A STUDY OF THE UNIQUENESS AND GENERALITY OF THE CITY HINTERLAND RELATIONSHIP : A CASE STUDY OF MADRAS

A DISSERTATION SUBMITTED TO THE SCHOOL OF SOCIAL SCIENCES IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF POPULATION STUDIES

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23rd May, 1978

I certify that the dissertation entitled "A Study of the Uniqueness and Generality of the City-Hinterland Relationship : A Case Study of Madras" submitted by M. Johnson Samuel, in fulfilment of six credits out of the total requirements of thirty credits for the degree of Master of Population Studies (M.P.S) of the University, is, to the best of my knowledge, his original work and may be placed before the examiners for evaluation.

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C O N T E N T S

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CHAPTER - I

INTRODUCTION

I.1 Cities come into existence as products of and as focal points in the social and economic life of people that has reached a certain stage of development. Cities are not physical, social or economic entities. They cannot be fully understood by reference only to their arbitrarily defined administrative areas. They have to be interpreted as an organic part of a social group.[1]

Cities do not produce their own food, milk, vegetables or raw materials and in most cases the labour to run their services and producing units. It is the surrounding area which is the source of these essential requirements of the city. The surrounding areas in turn derive several benefits from the city. The city provides services like schools, hospitals, entertainment etc. to the population of the surrounding area. Thus we find that both city and its surrounding area are inter-connected, coherent and single organic whole.

Modern communications have enabled town and city greatly to extend the range of their services and at the same time

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1. M. Aurousseau, "Recent Contributions to Urban Geography", Geographical Review, Vol. XIX, 1934, pp. 444 - 455.

have afforded the surrounding population more direct and immediate contacts with urban life and institutions. Further more there has been a great increase in the number of centralised services which by their very nature find their locus in towns. Thus the increasing range of urban services and the increasing directness of relations between town and surrounding territory have contributed to the development of the territorial compactness of our economic and social life. The areas surrounding the city contains a population which is rather closely integrated with the city economically and socially.

The area linked socially and economically to a town or city has been given various names. A.E. Smailes has coined the graphic expression "Urban Field" drawing an analogy from the study of magnetism.[2] The comparison is not exact since the relations between towns and their surroundings do not operate with the regularity of a physical law. Other similar expression like "Sphere of Influence", "Zone of Influence", are said to smack of political flavour. Synonyms like "Umland" "Tributary Area", "Catchment Area", "Service Area", "Economic Region" and "City Region" have also been used although they are not without difficulty. F.L.W. Green[3] prefers the use of the German term "Hinterland" as refering to an area beyond or behind the city limits.

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2. A.E. Smailes, "The Analysis and Delimitation of Urban Fields", Geography, Vol. 31 - 32, 1946-47, pp. 152-161.

3. F.L.W. Green, "Urban Hinterlands in England and Wales : An analysis of bus services", Geographical Journal, Vol. 116, 1950, pp. 64-68.

The city hinterland is atonce a territorial unit of fluid boundaries and a network of human relationships which may be called its social structure. Heterogeneous, constantly changing, fragmented, it presents a mosaic of social worlds arranged spatially in an often confused and seemingly incomparable pattern. No two city hinterlands are identical in their pattern. Each has its own unique characteristics. In one the sub urbs may be entirely residential, in another they may contain a substantial number of industrial satellites. Despite this uniqueness specific to each city hinterland, they have enough similarities to permit some generalisations. This uniqueness and generality of city hinterlands and the fluid nature of their boundaries and relationships make it imperative to study a large number of individual cities at different points of times. A comparison of a large number of such studies may help in inferring inductively generic concepts ~~about~~ . city-hinterland relationship.

I.2 Relevance of City-Hinterland Studies :

A knowledge of city-hinterland relationships is needed to influence the course of future urbanisation through policy. Besides, the analysis of the hinterlands of metropolitan cities has implications for the general study of regional geography.[4]

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4. James, H. Johnson, Urban Geography : An Introductory analysis, (Pregamon Press, 1973), pp. 87.

I.3 Some Studies in the Past on City-hinterland Relationship

City-hinterland has been an active field of research for some time past. A substantial literature continues to be built up around this topic attesting to the fascination of the problem.

The first problem confronted in city-hinterland studies is of defining and delimiting the boundary of the hinterland. Various methods have been developed for delimiting the hinterland of cities not only in foreign countries but also in our country. For delimiting the urban field of Ballymena, A.E. Smailes[5] depended upon such features as the area served by buses leaving the town after 9 P.M., the region in which the local weekly newspaper circulated as well as the tributary area of the town's shops and secondary schools. Howard L. Green[6] has used data on transportation (truck, rail, road, ship etc.) for delimiting the hinterland boundaries of New York city and Boston

In India Prof. R.L. Singh was the first geographer to venture in this field. He has followed the empirical method used by European Geographers for delimiting the hinterland of Benares[7]. He used the data on the flow of vegetables, milk

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5. A.E. Smailes, "The Geography of Towns", (Hutchinson University Library, 1970), pp. 145.

6. Howard L. Green, "Hinterland boundaries of New York and Boston in Southern New England", Economic Geography, XXI, 1955, pp. 283-300.

7. R.L. Singh, 'Benares : A Study in Urban Geography', (N.G.S.I., 1955), pp. 116.

etc. and drew a number of flow diagrams to show the linkages between the nodal city and the Umland. Total Umland was derived by superimposing one flow map over the other. He maintained this technique even in his latter work on Bangalore.[8]

On similar basis, Manzoor Alam[9] in his study of Metropolitan Hyderabad, has used such diverse indices as newspaper circulation, distribution of resident university students, regional accessibility and supply zones of such essential commodities as vegetables, milk and fruit. Besides these indices which he called principal elements, he has used reflective elements such as density of population, sex ratio, non agricultural workers, electric consumption etc. to demarcate the hinterland. In his study, the distribution pattern of reflective elements largely confirmed the trend of development indicated by the distribution of principal elements.

From a study of rural settlements around Poona and Madras, within a radius of 15 miles, Gananathan[10] found that the rural settlements which feel the urban pull can be considered of two types - A and B. The A type settlements which were constantly

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8. R.L. Singh, 'Bangalore - An Urban Survey', (N.G.S.I., 1964), pp. 83.

9. Shah Manzoor Alam, 'Metropolitan Hyderabad : Its Pattern of regional influence and delimitation of its planning areas, Census Centenary Monograph No. 7 - 1971, Economic and Socio Cultural Dimensions of Regionalisation, pp. 117-143.

10. V.S. Gananathan, "Some Aspects of Rural-Urban Relationship in India", Indian Geographer, Vol. IV, Dec., 1959, No. 2, pp. 29-36.

and continuously in touch with the big city because of their greater proximity to the city or due to their location on lines of communication had good residential houses and better infrastructural facilities. The B type of settlements which were farther away from the city had poor quality huts and lack of infrastructural facilities. He also observed that the people of A type settlements developed an inferiority complex towards the city dweller partly because of their economic dependence on city dweller and partly due to an unbalanced sense of values. The people of the B type settlements on the other hand possessed greater confidence in themselves because their economy was more independent of the city than the economy of the A type settlements.

Following R.L. Singh's method, Ujagir Singh[11] delimited the Umland of Allahabad by taking different service zones like daily newspaper circulation zone, milk and vegetables supply zones, catchment area of high schools etc.

A.B. Mukerji[12] studied the Modinagar's relationship with the surrounding area under three main categories - social, economic and cultural. Assuming that the symbiotic relationship between town and country side is economic in nature, he took as many as 6 linkages under economic category - milk supply,

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11. Ujagir Singh, "Umland of Allahabad", N.G.J.I., Vol. VII, Part I, March 1961, pp. 37-51.

12. A.B.Mukerji, "The Umland of Modinagar", N.G.J.I., Part 3 and 4, 1962, pp. 256-269.

vegetable supply, foodgrain supply, bus service, rickshaw service and banking service. Under the social category were five linkages educational, hospital, drug sale, police and communication. Under cultural category were two linkages cinema and newspaper circulation. He found that the trade areas based on the above thirteen linkages vary from one another in shape and size. The trade area based on rickshaw service was the largest of all while the smallest was based on the supply of milk. On the basis of newspaper circulation there was no Umland This, he concluded indicated huge lacuna in the cultural life of Modinagar Umland and also the illiteracy of the Umland population.

K.R. Dikshit[13], in a case study of the hinterland of Poona, illustrated the built in hierarchy of mono functional hinterlands around the core city. Secondly he tested the validity of certain population attributes to delienate the hinterland. His study showed that the spatial variations in population attributes indicated a trend only upto a few miles from the city and beyond that there was no gradient and the landscape became monotonously rural.

Gopalakrishnan[14] used 15 criterion to examine the varying intensity of functional relationships between Chandigarh and

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13. K.R. Dikshit, "Hinterland as a region - Its type, hierarchy demarcation and characteristics - illustrate in a case study of the hinterland of Poona", N.G.J.I., XIV, Part I, March 1968, pp. 1-22.

14. Gopalakrishnan, K., "Umland of Planned City - Chandigarh" N.G.J.I., Vol.XVI, Part I, March 1970, pp. 36.

various zones of its hinterland. While conducting the study it was found that a hierarchy of service centres existed within the Umland of Chandigarh. Though the service centres higher on the order of hierarchy generally had larger population, yet there was no necessary correlation between functional status and size of population of various service centres. Moreover as services centre went down in hierarchy, the variety of functions performed by it decreased successively. The various service centres however did not make any discernible pattern in their distribution. Bansal's[15] study on Saharanpur city also belongs to this genre.

R.L. Singh's studies and those of other North Indian Cities by his students just discussed, deal with each city as a unique entity making comparability on a nation wide basis more difficult. Moreover dependence on personal observation and survey for each specific case has not resulted in the development of a widely applicable method.

