) -	(43) 16
Total	84	555	4892	3641	741	1291	34	163	5767	2411	807	150	196

contd...

	Kashmir Valley and its surrounding hills	Bombay city and its conurbation Area	The intervening area along the railway between Bombay & Nagpur.	Coastal part of Maharashtra South of Bombay City	Western Maharahstra	Eastern Maharashtra	Central Maharashtra	Gujarat plains	Saurashtra	Kutch	Coastal plain of Andhra Pradesh.
	23	24	25	26	27	28	29	30	31	32	33
1.	(23) -	(18) -	(13) -	(15) -	(16) -	(17) -	(18) 15	(19) -	(18) -	(13) -	(20) -
2.	(21) 29	(13) 350	(8) 330	(14) 7	(17) 8	(6) -	(18) -	(18) -	(20) -	(22) -	(10) 75
3.	(9) 22	(22) 14	(17) -	(22) -	(21) -	(18) -	(20) -	(13) -	(14) -	(16) -	(27) -
4.	(15) 48	(22) 9	(24) -	(22) -	(21) -	(25) 1	(27) -	(10) 54	(11) -	(14) -	(23) -
5.	(12) -	(19) -	(21) -	(20) -	(19) -	(22) -	(24) -	(7) 61	(8) -	(11) -	(20) -
6.	(25) -	(11) 800	(12) 3	(13) -	(15) -	(20) -	(18) -	(4) 3880	(3) 2810	(4) 360	(25) -
7.	(32) 6	(12) 452	(7) 1730	(14) 31	(11) 6	(2) 60	(6) 153	(16) 560	(18) -	(20) -	(7) 450
8.	(36) -	(8) 1040	(7) 241	(7) 46	(5) 1210	(8) 14	(7) 620	(14) 260	(16) -	(18) -	(9) 2700
9.	(39) 9	(13) 53	(20) 34	(11) 2	(10) 143	(17) -	(17) 70	(19) -	(20) -	(22) -	(15) -
10.	(48) 17	(23) 200	(23) 16	(22) -	(19) 21	(13) -	(25) 3	(29) -	(30) -	(32) -	(20) 21
Total	131	2918	2354	86	1388	75	861	4815	2810	360	3246

contd.

	Telengana area	Rayalseema area	South Central Industrial area	South-eastern coast	Annamalai Cardamom & Nilgiri Hills	Western Coast	Mainad and western Ghat area	Maidan area	Total
	34	35	36	37	38	39	40	41	42
1.	(15) -	(22) -	(28) -	(34) -	(34) -	(32) -	(18) -	(22) -	11933
2.	(8) 16	(20) -	(24) -	(31) -	(32) -	(29) -	(22) -	(17) -	8547
3.	(22) -	(34) -	(37) -	(43) -	(43) -	(41) -	(34) -	(32) -	2454
4.	(18) -	(26) -	(31) -	(34) -	(35) -	(30) -	(25) -	(20) -	4035
5.	(15) -	(22) -	(29) -	(32) -	(32) -	(27) -	(22) -	(18) -	2388
6.	(20) -	(28) -	(25) -	(36) -	(37) -	(34) -	(26) -	(25) -	8126
7.	(1) 1060	(13) 10	(14) -	(22) -	(22) -	(20) -	(15) -	(11) -	4687
8.	(6) 1210	(7) 520	(10) 124	(17) -	(18) 4	(13) 280	(10) -	(5) 650	9246
9.	(15) -	(8) 100	(6) -	(11) -	(11) -	(8) 170	(1) 340	(4) 470	1686
10.	(21) 24	(11) 381	(18) 7110	(2) 1540	(1) 1500	(5) 1040	(11) 320	(14) 10	13116
Total	2310	1011	7234	1540	1504	1490	660	1130	66218

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TABLE NO. 9

Optimal Flow of Cement for 1971

Flow in '00 tonnes
*Distances in '00 Kms.