A departure from this method has been made by Mahadev and Jeyasankar[16], who have used a mathematical model for the delimitation of the potential hinterland of Mysore city. In their

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15. S.C. Bansal, "Town-country Relationship in Saharanpur City Region : A study in rural-urban inter-dependence problems", (Sanjeev Prakashan, Saharanpur, 1975), pp. 171.

16. P.D. Mahadev and D.C. Jeyasankar, "Concept of a city Region: An Approach with a case study", Indian Geographical Journal, XLIV, 1969, pp. 15-25.

model they have modified the simple and well known gravitational model of Newton. Underlying the model is the basic assumption that the amount of interaction between two cities is directly proportional tothe number of people living in those cities and inversely proportional to the intervening distance. They have demonstrated the operation of the model by delimiting the Umland of Mysore and have suggested that further refinement can be made by transforming the population and distance data using appropriate weightages for income, goods, produced etc. in the place of population.

Bradnock[17] used regression analysis and trend surface analysis to delienate the hinterland. His study has shown that population density and certain economic factors vary in a regular manner with increasing distance from some south Indian cities.

R.S. Dixit[18] delienated nine functional zones around Kanpur city on the basis of flows of goods and services. These nine linkages were not only those with which the city served the hinterland surrounding it but also included those with which the latter served the former. Thereafter twenty

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17. R.W. Bradnock, The Hinterlands of Madras and Bangalore, Indian Geographical Journal, XLIV, June 1974, No. 1, pp. 10-16.

18. R.S. Dixit, 'On the Delimitation of a Metropolis Kanpur - A case study', National Geographer, Vol. XII, No. 1, June 1977, pp. 77-92.

four radials diverging from Kanpur at 15° interval were drawn on the superimposed map of nine functional zones. The median value of each radial cutting the different limits of various zones were found out and the points thus located were joined serially. The region thus emerged was the median Umland of Kanpur. This empirical Umland was further tested against Gravity model Umland and found that both resembled each other closely.

Lack of accurate data on commodity flows particularly in Indian context and the high cost and time involved in collecting such data, have made geographers to tap other sources of data for city - hinterland analysis. For instance, Ellefesen[19] attempted to study urban impact inferentially from averaged population data for five major city hinterlands. Using indices of economic structure for the population in villages within 15 miles of the cities studied, he deduced patterns and strengths of urban influence from the distribution of population with urban characteristics. He found steep lapse rates of these urban characteristics signifying rapidly declining urban influence not only by straight line distance away from the city but also by an alternative measure of differential accessibility.

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19. Richard A. Ellefesan, 'City Hinterland Relationships in India with special reference to the hinterlands of Bombay, Delhi, Madras Hyderabad and Baroda', Roy Turner ed., India's Urban Future, (Oxford University Press, Bombay), pp. 94.

Nangia[20] has used gradient analysis techniques to focus attention on the changes in the demographic structure of hinterland population with increasing distance from Delhi Metropolis. She measured the distance decay function by fitting out both linear and non linear curves - linear, pareto, exponential and log normal curves - to data on population density, relative change in population density, population growth, sex ratio and share of non agricultural workers in the total working force. Her exercise has shown that different variables have different gradient patterns. Berry[21] explored the relationship between central place theory and metropolitan region. Settlements around large metropolis develop unique functional attributes as dormitory towns or satellite towns. This process often leads to distortion in the spatial structure of settlement hierarchy. He studied the Metropolis Seattle and found functional imbalance and progressive specialisation of the business pattern within the Metropolitan community. He also noted that with improved accessibility the metropolis and higher order settlements usurped the functions of lower order settlements around them. A few works in Indian context may be referred to in this

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20. S. Nangia, 'Delhi Metropolitan Region - A Study in Settlement Geography', (Rajesh Publications, New Delhi),

21. B.J.L. Berry, 'The Impact of Expanding Metropolitan Community upon the Central Place Hierarchy, AAAG, Vol. 50, June 1960, pp. 112-116.

connection. Harikesh N. Mishra[22] studied the hierarchy of towns in the Umland of Allahabad and came to the conclusion that the spatial arrangement of towns based on hierarchy is neither ideal nor balanced within the Umland of Allahabad and suggested a remodelling of the hierarchy with regular order of spatial relationship. Ramesh Chander Tyagi[23] after examining the existing structure of settlement hierarchy and the location of different orders of settlements in the Delhi National Capital Region, has suggested the planting of a few more growth centres there.

Bryn's[24] article discusses the analytical approaches employed by various disciplines in the study of Metropolitan region, in order to point up a strategy for research to test adequately the conceptual bases. It also examines in great depth certain problems of definition and data sources.

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22. Harikesh N. Mishra, Hierarchy of Towns in the Umland of Allahabad, Decan Geographer, 1976, Vol. XIV, pp. 33-46.

23. Ramesh Chander Tyagi, 'Location of a Hierarchy of Centres in the National Capital Region', (Unpublished Ph.D. thesis submitted to Meerut University).

24. Bryn Greer Wootten, "Metropolitan Regional Analysis" Progress in Geography, Vol. 4, International Review of Current Research, Edward Arnold, 197 .

Veerandra Nath's[25] article contains a lucid exposition of the concept of Umland and also the regional relations of the towns. It also critically examines the various attempts at regional delimitation pointing out the difficulties associated with boundaries drawn for various functions and with research designs.

H.N. Mishra's[26] paper reviews the current concept of Umland and suggests alternate methods which can be used for delineating the Umland in a variety of urban situations with particular reference to India.

I.4 Scope and Objectives of the Present Study

The present study is frankly exploratory and limited in scope. Because of the constraints of time and money, no attempt has been made to collect, through field work, information on the flow of commodities and passengers between city and hinterland. The study is rather confined to secondary data on population published by the Census. It is mainly a cross sectional study restricted to one point of time. The objective is to study in outline the impact of the city on the hinterland population and infrastructural facilities and

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25. Veerandra Nath, "The Concept of Umland and its delimitation", Decan Geographer, Vol. 1, No.1, July 1962, pp. 33-44.

26. H.N. Mishra, Nomenclature and delimitation of the Umland - An Appraisal - Indian Geographical Journal, XLVI, pp. 16-23.

resultant spatial patterns. Thus the whole problem is looked at from the viewpoint of a geographer. It is not intended in the present study to present a complete analysis of different aspects of city hinterland relationship much less to offer any solution as it would be grossly underestimating the involved complexity.

I.5 Methodology

The major areas of attention in this methodology are given here.

Methodology related to the handling of data and areal - unit for analysis :

When the project was conceived, the first question posed before us was what are the boundaries of a city hinterland. Therefore our first task was to delimit the hinterland. An analysis of the taluk level data within a radius of 100 miles on population showed us that the urban influence of Madras Metropolis extends upto a radial distance of 30 miles from the city centre. A map of the Madras city with surrounding taluks was prepared. All the settlements lying at 30 mile distance from the city centre were marked on the map and the boundary of the hinterland was drawn connecting all these settlements. Since Madras is a coastal city, its hinterland so carved out was semi circular in shape.

Methodology related to the understanding of city hinterland relationship

Once the hinterland was delimited, the next problem was

to assess the strength of ties between city and hinterland. Concentric Zone model of spatial structure was used for the purpose. The analysis consisted of dividing the city hinterland into concentric semi circles and compute the average values for selected variables for each arc. The analysis showed that the influence of metropolis over surrounding settlements tends to decrease with distance outward. This gradient pattern of city's influence was illustrated by a series of statistics, demographic, social, economic and infrastructural profiles.

The arbitrary concentric circle was found useful for purposes of comparison of successive distance zones. It may however conceal much in the difference remaining hidden within each of the zones. It is known that individual settlements in the hinterland of a large metropolis differ from one another in their relationship with the metropolis. Therefore the next area of attention in this study was to investigate the manner and extent of relationship of each of the settlements in the hinterland to Madras city as well as to other settlements within the hinterland. The functional relationship of a settlement to other settlements was determined by taking into consideration all the central functions that it performs like education, health, communication and so forth. On the basis of chosen indicators, a composite index was constructed to identify the hierarchical pattern of settlements and their classification into totally dependent

settlements, dependent settlements partially dependent settlements and service centres.

Use of Theoretical Models :

Using the Nelson's method[27], a functional classification of service centres was made and their functional specialisation was linked up with the influence of the metropolis.

Within the conceptual framework of Christaller's Central Place theory, the location, size and spacing of service centres of different orders were analysed and the impact of metropolis on their spatial pattern assessed.

Use of Statistical and Cartographic Methods :

Various statistical and cartographic techniques have been applied for the analysis of the data. Rank-size rule, correlation and regression analysis, analysis of variance, standard deviation technique, spacing index, near neighbour technique, Thiessen Polygons are some of the techniques used in the study. Detailed account of these techniques with their applications are given in the text as foot notes.

I.6 Sources of Data and Maps

The secondary data relating to population and occupation

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27. Howard, J. Nelson, "A Service Classification of American Cities", Economic Geography, Vol. 31, 1955, pp. 189-210.

have been collected from the District Census Hand Books of relevant districts published by the Census of India. Data regarding several infrastructural facilities like schools and hospitals have been collected from Town and Village Directories brought out for every District by the Census of India.

The base map mainly the physical map has been traced from the survey of India relevant topographical sheets on one inch to sixteen miles scale. The Taluk maps showing the location of settlements were obtained from the office of the Director of Census Operations, Madras, on one inch to one mile scale and reduced to their present size.

I.7 Plan of the Thesis

Chapter I of the thesis is introductory in nature. The first part of the chapter poses the problem of city-hinterland relationship in geographical perspective. The latter part of the chapter is devoted to the understanding of the physical framework of the region where Madras city is located. A brief history of Madras city is given highlighting its primate nature around the surrounding area.