	Upper Brahmaputra Valley	Lower Brahmaputra Valley	Mineralised plateau	Eastern & Northern Hills and Basins	Calcutta Hoogly area	Damodar Valley area	Chhota Nagpur and Northern plateau	Southern hills and pleateaus of Orrisa	Lower Ganga plain including deltas & Coastal areas.
	1	2	3	4	5	6	7	8	9
1. a) Rhotas, b) Ashoka, c) Churk d) Japla, e) Khalari, f) Sindri g) Satna, h) Dalla, i) Banjari	(29) -	(24) -	(26) -	(29) -	(18) -	(15) -	(11) -	(15) -	(11) 2102
2. a) Chaibasa, b) Mandhar c) Jamul, d) Rajgangpur e) Bargarh	(26) 269	(20) 227	(22) -	(26) 85	(11) 1267	(10) 1274	(7) 2122	(11) -	(12) 1882
3. a) Bhupendra, b) Dalmia Dadri	(39) -	(34) -	(36) -	(39) -	(34) -	(33) -	(34) -	(31) -	(36) -
4. a) Lakheri, b) Madhopur, c) Banmore	(34) -	(28) -	(30) -	(34) -	(24) -	(22) -	(25) -	(22) -	(25) -
5. a) Chittorgarh, b) Udaipur	(36) -	(31) -	(33) -	(36) -	(27) -	(24) -	(28) -	(25) -	(28) -
6. a) Savalia, b) Ahmedabad c) Sikka, d) Dwarka, e) Ranavav	(42) -	(36) -	(38) -	(42) -	(32) -	(30) -	(33) -	(32) -	(34) -
7. a) Chanda, b) Ramagundam, c) Mancherial	(34) -	(28) -	(30) -	(34) -	(17) -	(15) -	(16) -	(18) -	(18) -
8. a) Kurkunta, b) Wadi, c) Marcherla, d) Buggirapallia, e) Vijamada, f) Kistna, g) Bagalkot	(41) -	(35) -	(37) -	(41) -	(36) -	(23) -	(20) -	(26) -	(25) -
9. a) Bhadravati, b) Ammasandra	(45) -	(39) -	(41) -	(45) -	(32) -	(29) -	(29) -	(24) -	(32) -
10. a) Sankaridueg, b) Karur, c) Madukkarai, d) Dalmiapuran, e) Alungulam, f) Tulukapatti g) Talaiyuthu	(54) -	(49) -	(51) -	(54) -	(41) -	(39) -	(36) -	(27) 337	(41) -
TOTAL . . .	269	227	-	85	1267	1274	2122	337	3984

* Distances are given in brackets.

contd...

	Darjeeling Hills & Dhar areas	Northern Himalayan areas	Western Ganga Plain	Eastern Ganga Plain	Eastern Madhya Pradesh	Western Madhya Pradesh	Bastar area	Central Madhya Pradesh	Punjab Plain	Delhi	Western Rajasthan	Eastern Rajasthan	Himalayan Hills including Dun areas
	10	11	12	13	14	15	16	17	18	19	20	21	22
1.	(17) -	(22) -	(8) 3334	(5) 3641	(6) -	(6) 1291	(8) -	(3) 163	(16) 1402	(13) -	(15) -	(11) -	(17) -
2.	(17) 84	(29) 33	(16) -	(13) -	(1) 741	(12) -	(4) 34	(6) -	(23) -	(27) -	(21) -	(17) -	(24) -
3.	(39) -	(8) -	(11) -	(18) -	(20) -	(13) -	(24) -	(18) -	(3) 2402	(5) -	(5) -	(6) -	(5) 52
4.	(31) -	(7) 555	(5) 1558	(11) -	(13) -	(4) -	(18) -	(10) -	(8) -	(5) 1653	(6) -	(2) 150	(9) 119
5.	(36) -	(10) -	(9) -	(14) -	(17) -	(7) -	(21) -	(9) -	(8) 1132	(5) 590	(6) 666	(2) -	(6) -
6.	(37) -	(19) -	(18) -	(26) -	(23) -	(13) -	(27) -	(20) -	(18) -	(15) -	(13) 141	(12) -	(19) -
7.	(22) -	(22) -	(18) -	(14) -	(6) -	(12) -	(10) -	(8) -	(24) -	(21) 168	(20) -	(17) -	(25) -
8.	(30) -	(27) -	(23) -	(22) -	(14) -	(16) -	(10) -	(15) -	(28) -	(25) -	(25) -	(22) -	(23) -
9.	(36) -	(41) -	(36) -	(30) -	(23) -	(26) -	(23) -	(23) -	(32) -	(29) -	(29) -	(26) -	(27) 25
10.	(47) -	(46) -	(41) -	(43) -	(30) -	(32) -	(25) -	(35) -	(40) 831	(38) -	(40) -	(37) -	(43) -
Total	84	555	4892	3641	741	1291	34	163	5767	2411	807	150	196

contd....