Chapter II deals with the problem of delimiting the Madras city hinterland.

Chapter III contains an analysis of interdependence between city and hinterland. It is divided into five parts.

Under part I Demographic aspects are discussed. In part II social aspects are dealt with. Part III studies economic aspects while part IV is devoted to social amenities. Part V sums up the inter-relationships and identifies in the hinterlands three broad zones on the basis of the intensity range of their response to city's influence.

Chapter IV is devoted to the determination of centrality and hierarchy of settlements and the impact of city on the hierarchical structure. It also deals with functional classification of settlements designated as service centres, highlighting the possible effects of city on their functional specialisation.

Chapter V examines the spatial patterns of settlements hierarchy and searches for uniqueness in their location and spacing in a metropolitan setting.

Finally chapter VI gives a summary of the observations made in the text and general conclusions derived from this study.

I.8 Madras city and its Hinterland - Physical and Cultural Setting

The city of Madras is situated on the east coast in latitude 13° North and longitude 80° 15' East. It is an important port on the east coast.

The climate of Madras city and its hinterland is essentially tropical. It is, however, more equable than the climate of North India, summers being less hot and winters less cold. The maximum temperature hardly exceeds 110° F (43° C) and the minimum seldom falls below 65° F (18° C). The climate of Madras is determined by its configuration and situation as well as relief and proximity to the sea. For most part of the year it is exposed to the full blast of the monsoon. But the hinterland as a whole receives most of the rain in October through December.[28] The annual rainfall is 40" - 45" (1016 - 1143 mm).

The city of Madras has emerged as the fourth biggest city in the country. Strictly speaking its site has no advantages whatever except that its position midway between Penner and Ponnaiar probably counts for something.[29] About 300 years ago, when the site at Madras was chosen as a settlement by the British traders, it was nothing more than a tiny village. From an obscure hamlet, the city expanded with the Fort St. George as the nucleus and it has now grown as an important metropolis. From a population of 4 lakhs in 1871, it has grown to such a size as to accommodate about

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28. Census of India, 1961, General Report; Tamil Nadu

29. O.H.K. Spate, India, Pakistan and Ceylon, The Regions (Methune & Co. Ltd., London, 1972), pp. 745.

25 lakhs in 1971. During this century, the highest decadal growth was during 1941-51 with an increase of 65.3%. In this decade, the limits of the city was extended from 30 sq. miles to about 50 sq. miles. The city limit has not been extended after this.

The growth of the city in the first stage was due to the commercial activities of the English. The opening of a port, the establishment of a spinning and weaving mill (Binny), light and medium engineering industries and the electrification of the sub-urban railway tract encouraged the industrial growth. Besides, a large number of educational, institutional and technical institutions were established. The Five Year Plans also brought about the establishment of some important large scale industrial ventures like the Integral Coach Factory (I.C.F), Hindustan Teleprinters, Surgical Tools Factory etc. The city being the administrative headquarter of the State of Tamil Nadu also influenced the economic growth of the city.

The city is rectangular in shape. Roads coming from outlying places converge at the point known as Parry's corner lying between port and fort. The south Beach road along the coast, Mount Road, Poonamallee High Road branch off from this point. The Railway lines also converge somewhere near this point. As Madras grew in importance, it started growing along these radial roads and railway lines and in this process, the city engulfed the nearby villages of Chepauk, Triplicane,

Mylapore, Teynampet and Perambur. Thus the city has tended to grow all around except the east.

China Bazar and Mount Road continue to be the chief places for shopping and entertainment, though each major residential locality has developed its own shopping centre.

As the city could not accommodate new industrial units, satellite towns like Avadi, Ambathur, Tiruvotiyur etc. have come up around the city.

I.9 Primate Nature of Madras city in the surrounding Area

The rank-size rule is an empirical regularity found in the urban system of many countries of the world. When rank-size rule[30] is applied to Madras city and other towns located within 100 mile radial distance from it, Madras emerges as a primate city. Table I.1 gives the results of the applicatior of rank-size rules.

Table I.1 shows that the second ranking town Vellore and the third ranking town Nellore have just one-eighteenth population of the first ranking city Madras whereas they are

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30. The rank size rule relationship can be expressed as $P_n = P_1 (n)^{-1}$ where P_n is the population of the nth town in the series 1,2,3,.....n in which all towns in a region are arranged in descending order by population and P_1 is the population of the largest town (Primate city). Ref. Peter Hagget - Locational Analysis in Human Geography (Edward Arnold, 1971) pp. 101.

TABLE - I.1

Application of the Rank-size Rule to all Class I & II Towns within 100 Mile Radial Distance

Name of city/town	Rank of population size	Actual population size	Proportion of population to that of first ranking city (Madras)
Madras	1	2,469,449	1
Vellore	2	139,082	1/18
Nellore	3	133,590	1/18
Kanchipuram	4	110,657	1/22
Cuddalore	5	101,335	1/24
Pondicherry	6	90,637	1/27
Thirurotiyur	7	82,853	1/30
Avadi	8	77,413	1/32
Tirupathy	9	65,843	1/37
Alandur	10	65,039	1/38
Chittoor	11	63,035	1/39
Thiruvannamalai	12	61,370	1/40
Villupuram	13	60,242	1/41
Tambaram	14	58,805	1/42
Ambur	15	54,011	1/45
Pallavapuram	16	51,374	1/48

expected to have atleast half and one third respectively of the population of Madras city. The population size of other towns is also much lower than what is expected by rank size rule. All these point out the primate nature of Madras city around hundred miles.

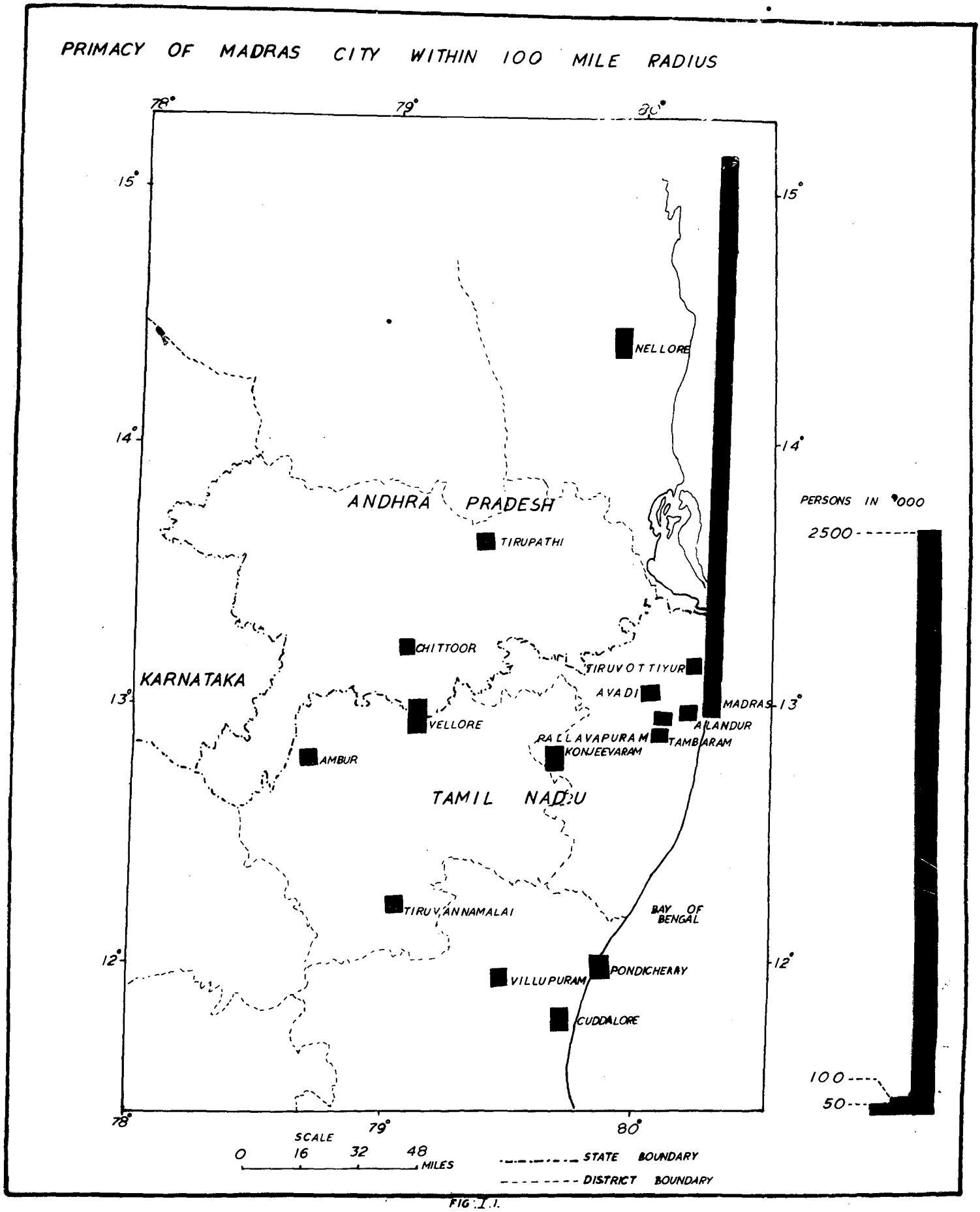
PRIMACY OF MADRAS CITY WITHIN 100 MILE RADIUS
78°
79°
80°
15°
14°
13°
12°
NELLORE
ANDHRA PRADESH
TIRUPATHI
CHITTOOR
KARNATAKA
VELLORE
AMBUR
TIRUVOTTIYUR
AVADI
MADRAS
ALANDUR
TAMBARAM
PALLAVAPURAM
KONJEEVARAM
TAMIL NADU
TIRUVANNAMALAI
BAY OF BENGAL
PONDICHERRY
VILLUPURAM
CUDDALORE
PERSONS IN '000
2500
100
50
SCALE
0 16 32 48 MILES
STATE BOUNDARY
DISTRICT BOUNDARY

FIG. 1.1.