	Kashmir Valley and its surrounding hills	Bombay city and its conurbation Area	The intervening area along the railway between Bombay & Nagpur.	Coastal part of Maharashtra South of Bombay City	Western Maharashtra	Eastern Maharashtra	Central Maharashtra	Gujarat plains	Saurashtra	Kutch	Coastal plain of Andhra Pradesh.
	23	24	25	26	27	28	29	30	31	32	33
1.	(23) -	(18) -	(13) -	(16) -	(16) -	(17) -	(18) -	(19) -	(18) -	(13) -	(20) -
2.	(21) 131	(13) -	(8) 431	(14) -	(17) -	(6) -	(18) -	(18) -	(20) -	(22) -	(10) -
3.	(9) -	(22) -	(17) -	(22) -	(21) -	(18) -	(20) -	(13) -	(14) -	(16) -	(27) -
4.	(15) -	(22) -	(24) -	(22) -	(21) -	(25) -	(27) -	(10) -	(11) -	(14) -	(23) -
5.	(12) -	(19) -	(21) -	(20) -	(19) -	(22) -	(24) -	(7) -	(8) -	(11) -	(20) -
6.	(25) -	(11) -	(12) -	(18) -	(15) -	(20) -	(18) -	(4) 4815	(3) 2810	(4) 360	(25) -
7.	(32) -	(12) -	(7) -	(14) -	(11) -	(2) 75	(6) -	(16) -	(18) -	(20) -	(7) 2134
8.	(36) -	(8) 2918	(7) 1923	(7) -	(5) 1388	(8) -	(7) 861	(14) -	(16) -	(18) -	(9) 1112
9.	(39) -	(13) -	(20) -	(11) 86	(10) -	(17) -	(17) -	(19) -	(20) -	(22) -	(15) -
10.	(48) -	(23) -	(23) -	(22) -	(19) -	(13) -	(25) -	(29) -	(30) -	(32) -	(20) -
Total	131	2918	2354	86	1388	75	861	4815	2810	360	3246

contd...

	Telengana area	Rayalseema area	South Central Industrial area	South-eastern Coast	Annamalai Cardamom & Nilgiri hills	Western Coast	Mainad and western Ghat area	Maidan area	Total
	34	35	36	37	38	39	40	41	42
1.	(15) -	(22) -	(28) -	(34) -	(34) -	(32) -	(18) -	(22) -	11933
2.	(8) -	(20) -	(24) -	(31) -	(32) -	(29) -	(22) -	(17) -	18547
3.	(22) -	(34) -	(37) -	(43) -	(43) -	(41) -	(34) -	(32) -	72454
4.	(18) -	(25) -	(31) -	(34) -	(35) -	(30) -	(25) -	(20) -	4035
5.	(15) -	(22) -	(29) -	(32) -	(32) -	(27) -	(22) -	(18) -	2388
6.	(20) -	(28) -	(25) -	(36) -	(37) -	(34) -	(26) -	(25) -	8126
7.	(1) 2310	(13) -	(14) -	(22) -	(22) -	(20) -	(15) -	(11) -	4687
8.	(6) -	(7) -	(10) -	(17) -	(18) -	(13) -	(10) -	(5) 1044	9246
9.	(15) -	(8) -	(6) 1575	(11) -	(11) -	(8) -	(1) -	(4) -	1686
10.	(21) -	(11) 1011	(18) 5659	(2) 1540	(1) 1504	(5) 1490	(11) 660	(14) 86	13116
Total	2310	1011	7234	1540	1504	1490	660	1130	66218

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TABLE NO. 10

Total Tonne Kilimetres - Actual Flow - 1971

In '00 Kms.

	Upper Brahmaputra Valley	Lower Brahmaputra Valley	Mineralised plateau	Eastern & Northern Hills and Basins	Calcutta Hoogly area	Damodar Valley area	Chhota Nagpur and Northern plateau	Southern hills and plateaus of Orrisa	Lower Ganga plain including deltas & Coastal areas.
	1	2	3	4	5	6	77	8	9
1. a) Rohtas, b) Ashoka, c) Churk d) Japla, e) Khalari, f) Sindri g) Satna, h) Dalla, i) Banjári	2291	1944	-	435	12834	12990	14300	-	28083
2. A) Chaibasa, b) Mandhar c) Jamul, d) Rajgangpur e) Bargarh	4040	2920	-	1820	2420	4080	5754	1485	14832
3. a) Bhupendra, b) Dalmia Dadri	-	-	-	-	-	-	-	-	-
4. a) Lakheri, b)Madhopur, c) Banmore	-	-	-	-	-	-	-	176	-
5. a) Chittorgarh, b) Udaipur	-	-	-	-	-	-	-	-	-
6. a) Sevalia, b) Ahmedabad c) Sikka, d) Dwarka, e) Ranav v	-	-	-	-	-	-	-	-	-
7. a) Chanda, b) Ramagrndam, c) Mancherial	-	-	-	-	-	-	-	-	-
8. a) Kurkunta, b) Wadi, c) Marcherla d) Buggirapallia, e) Vijaymada, f) Kistna, g) Bagalkot	-	-	-	-	144	-	-	3952	4450
9. a) Bhadravati, b) Ammasandra	-	-	-	-	-	-	-	-	-
10. a) Sankaridueg, b) Karur, c) Madukkarai, d) Dalmiapuran, e) Alungulam, f) Tulukapatti g) Talaiyuthu	-	-	-	-	13530	-	-	1134	697

1633710

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	Darjeeling Hills & Dhar area	Northern Himalayan areas	Western Ganga Plain	Eastern Gangal Plain	Eastern Madhya Pradesh	Western Madhya Pradesh	Bastar area	Central Madhya Pradesh	Punjab Plain	Delhi	Western Rajasthan	Eastern Rajasthan	Himalyan Hills including Dun areas
	10	11	12	13	14	15	16	17	18	19	20	21	22
1.	1224	5852	22720	14534	108	864	-	240	-	-	-	-	-
2.	204	7917	15760	923	720	9360	136	480	16790	21600	-	-	480
3.	-	32	990	-	-	-	-	-	5820	1005	15	540	455
4.	-	21	3710	2563	[illegible]	1324	-	20	10840	5100	1556	120	549
5.	-	90	2115	6020	51	224	-	-	8320	805	2520	-	-
6.	-	-	-	-	-	13	-	-	-	1845	1729	-	-
7.	-	-	-	-	-	36	-	8	3696	-	-	-	-
8.	-	-	-	-	-	-	-	-	-	-	-	-	-
9.	-	-	-	-	-	-	-	-	8736	174	-	-	216
10.	-	-	-	-	-	-	-	-	16000	3800	-	-	688

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	Kashmir Valley and its surrounding hills	Bombay city and its conurbation Area	The intervening area along the railway between Bombay & Nagpur	Coastal part of Maharashtra South of Bombay City	Western Maharashtra	Eastern Maharashtra	Central Maharashtra	Gujarat plains	Saurashtra	Kutch	Coastal plain of Andhra Pradesh.
	23	24	25	26	27	28	29	30	31	32	33
1.	-	-	-	-	-	-	270	-	-	-	-
2.	609	4550	2640	98	136	-	-	-	-	-	750
3.	198	308	-	-	-	-	-	-	-	-	-
4.	720	198	-	-	-	25	-	540	-	-	-
5.	-	-	-	-	-	-	-	427	-	-	-
6.	-	8800	36	-	-	-	-	15520	8430	1440	-
7.	192	5424	12110	434	626	120	918	8960	-	-	3150
8.	-	8320	1687	322	6050	112	4340	3640	-	-	24300
9.	361	689	680	22	1430	-	1190	-	-	-	-
10.	816	4600	368	-	399	-	75	-	-	-	420