CHAPTER - II

DELIMITATION OF CITY - HINTERLAND OF MADRAS

II.1 Criteria adopted for hinterland delimitation

The purpose of this chapter is to define and delimit the hinterland boundary of Madras city. Ideally, the most important metropolitan functions should be chosen as measures. In practice, however, this is impossible because of lack of data. In the western countries more comprehensive data on many characteristics both economic and demographic aspects are available e.g. volume of trade retail and whole sale, newspaper circulation etc. Unfortunately in India, such data are not available. So one has to satisfy himself with census data on population. The rationale behind using population data for delimiting hinterland is that, in modern society the metropolis has tended more and more to control the conditions of life of the population in the areas surrounding the metropolis. If this hypothesis be true, then the surrounding or hinterland population should be spatially organised atleast loosely with reference to metropolis. This organization should manifest itself in a series of gradients in the characteristics with reference to spatial distance from the metropolis.[1]

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1. T.R. Anderson and Jane Collier, "Metropolitan dominance and the Rural Hinterland", Rural Sociology, vol. 21, 1956, pp. 34 - 47.

That is, the urban influence must decrease with distance. A short coming of this method in using population data alone is that it indicates more of hinterland's reaction to urban influence than its economic interdependence on the city.

In this study, population data are used to delimit the hinterland boundary of Madras city region. The demographic characteristics employed, each measures a different aspect of urbanisation. The following population characteristics are chosen as they are considered more reliable indicators of the degree of urban influence on the hinterland.

1. Sex Ratio
2. (a) Male participation rate in labour force
   (b) Female participation rate in labour force
3. Proportion of agricultural workers in the working force
4. Density of population
5. Proportion of urban population
6. (a) Male literacy rate
   (b) Female literacy rate

While the first three indicators are negatively related to urbanisation, the latter three are positively related.

In most of the studies using population data for hinterland delimitation, it is found that the boundary was fixed at the place where the value of the chosen indicators say density

of population equalled the rural density of the country or state. The resulting hinterland is always small in areal extent. For instance in the study of Ellefsen[2], the hinterlands of Indian cities extended outward from the city not more than fifteen miles. This has made observers to say that in India modernisation stops at the edge of the city. This concept seems to emerge from two not so well conceived notions.

1. In India, a large number of villages in the interior remain tied to a barter economy and do not receive any influence from the city. They make a world by themselves and therefore cannot be included in any hinterland.

2. The small areal extent of the Indian city hinterland so imagined is attributable to the stage of the development of the country. In other words, a city hinterland in India has to be very small because of a low level of economic development.

This notion is untenable. The villages in India, though least urbanised or not at all urbanised and apparently isolated, always look to one city or the other for the supply of certain essential non agricultural commodities and certain services.

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2. Richard A. Ellefesen, City hinterland relationships in India with special reference to the hinterlands of Bombay, Delhi, Madras, Hyderabad and Baroda, Indias Urban Future, Roy Turner (ed.) (Oxford University Press, Bombay), pp. 94.

Such a village may not be directly linked with the city but they operate the economy through small market centres located at different levels of hierarchy. The rural-urban relationship may not be very conspicuous in India, yet it has an unquestionable existence.

We have therefore chosen a slightly different cut off point for fixing the hinterland boundary. Instead of fixing the hinterland boundary at the zone where urbanization index equals state or national average, we have fixed the boundary at the zone where the city's influence is fully worked out in all directions and the index reaches the lowest ebb. Beyond this zone, the urbanisation index will show a reversal of the trend. This we assume to be the result of the competition offered by other urban centres in the neighbourhood. Therefore, the areas lying in this zone and beyond will belong to the hinterland of these competing urban centres.

II.2 Method of Analysis

For the purpose of our analysis, the Madras city and the area surrounding it over a radial distance of 100 miles was taken into consideration. The study is based on secondary data from the General Population Tables published by the Census of India for 1971 for the State of Tamil Nadu and Andhra Pradesh and the Union Territory of Pondicherry. Taluk was taken as the unit of observation.

Madras city and the area surrounding it was divided into eight concentric zones. The city of Madras forms the

first zone. Table II.1 shows the radial distance of each zone, and the number and the name of taluks coming under each of the zones. In most cases, the taluk boundary cuts across more than one zone. In all these cases, the taluk was assigned to that zone where greater part of the taluk is lying.

The selected urbanisation indices based on taluk level data are given zone wise in Table II.2. In each column of the table, a dash is marked where the urbanisation index shows a reversal of the trend.

II.3 Results of Analysis

A significant gradient relationship was discovered in the successive concentric zones. The negative indices of urbanisation i.e. sex ratio, participation rates in the labour force and proportion of agricultural workers in the working force show an upward trend with increasing distance from city centre upto first four zones and in the case of sex ratio, this trend is noticed even upto first six zones. Thereafter the value of indices fluctuate between one zone and another.

The positive indices i.e. density of population, proportion of urban population and literacy consistently decline upto four zones and beyond this zone their values also fluctuate from zone to zone. Thus from zone 1 to zone IV there is consistency in the trend of all indices whether positive or negative.

TABLE - II.1

Distribution of Taluks - by Zone

Serial No. of the zone and radial distance from city Centre	No. of Taluks	Name of Taluks	Name of District	Name of State
I 0 - 4 miles	1(Dist.)	Madras city	Madras	Tamil Nadu
II 4 - 10 miles	1	Saidapet	Chingleput	Tamil Nadu
III 10 - 20 miles	1	Sriperumlndur	Chingleput	Tamil Nadu
IV 20 - 30 miles	2	Pooneri	Chingleput	Tamil Nadu
		Tiruvallur		
V 30 - 40 miles	2	Kanchipuram	Chingleput	Tamil Nadu
		Chingleput		
VI 40 - 60 miles	7	Tirutani	Chingleput	Tamil Nadu
		Madurantakam	Chingleput	Tamil Nadu
		Arakonam	North Arcot	Tamil Nadu
		Cheyyar	North Arcot	Tamil Nadu
		Satyavedu	Chittoor	Andhra Pradesh
		Puttur	Chittoor	Andhra Pradesh
		Sulurpet	Nellore	Andhra Pradesh
VII 60 - 80 miles	9	Wallajahpet	North Arcot	Tamil Nadu
		Wandiwash	North Arcot	Tamil Nadu
		Arni	North Arcot	Tamil Nadu
		Arcot	North Arcot	Tamil Nadu
		Tindivanam	South Arcot	Tamil Nadu
		Chittoor	Chittoor	Andhra Pradesh
		Kalahasti	Chittoor	Andhra Pradesh
		Gudur	Nellore	Andhra Pradesh
		Venkatagiri	Nellore	Andhra Pradesh
VIII 80 - 100 miles	12	Vellore	North Arcot	Tamil Nadu
		Polur	North Arcot	Tamil Nadu
		Tiruvannamalai	North Arcot	Tamil Nadu
		Gingee	South Arcot	Tamil Nadu
		Vilupuram	South Arcot	Tamil Nadu
		Cuddalore	South Arcot	Tamil Nadu
		Pondicherry	Pondicherry	Union Territory of Pondicherry
		Bangarupallam	Chittoor	Andhra Pradesh
		Chandragiri	Chittoor	Andhra Pradesh
		Rajampet	Cuddapah	Andhra Pradesh
		Nellore	Nellore	Andhra Pradesh
		Rapur	Nellore	Andhra Pradesh

TABLE - II.2

Urbanisation Indices - By Zone

Zone	Sex Ratio	Male Participation rate	Female Participation rate	%agri-workers in the working force	Density of Population Km^2	%urban population	Male Literacy rate	Female Literacy rate
I City	904	49	5	2	19293	100	71	53
II 4 - 10 miles	906	51	7	18	11781	79	65	43
III 10 - 20 miles	943	54	12	54	427	48	55	29
IV 20 - 30 miles	957	57	14	78	288	25	44	20
V 30 - 40 miles	963	55	11	63	311	29	52	26
VI 40 - 60 miles	975	58	19	80	229	18	20	8
VII 60 - 80 miles	970	57	18	76	264	18	22	9
VIII 80 - 100 miles	963	55	14	74	332	25	24	11

The urban indices are controlled by the competition offered by neighbouring urban centres also which can offer similar or better services than Madras city. In zone five and beyond the influence of the competiting urban centres are strong enough that the urban indices start fluctuating.

Thus thirty miles which is the upper limit of the radial distance for the fourth zone is fixed as the limit where the urban influence of Madras Metropolis fades out. Therefore the boundary of Madras city hinterland extends about thirty miles from the city centre and it indicates the extreme range of Madras city's urban influence on the hinterland. Madras city, as it does, facing the Bay of Bengal on an even coast line, its urban influence extends in three directions only.

All settlements located at about thirty miles' distance from city centre were marked on the map and a boundary line of the hinterland was drawn touching all these settlements. Fig. II.1 and Fig. II.2 show the resultant hinterland.