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	Telengana area	Rayalseema area	South Central Industrial area	South-eastern coast	Annamalai Cardamom & Nilgiri Hills	Western Coast	Mainad and western Ghat area	Maidan area	Total
	34	35	36	37	38	39	40	41	42
1.	-	-	-	-	-	-	-	-	118420
2.	128	-	-	-	-	-	-	-	21532
3.	-	-	-	-	-	-	-	-	9358
4.	-	-	-	-	-	-	-	-	27442
5.	-	-	-	-	-	-	-	-	20574
6.	-	-	-	-	-	-	-	-	37813
7.	1060	130	-	-	-	-	-	-	36304
8.	7260	3640	1240	-	72	3640	-	3250	76419
9.	-	800	-	-	-	1360	340	1880	17878
10.	504	4191	127980	3080	1500	5200	3520	140	188642
									638380

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TABLE NO. 11

Total Tonne Kilometers - Optimal Flow

	Upper Brahmaputra Valley	Lower Brahmputra Valley	Mineralised plateau	Eastern & Northern Hills and Basins	Calcutta Hoogly area	Damodar Valley area	Chhota Nagpur and Northern plateau	Southern hills and plateaus of Orrisa	Lower Ganga plain including deltas & Coastal areas.
	1	2	3	4	5	6	7	8	9
1. a) Rohtas, b) Ashoka, c) Churk d) Japla, e) Khalari, f) Sindri g) Satna, h) Dalla, i) Banjari	-	-	-	-	-	-	-	-	23122
2. a) Chaibasa, b) Mandhar c) Jamul, d) Rajgangpur e) Bargarh	6994	4540	-	2210	18937	12740	14854	-	22584
3. a) Bhupendra, b) Dalmia Dadri	-	-	-	-	-	-	-	-	-
4. a) Lakheri, b) Madhopur, c) Banmore	-	-	-	-	-	-	-	-	-
5. a) Chittorgarh, b) Udaipur	-	-	-	-	-	-	-	-	-
6. a) Senalia, b) Ahmedabad c) Sikka, d) Dwrka, e) Ranavav	-	-	-	-	-	-	-	-	-
7. a) Chanda, b) Ramagundam, c) Mancherial	-	-	-	-	-	--	-	-	-
8. a) Kurkunta, b) Wadi, c) Marcherla, d) Buggirapallia, e) Vijaymada, f) Kistna, g) Bagalkot	-	-	-	-	-	-	-	-	-
9. a) Bhadravati, b) Ammasandra	-	-	-	-	-	-	-	-	-
10. a) Sankaridurg, b) Karur, c) Madukkarai, d) Dalmiapuran, e) Alungulam, f) Tulukapatti g) Talaiyuthu	-	-	-	-	-	-	-	9099	-

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	Darjeeling Hills & Dhar areas	Northern Himalayan areas	Western Ganga plain	Eastern Gangal plain	Eastern Madhya Pradesh	Western Madhya Pradesh	Bastar area	Central Madhya Pradesh	Punjab Plain	Delhi	Western Rajasthan	Eastern Rajasthan	Himalayan Hills including Dun areas
	10	11	12	13	14	15	16	17	18	19	20	21	22
1.	-	-	26672	18205	-	7746	-	489	22432	-	-	-	-
2.	1428	-	-	-	741	-	136	-	-	-	-	-	-
3.	-	-	-	-	-	-	-	-	7206	-	-	-	260
4.	-	3885	7790	-	-	-	-	-	-	8265	-	300	1071
5.	-	-	-	-	-	-	-	-	9056	2950	3996	-	-
6.	-	-	-	-	-	-	-	-	-	-	1833	-	-
7.	-	-	-	-	-	-	-	-	-	3528	-	-	-
8.	-	-	-	-	-	-	-	-	-	-	-	-	-
9.	-	-	-	-	-	-	-	-	-	-	-	-	675
10.	-	-	-	-	-	-	-	33240	-	-	-	-	-

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	Kashmir Valley and its surrounding hills	Bombay city and its conurbation Area	The interve-ning area along the railway between Bombay & Nagpur	Coastal part of Maharashtra South of Bombay City	Western Maharashtra	Eastern Maharashtra	Central Maharashtra	Gujarat plains	Saurashtra	Kutch	Coastal plain of Andhra Pradesh
	23	24	25	26	27	28	29	30	31	32	33
1.	-	-	-	-	-	-	-	-	-	-	-
2.	2751	-	3448	-	-	-	-	-	-	-	-
3.	-	-	-	-	-	-	-	-	-	-	-
4.	-	-	-	-	-	-	-	-	-	-	-
5.	-	-	-	-	-	-	-	-	-	-	-
6.	-	-	-	-	-	-	-	19260	8430	1440	-
7.	-	-	-	-	-	150	-	-	-	-	14868
8.	-	23344	13461	-	6940	-	6027	-	-	-	100008
9.	-	-	-	869	-	-	-	-	-	-	-
10.	-	-	-	-	-	-	-	-	-	-	-

contd ...