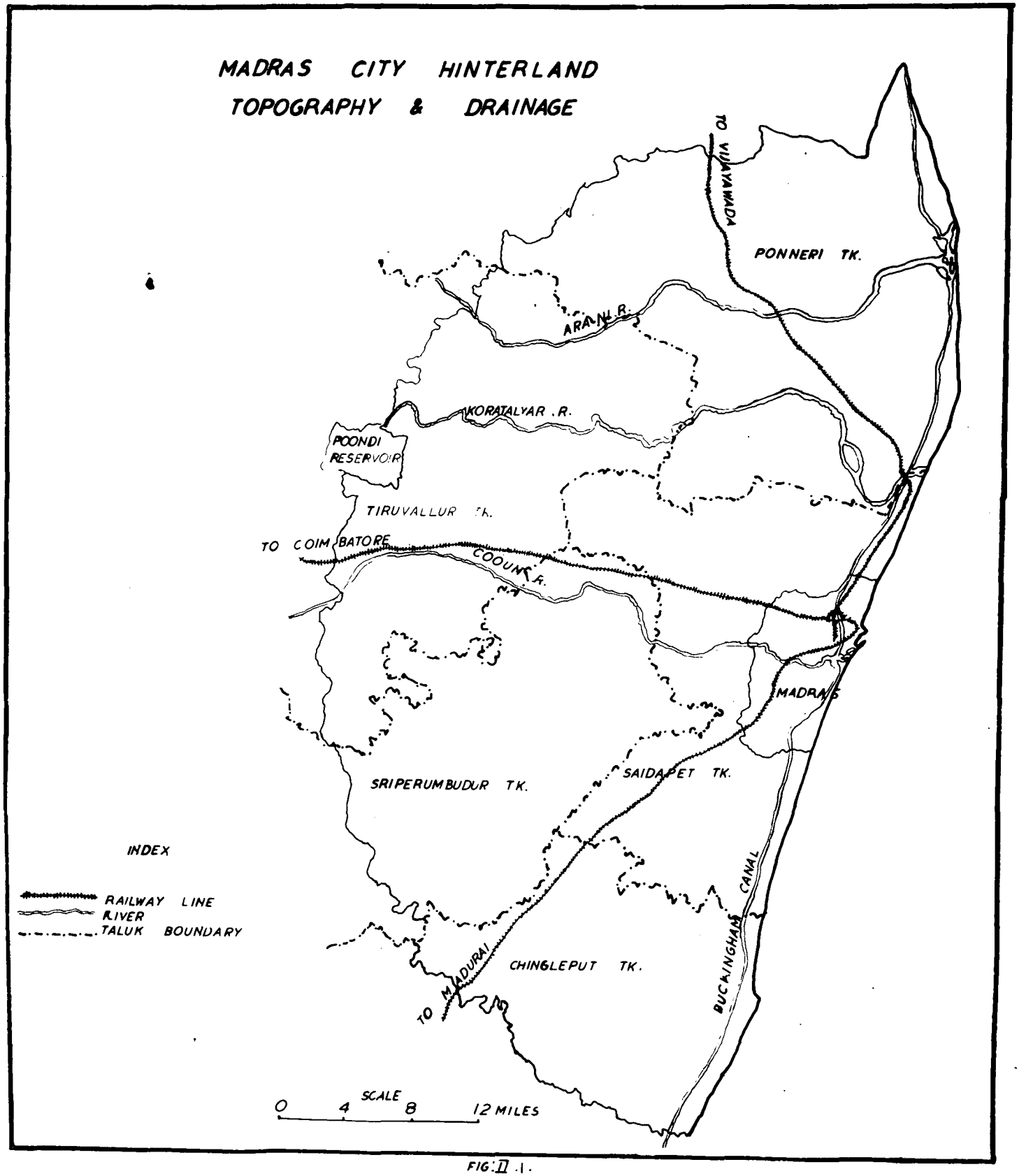

MADRAS CITY HINTERLAND
TOPOGRAPHY & DRAINAGE
TO VIJAYAWADA
PONNERI TK.
ARANI R.
KORATALYAR R.
POONDI RESERVOIR
TIRUVALLUR TK.
TO COIMBATORE
COOUM R.
MADRAS
SRIPERUMBUDUR TK.
SAIDAPET TK.
CHINGLEPUT TK.
TO MADURAI
BUCKINGHAM CANAL
INDEX
RAILWAY LINE
RIVER
TALUK BOUNDARY
SCALE
0 4 8 12 MILES

FIG: II .1.

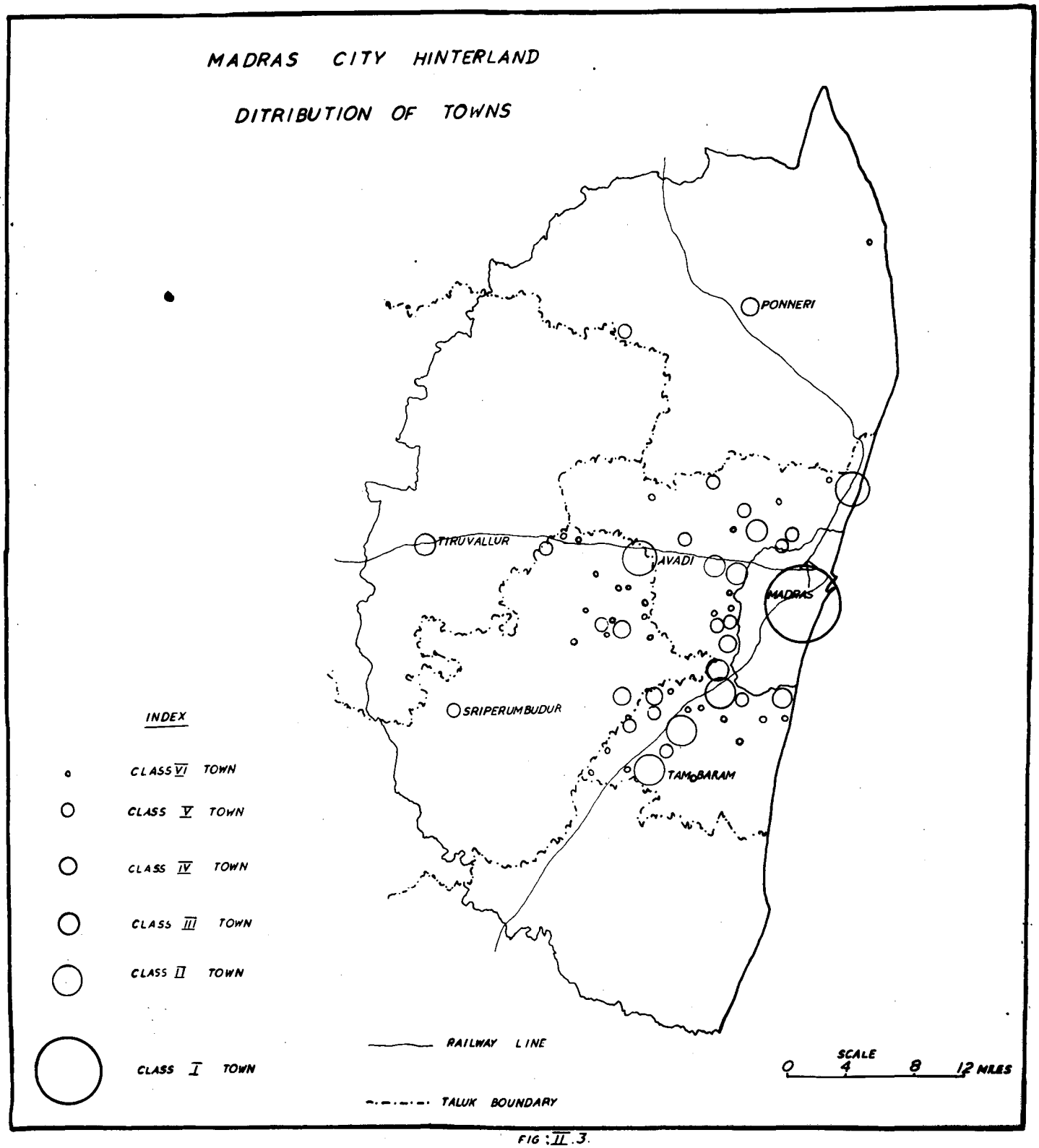

MADRAS CITY HINTERLAND
DITRIBUTION OF TOWNS
PONNERI
TIRUVALLUR
AVADI
MADRAS
SRIPERUMBUDUR
TAMBARAM
INDEX
CLASS VI TOWN
CLASS V TOWN
CLASS IV TOWN
CLASS III TOWN
CLASS II TOWN
CLASS I TOWN
RAILWAY LINE
TALUK BOUNDARY
SCALE
0 4 8 12 MILES

FIG : II.3.

CHAPTHER - III

INTERDEPENDENCE BETWEEN CITY AND HINTERLAND

III.1 Introduction

The territorial extent of the influence exerted by Madras city has been determined in the preceding chapter. This chapter is concerned with a more specific reference to the details of interdependence between the city and the various segments of the hinterland. It also indicates how much the strength of influence is conditioned by distance and accessibility to the city. For convenience, these inter relationships are grouped under four headings : (i) Demographic, (ii) Social, (iii) Economic and (iv) Social amenities.

III.2 Method of Analysis

The concentric zone model was used for the analysis of data. Upon examination of the map, it was found that a few towns in the hinterland are linear in form and situated along the railway lines radiating from Madras city and that one mile radius would be too small to cover the entire town in one zone. Therefore, concentric zones were fixed at two mile interval.

The interaction between the city and hinterland is channelled along particular routes - notably along lines of transport and communication. The urban influence spreads to the hinterland vigorously along the radiating arteries while interstitial settlements feel the urban influence less intensely. Accessibility is thus a key factor in spreading the effects of urbanisation in the hinterland.

The settlements in the hinterland were, therefore, first classified into concentric semi circular zones and then within each zone, they were sorted out into two categories - (i) corridor settlements and (ii) interstitial settlements. The first category consists of those settlements situated within two miles of distance from any one of the three major arteries connecting the city with the hinterland. The settlements not so situated were put into the second category called 'interstitial settlements'. This was done in order to study separately both distance decay function and the role of transport lines in carrying the urban influence into the hinterland. The location of a settlement within a zone was determined by its distance from Fort St. George which is the city centre of Madras.