	Telengana area	Rayalseema area	South Central Industrial area	South-eastern coast	Annamalai Cardamom & Nilgiri Hills	Western Coast	Mainad and western Ghat area	Maidan area	Total
	34	35	36	37	38	39	40	41	42
1.	-	-	-	-	-	-	-	-	98666
2.	-	-	-	-	-	-	-	-	91363
3.	-	-	-	-	-	-	-	-	7466
4.	-	-	-	-	-	-	-	-	21311
5.	-	-	-	-	-	-	-	-	16002
6.	-	-	-	-	-	-	-	-	30963
7.	2310	-	-	-	-	-	-	-	20856
8.	-	-	-	-	-	-	-	1044	65000
9.	-	-	9450	-	-	-	-	-	10994
10.	-	11121	101862	3080	1504	7050	7260	1204	175890
									538511

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TABLE NO.12

Freight Charges paid over different distances - Actual flow (in rupees)

	Upper Brahmaputra Valley	Lower Brahmputra Valley	Mineralised plateau	Eastern & Northern Hills and Basins	Calcutta Hoogly area	Damodar Valley area	Chhota Nagpur and Nrothern plateau	Southern Hills & Plateaus of Orrisa	Lower Ganga plain incl-uding delt-as & Coas-tal areas.	Darjelling Hills & Dnar areas
	1	2	3	4	5	6	7	8	9	10
1. a) Rohtas, b) Ashoka, c) Churk d) Japla, e) Khalari, f) Sindri g) Satna, h) Dalla, i) Banjari	8223.93	7441.47	-	1010.55	54387.64	58342.22	70486.00	-	138423.66	5242.32
2. a) Chaibasa, b) Mandhar c) Jamul, d) Rajgangpur e) Bargarh	18281.80	11847.90	-	6735.20	11928.40	20791.68	32715.50	3719.70	71317.20	873.72
3. a) Bhupendra, b) Dalmia Dadri	-	-	-	-	-	-	-	-	-	-
4. a) Lakheri, b) Madhopur, c) Banmore	-	-	-	-	-	-	-	-	-	-
5. a) Chittorgarh, b) Udaipur	-	-	-	-	-	-	-	-	-	-
6. a) Senalia, b) Ahmedabad c) Sikka, d) dwarka, e) Ranavav	-	-	-	-	-	-	-	-	-	-
7. a) Chanda, b) Ramagundam c) Mancherial	-	-	-	-	-	-	-	-	-	-
8. a) Kurkunta, b) Wadi c) Marcherla, d) Buggirapalli e) Vijaymada, f) Kistna, g) Bagalkot	-	-	-	-	-	-	-	14625.22	16607.40	-
9. a) Bhadravati, b) Ammasandra	-	-	-	-	-	-	-	-	-	-
10. a) Sankaridueg, b) Karur c) Madukkarai, d) Dalmiapuran e) Alungulam, f) Tulukapatti g) Talaiyuthu	-	-	-	-	43302.60	-	-	4168.92	2230.74	-

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	Northern Himalayan areas	Western Ganga Plain	Eastern Ganga Plain	Eastern Madhya Pradesh	Western Madhya Pradesh	Bastar area	Central Madhya Pradesh	Punjab Plain	Delhi	Western Rajasthan	Eastern Rajasthan	Himalayan Hills including	Kashmir Valley and its surrounding hills
	11	12	13	14	15	16	17	18	19	20	21	22	23
1	22969.10	1233966.00	93053.07	652.32	5218.65	-	1820.00	-	-	-	-	-	-
2	28419.30	68457.50	4290.50	7783.20	45006.00	931.60	2899.20	4313.00	79408.00	-	-	1837.40	2427.01
3	174.60	4879.80	-	-	-	-	-	44135.00	6434.01	96.03	3261.60	2912.91	1037.52
4	-	23751.42	12633.26	-	9069.40	-	101.92	53689.50	32650.20	2096.24	1032.60	2876.76	3233.76
5	458.64	11082.60	27223.30	218.43	1273.60	-	-	45396.00	5153.61	15220.80	-	-	-
6	-	-	-	-	60.43	-	-	-	8286.51	8036.19	-	-	-
7	-	-	-	-	173.10	-	43.65	14147.98	-	-	-	-	663.92
8	-	-	-	-	-	-	-	-	-	-	-	-	
9	-	-	-	-	-	-	-	30210.18	624.06	-	-	794.08	1145.16
10	-	-	-	-	-	-	-	4858.00	12340.00	-	-	2165.92	2486.93

contd...

	Bombay city and its conurbation Area	The intervening area along the railway between Bombay & Nagpur	Coastal part of Maharashtra south of Bombay city.	Western Maharashtra	Eastern Maharashtra	Central Maharashtra	Gujarat plains	Saurashtra	Kutch	Coastal plain of Andhra Pradesh.
	24	25	26	27	28	29	30	31	32	33
1.	-	-	-	-	-	1144.20	-	-	-	-
2.	21150.50	14404.50	443.17	582.48	-	-	-	-	-	3822.00
3.	1208.90	-	-	-	-	-	-	-	-	-
4.	777.15	-	-	-	93.30	-	2751.84	-	-	-
5.	-	-	-	-	-	-	2427.80	-	-	-
6.	43376.00	173.10	-	-	-	-	106312.00	63927.50	9864.00	-
7.	26049.00	68854.00	1962.61	596.42	1032.60	5544.72	38920.00	-	-	171910.00
8.	45396.00	9591.80	1830.80	38732.10	611.10	24676.00	16460.60	-	-	127322.00
9.	3202.79	2759.10	108.44	7287.28	-	5096.70	-	-	-	-
10.	17620.00	1409.60	-	1626.60	-	279.90	-	-	-	1704.15

contd ...

	Telengana area	Rayali Seema area	South-Central Industrial area	South-eastern coast	Annamalai Cardamom Coast & Niligir hills	Western Coast	Mainad and western Ghat area	Maidan area	Total
	34	35	36	37	38	39	40	41	42
1.	-	-	-	-	-	-	-	-	582381.04
2.	698.40	-	-	-	-	-	-	-	468684.86
3.	-	-	-	-	-	-	-	-	64140.37
4.	-	-	-	-	-	-	-	-	151757.35
5.	-	-	-	-	-	-	-	-	108454.78
6.	-	-	-	-	-	-	-	-	240036.73
7.	11458.60	604.30	-	-	-	-	-	-	341951.90
8.	43850.40	20696.00	6319.04	-	305.12	16920.40	-	20806.50	904760.48
9.	-	4365.00	-	-	-	4720.50	3675.40	12878.00	356982.69
10.	2008.56	20657.82	542350.80	26503.40	16215.00	33290.40	17350.40	633.10	753202.90
								Rs .	3482353.10

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TABLE NO.13

Freight Charges paid over different distances - Optimal Flow (in rupees)

	Upper Brahmaputra Valley	Lower Brahmputra Valley	Mineralised plateau	Eastern & Northern Hills and Basins	Calcutta Hoogly area	Damodar Valley area	Chhota Nagpur and Northern plateau	Southern Hills and plateaus of Orrisa	Lower Ganga plain including deltas & Coastal areas.
	1	2	3	4	5	6	7	8	9
1. a) Rohtas, b) Ashoka, c) Churk d) Japla, e) Khalari, f) Sindri g) Satna, h)Dalla, i) Banjari	-	-	-	-	-	-	-	-	113970.44
2. a) Chaibasa, b) Mandhar c) Jamul, d) Rajgangpur e) Bargarh	25883.18	18421.03	-	8178.70	68696.74	64923.04	84455.60	-	108591.40
3. a) Bhupendra, b) Dalmia Dadri	-	-	-	-	-	-	-	-	-
4. a) Lakheri, b)Madhopur, c) Banmore	-	-	-	-	-	-	-	-	-
5. a) Chittorgarh, b) Udaipur	-	-	-	-	-	-	-	-	-
6. a) Senalia, b) Ahmedabad c) Sikka, d) dwarka,,e) Ranavav	-	-	-	-	-	-	-	-	-
7. a) Chanda, b) Ramagundam c) Mancherial	-	-	-	-	-	-	-	-	-
8. a) Kurkunta, b) Wadi c) Marcherla, d) Buggirapalli e) Vijaymada, f) Kistna, g) Bagalkot	-	-	-	-	-	-	-	-	-
9. a) Bhadravati, b) Ammasandra	-	-	-	-	-	-	-	-	-
10. a) Sankaridueg, b) Karur c) Madukkarai, d) Dalmiapuran e) Alungulam, f) Tulukapatti g) Talaiyuthu	-	-	-	-	-	-	-	33450.62	-