The three corridors radiating from Madras city are - (i) Madras - Coimbatore Railway line, (ii) Madras - Madurai Railway line and (iii) Madras - Vijayawada Railway line. Roads also run parallel and very close to the above three Railway lines.

The city of Madras forms the first zone and extends about 4 miles from city centre. The hinterland was divided into 13 more concentric zones starting from fourth mile and ending with thirtieth mile. The three corridors converge upon Madras city in a spoke like fashion, the second zone (4 - 6 mile zone) is not only close to the city in absolute distance, it is also highly penetrated by railways and highways, that all the settlements are within easy reach of the city. Proceeding outwards, the zones increase in total areas and towards the rim of the hinterland, i.e. at 30 miles, the spokes become farther apart. This means that the number of interstitial settlements rises progressively as the distance from the city centre increases.

Table III.1 gives the number of settlements in each zone.

As a first step, population and social amenities data collected at village level were aggregated by zone, by corridor and by interstitial sectors. They were then converted into proportions and ratios in order to remove the biases arising from unequal population size of different sectors. To explain the metropolitan influence on the hinterland, a few hypotheses were set up. Simple regression analysis was used to test the hypotheses.

TABLE - III.1

Distribution of Settlements by Zone

S.No. of the zone	Radial distance from city centre	No. of corridor settle-ments	No. of Inters-titial settle-ments	Aggregate no. of settlements
I	Madras city 0 - 4 miles	1	-	1
II	4 - 6 miles	7	-	7
III	6 - 8 miles	7	11	18
IV	8 - 10 miles	7	34	41
V	10 - 12 miles	9	34	43
VI	12 - 14 miles	10	41	51
VII	14 - 16 miles	15	44	59
VIII	16 - 18 miles	19	56	75
IX	18 - 20 miles	11	68	79
X	20 - 22 miles	23	62	85
XI	22 - 24 miles	18	59	77
XII	24 - 26 miles	16	77	93
XIII	26 - 28 miles	9	64	73
XIV	28 - 30 miles	23	82	105

PART - 1

DEMOGRAPHIC INTER-RELATIONS

A. Density of Population :

The first hypothesis is that population density decreases with increasing distance from city centre. The densities analyzed are the total population densities for a number of settlements grouped into concentric arcs at successive distances from the city centre. Such a calculation assumes that those parts of a hinterland which are the same distance from the city centre also possess a similar morphology. The other assumptions underlying the hypothesis are that the most desirable and hence more expensive sites for all urban land uses lie close to the city centre where maximum accessibility is provided by converging transport routes. The farther a settlement lies from the city, the lower is the value of its land. These lower land values encourage lower intensity of use away from the centre. The workers find transport costs a more important part of their budget and they tend to live closer to the centre where they have more immediate accessibility to their jobs. As a result they can only afford to utilize relatively small amounts of this more expensive land for their houses and thus live at high density. The more distant a settlement is from the city, the land is cheaper and people utilize more of it for their houses. Besides,

more and more land is put to agricultural uses. Thus the density of population must decline with increasing distance from city centre.

Table III.2 shows that there is intense crowding in the city. About 19,293 persons are packed into every sq. km. But from this peak, there is very rapid drop in density from the first zone to the second zone.

The high density noticed along the corridor is due on the one hand to some overflow of city population which takes up residence in accessible hinterland settlements while on the other hand people from the most isolated interstitial villages also move closer to the corridors where they can easily benefit from city contacts. In the interstitial settlements densities are controlled more by the type of agriculture practiced than by the distance from city. Therefore in the interstitial settlements the density is always much lower than the corridor settlements of the same distance from city.

The coefficient of correlation between density and distance is -0.57 which confirms the hypothesis that variations in density in the hinterland are inversely associated linearlly with variations in distance.

The distance from city centre explains about 35% variations in population density along the corridors and

TABLE - III.2

Correlation between Density of Population and radial distance from city centre

Zonal number and radial distance from city centre	Corridor settlements	Interstitial settlements	Aggregate
Density of Population per square kilometre			
I 0 - 4 miles	19293	-	19293
II 4 - 6 miles	2462	-	2462
III 6 - 8 miles	2116	1232	1761
IV 8 - 10 miles	3248	704	1512
V 10 - 12 miles	475	447	453
VI 12 - 14 miles	1702	622	1084
VII 14 - 16 miles	1567	460	778
VIII 16 - 18 miles	518	259	314
IX 18 - 20 miles	445	241	285
X 20 - 22 miles	316	270	281
XI 22 - 24 miles	432	221	259
XII 24 - 26 miles	478	229	268
XIII 26 - 28 miles	796	179	291
XIV 28 - 30 miles	379	221	247
a intercept	7904.64	1052.45	7440.98
b regression coefficient	-342.74	-34.90	-335.78
r coefficient of correlation	-0.59	-0.82	-0.57
R^2 coefficient of determination	.3472	.6718	.3251
Calculated values of 't'	2.56*	4.52**	2.43*

* For 12 degrees of freedom the tabulated values of 't' at 1% and 5% levels of significance are 3.06 and 2.18 respectively.

** For 10 degrees of freedom the tabulated values of 't' at 1% and 5% levels of significance are 3.17 and 2.23 respectively.

67% of the variations in the interstitial settlements.

B. Sex Ratio

The second hypothesis on demographic inter-relations is that the sex ratio improves with increasing distance from city centre. The hypothesis is based on the following premises. The pull to the city, the demand of labour and the employment opportunities in the city lead to a drain of manpower from the hinterland. Rural-urban migration is selective and involves essentially male labour which migrates to the city and its outskirts wherever industries are located. As a result, the population of the city and its immediate vicinity will be more masculine than that of the hinterland.

Table III.3 shows that even in the hinterland the sex ratio is low. The low sex ratio in the hinterland is mainly due to differential births and differential deaths among the two sexes. The male selective migration depresses further the already low sex ratio nearer the city. Another feature to be noted is that the sex ratio of corridor settlements is always lower than that of the interstitial settlements located at corresponding distance from city centre.

About 55% variations in sex ratio along the corridor and 43% variations in the sex ratio in the interstitial settlements are explained by distance from city centre.

The coefficient of correlation between sex ratio and distance is 0.84 which confirms the hypothesis that variations

TABLE - III.3

Correlation between Sex Ratio and Radial Distance from City Centre

Zonal number and radial distance from city centre	Corridor settlements	Interstitial settlements	Aggregate
Sex Ratio			
I 0 - 4 miles	904	-	904
II 4 - 6 miles	923	-	923
III 6 - 8 miles	874	949	895
IV 8 - 10 miles	893	941	908
V 10 - 12 miles	927	950	945
VI 12 - 14 miles	903	929	912
VII 14 - 16 miles	899	964	926
VIII 16 - 18 miles	962	964	963
IX 18 - 20 miles	937	978	964
X 20 - 22 miles	931	974	962
XI 22 - 24 miles	962	970	968
XII 24 - 26 miles	937	983	971
XIII 26 - 28 miles	955	961	958
XIV 28 - 30 miles	955	964	962
a intercept	887.31	934.60	896.74
b regression coefficient	2.42	1.44	2.72
r coefficient of correlation	0.74	0.66	0.84
R^2 coefficient of determination	.5451	.4341	.7111
Calculated value of 't'	3.90*	2.76**	5.55**

* For 12 degrees of freedom the tabulated value of 't' at 1% and 5% levels of significance are 3.06 and 2.18 respectively

** For 10 degrees of freedom, the tabulated value of 't' at 1% and 5% levels of significance are 3.17 and 2.23 respectively.

in sex ratio are directly associated linearlly with variations in distance.

The regression analysis indicates that the rate of change in sex ratio is much faster along the corridors than along the interstitial sector. Since the calculated value of 't' for corridor is 3.90, the relationship is significant at 1% level of significance. In the case of interstitial settlements the calculated value of 't' comes to 2.76 and therefore it is significant at 5% level of significance only.

PART - II

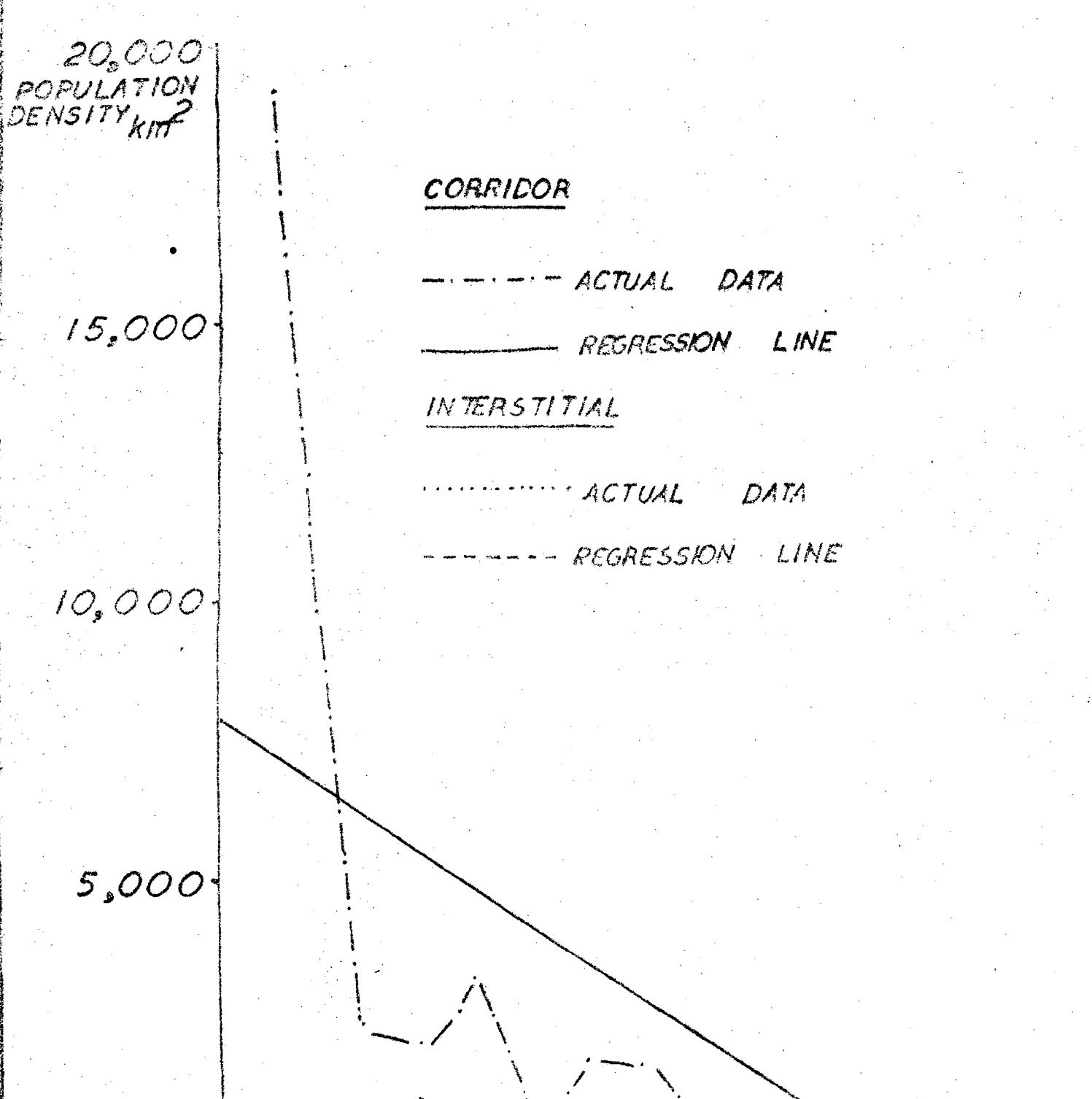
SOCIO-CULTURAL INTER-RELATIONS

A. General Literacy Rate

One of the hypotheses under social interdependence is that literacy level declines with distance from city. The logic behind the hypothesis is that city and its suburbs have wider educational facilities and that there is greater need for education to handle complex urban functions.

Table III.4 shows the general literacy rates at fixed distances from the city centre. The literacy is maximum in the city, moderate in the inner zones which are suburbs of the city and very low in the outer zones which are rural areas.

VARIATIONS IN POPULATION DENSITY BY DISTANCE INCREMENTS



GRAPH: III : 1

VARIATIONS IN SEX RATIO BY DISTANCE INCREMENTS

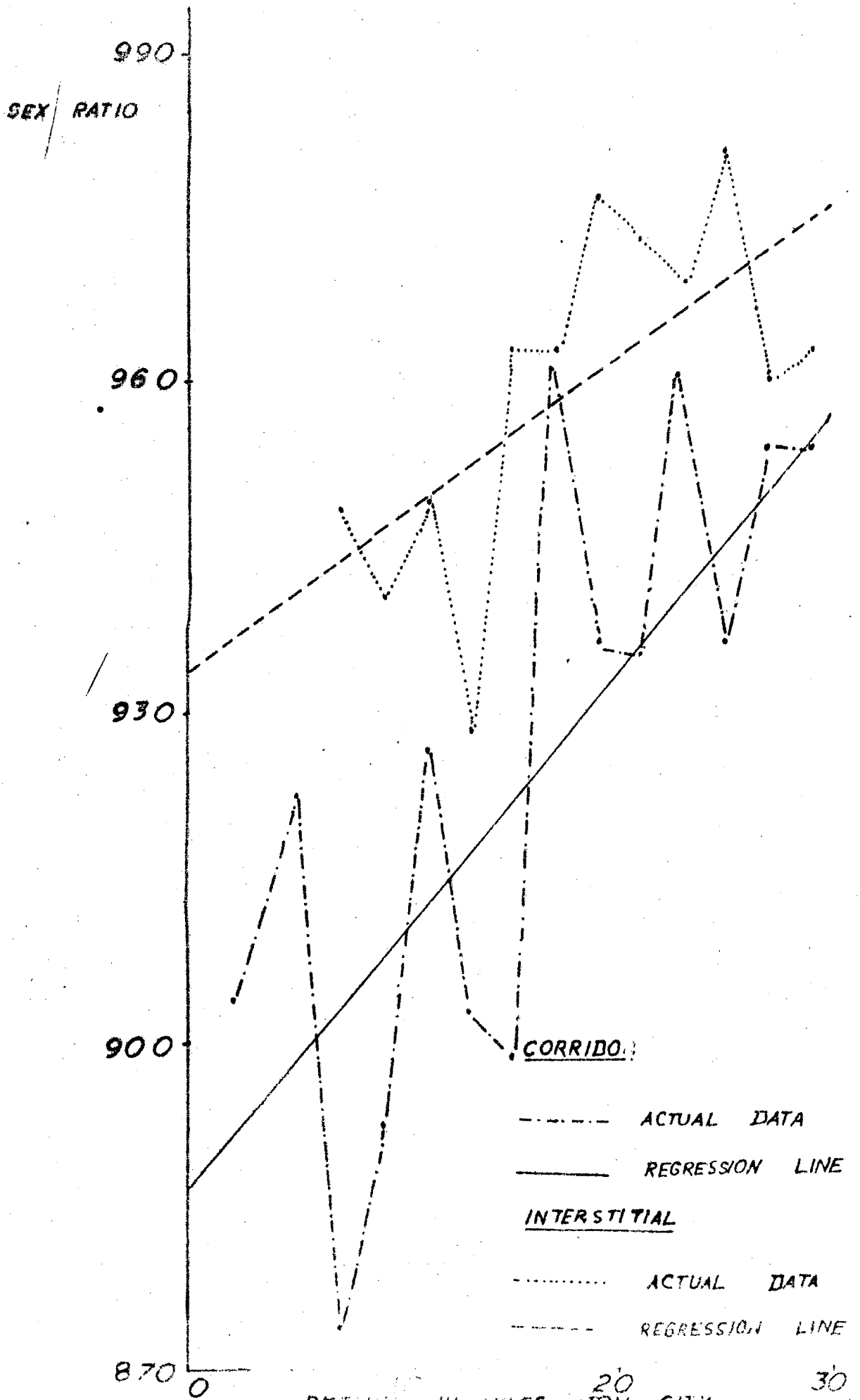


TABLE - III.4

Correlation between General Literacy Level and Radial Distance from City Centre

Zone number and radial distance from city centre	Corridor settlements	Interstitial settlements	Aggregate
General Literacy Rate			
I 0 - 4 miles	62	-	62
II 4 - 6 miles	58	-	58
III 6 - 8 miles	55	48	53
IV 8 - 10 miles	60	38	53
V 10 - 12 miles	38	40	40
VI 12 - 14 miles	57	39	51
VII 14 - 16 miles	59	36	50
VIII 16 - 18 miles	44	27	33
IX 18 - 20 miles	48	29	35
X 20 - 22 miles	38	35	36
XI 22 - 24 miles	45	32	36
XII 24 - 26 miles	40	34	35
XIII 26 - 28 miles	48	27	38
XIV 28 - 30 miles	35	31	32
a intercept	61.81	46.01	60.60
b regression coefficient	-0.80	-0.63	-1.06
r coefficient of correlation	-0.73	-0.75	-0.88
R^2 coefficient of determination	.5340	.5599	.7677
Calculated value of 't'	3.81*	3.70**	6.62**

* For 12 degrees of freedom the tabulated values of 't' at 1% and 5% levels of significance are 3.06 and 2.18 respectively.

** For 10 degrees of freedom the tabulated values of 't' at 1% and 5% levels of significance are 3.17 and 2.23 respectively

The correlation coefficient between general literacy and distance is -0.88 which confirms the hypothesis that variations in general literacy are inversely associated linearlly with variations in distance.

About 53% variations in literacy along the corridors and 56% variations in the interstitial settlements can be explained by distance from city centre alone.

Regression analysis has borne out the fact that literacy level declines more rapidly along the corridors than along the interstitial sector. For both corridor and interstitial settlements, the calculated values of 't' are more than the tabulated values of 't' at 1% level of significance.

B. Male-Female Literacy Differential

Yet another hypothesis tested is that sex-wise disparity in literacy widens as one moves from city to the hinterland. It is common knowledge that cities have always produced and perpetuated a style of life different from that of the surrounding rural areas. Since the urban dweller has to adjust continuously to a wide variety of new and strange things and events and new ideas, his reaction to newness and change is likely to be very different from that of rural inhabitant. The typical urban person is more sophisticated and less bound by traditional values whereas the rural dweller still has traditional prejudices against female education.

The sex equality in literacy was measured in the following manner.

$$\text{Literacy equality index} = \frac{\text{Female literacy rate}}{\text{Male literacy rate}} \times 100$$

A vale of 100 indicates there is complete equality between males and females in literacy. A value of less than 100 implies a comparatively lower female literacy rate and a value of more than 100, a comparatively higher literacy rate among females.

Table III.5 shows that the disparity in literacy level between male and female is very wide in the interstitial sector which is basically rural in character. For most parents in rural areas, female education has little economic value since there are strong prejudices against their employment outside their own home or farms. Female children suffer a relative neglect and the same is the case with their education. They are also not permitted much mobility and may not be sent to a school even in an adjoining village. Even in the corridor settlements the parity between sexes in the matter of education declines as one moves away from the city. This negative relationship is supported by the data.