contd....

	Darjeeling Hills & Dnar areas	Northern Himalayan areas	Western Ganga Plain	Eastern Ganga Plain	Eastern Madhya Pradesh	Western Madhya Pradesh	Bastar area	Central Madhya Pradesh	Punjab Plain	Delhi	Western Rajasthan	Eastern Rajasthan	Himalayan Hills including Dun areas
	10	11	12	13	14	15	16	17	18	19	20	21	22
1.	-	-	145529.10	116548.41	-	46785.84	-	3708.25	97439.00	-	-	-	-
2.	6116.04	-	-	-	8010.21	-	931.60	-	-	-	-	-	-
3.	-	-	-	-	-	-	-	-	54645.50	-	-	-	1664.52
4.	-	22089.00	49871.58	-	-	-	-	-	-	52912.53	-	2581.50	5612.04
5.	-	-	-	-	-	-	-	-	49411.80	18885.90	24135.84	-	-
6.	-	-	-	-	-	-	-	-	-	-	8520.63	-	-
7.	-	-	-	-	-	-	-	-	-	14059.92	-	-	-
8.	-	-	-	-	-	-	-	-	-	-	-	-	-
9.	-	-	-	-	-	-	-	-	-	-	-	-	2481.50
10.	-	-	-	-	-	-	-	-	100924.95	-	-	-	-

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	Kashmir Valley and its surrounding hills	Bombay city and its conurbation Area	The intervening area along the railway between Bombay & Nagpur.	Coastal part of Maharashtra South of Bombay City	Western Maharashtra	Eastern Maharashtra	Central Maharashtra	Gujarat plains	Saurashtra	Kutch	Coastal plain of Andhra Pradesh.
	23	24	25	26	27	28	29	30	31	32	33
1.	-	-	-	-	-	-	-	-	-	-	-
2.	10963.39	-	18813.15	-	-	-	-	-	-	-	-
3.	-	-	-	-	-	-	-	-	-	-	-
4.	-	-	-	-	-	-	-	-	-	-	-
5.	-	-	-	-	-	-	-	-	-	-	-
6.	-	-	-	-	-	-	-	131931.00	63927.50	9864.00	-
7.	-	-	-	-	-	1290.75	-	-	-	-	84933.20
8.	-	127370.70	76535.40	-	44429.88	-	34267.80	-	-	-	52441.92
9.	-	-	-	4662.92	-	-	-	-	-	-	-
10.	-	-	-	-	-	-	-	-	-	-	-

contd.

	Telengana area	Rayalseema area	South-Central Industrial area	South-eastern coast	Annamalai Cardamom & Nilgiri Hills	Western Coast	Mainad and western Ghat area	Maidan area	Total.
	34	35	36	37	38	39	40	41	42
1.	-	-	-	-	-	-	-	-	523981.04
2.	-	-	-	-	-	-	-	-	394207.56
3.	-	-	-	-	-	-	-	-	56310.02
4.	-	-	-	-	-	-	-	-	133066.65
5.	-	-	-	-	-	-	-	-	92433.54
6.	-	-	-	-	-	-	-	-	306676.67
7.	42971.10	-	-	-	-	-	-	-	125254.97
8.	-	-	-	-	-	-	-	33418.44	253464.14
9.	-	-	57078.00	-	-	-	-	-	64222.42
10.	-	54816.42	431668.52	26503.40	16258.24	47694.90	35785.20	5444.66	752546.91
								Rs.	2702163.92

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