The coefficient of correlation between literacy equality index and distance is -0.89 which confirms the hypothesis that sex differentials in literacy increase with distance

TABLE - III.5

Correlation between Male-Female Literacy Differential and Radial distance from city centre

Zone number and radial distance from city centre	Corridor settlements	Interstitial settlements	Aggregate
Ratio of Female Literacy to Male Literacy Rate			
I 0 - 4 miles	75	-	75
II 4 - 6 miles	72	-	72
III 6 - 8 miles	65	49	62
IV 8 - 10 miles	71	49	66
V 10 - 12 miles	51	54	55
VI 12 - 14 miles	67	53	63
VII 14 - 16 miles	70	47	61
VIII 16 - 18 miles	61	39	49
IX 18 - 20 miles	58	39	47
X 20 - 22 miles	47	46	46
XI 22 - 24 miles	66	41	49
XII 24 - 26 miles	48	43	41
XIII 26 - 28 miles	59	41	52
XIV 28 - 30 miles	47	42	45
a intercept	74.11	54.25	73.61
b regression coefficient	-0.81	-0.50	-1.11
r coefficient of correlation	-0.70	-0.70	-0.89
R^2 coefficient of determination	.4960	.4883	.7876
Calculated values of 't'	3.52*	3.12**	6.93*

* For 12 degrees of freedom the tabulated values of 't' at 1% and 5% levels of significance are 3.06 and 2.18 respectively.

** For 10 degrees of freedom the tabulated values of 't' at 1% and 5% levels of significance are 3.17 and 2.23 respectively.

from city. About 50% variations in disparity along the corridors and 49% variations in disparity noticed in the interstitial settlements are explained by distance from city.

The calculated value of 't' for corridor settlements is higher than the tabulated value of 't' at 1% level of significance. With regard to interstitial settlements, the calculated value of 't' is greater than the tabulated value of 't' at 5% level of significance.

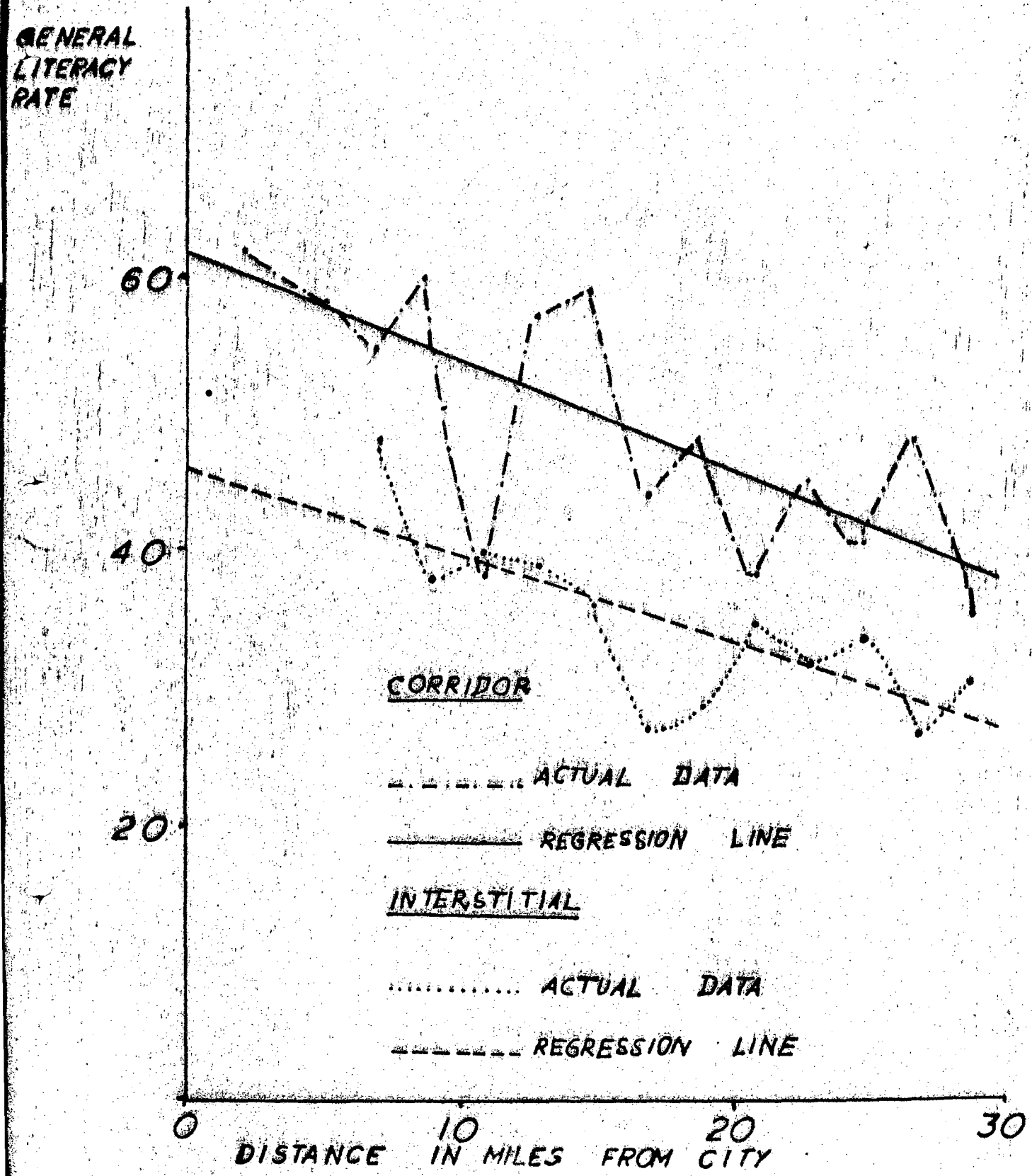
PART - III

ECONOMIC INTER-RELATIONS

A. Labour Force Participation

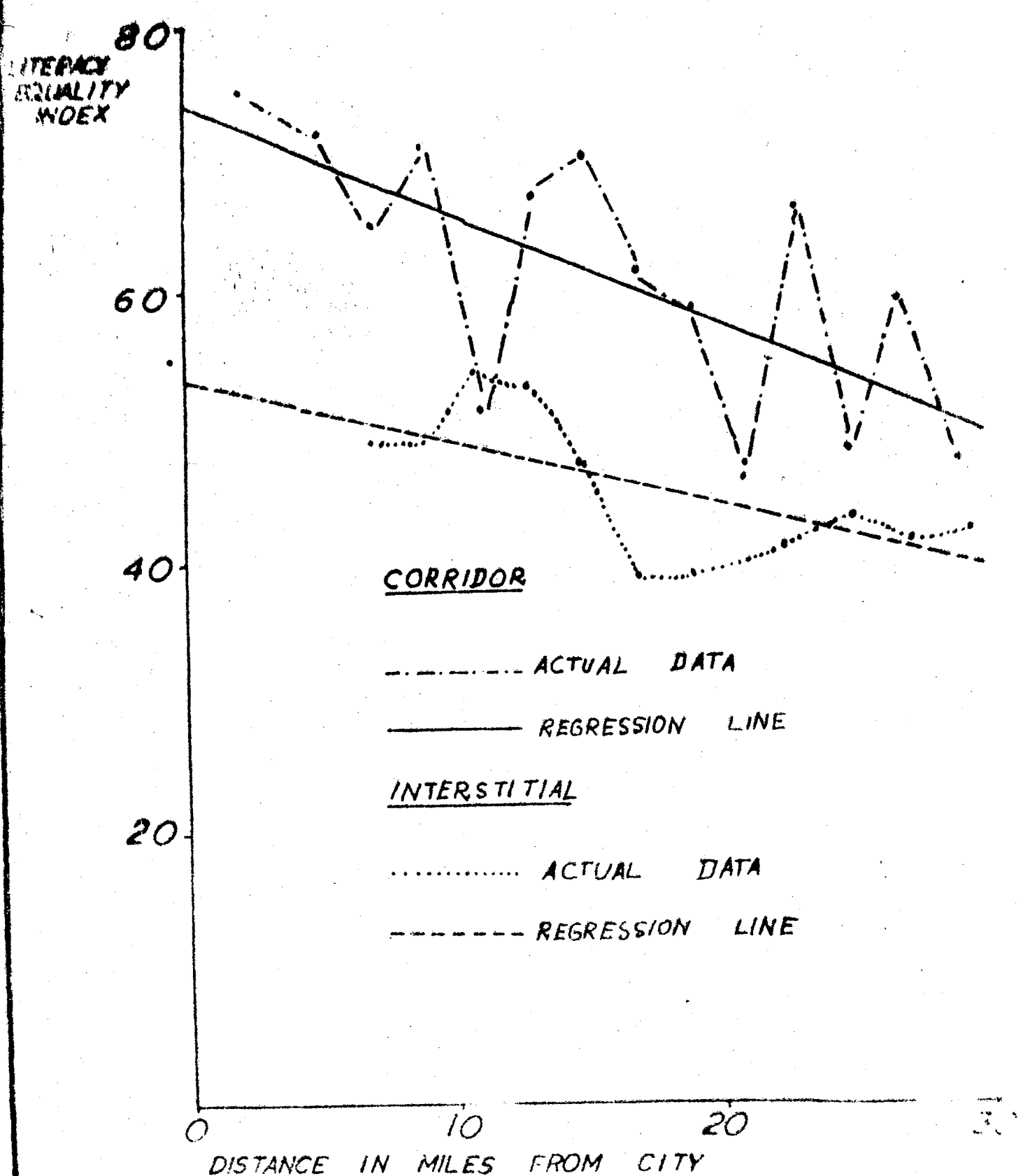
The first hypothesis tested under economic inter-relations is that participation in labour force will rise with distance from city. This flows from the premises that in the city and in the most urbanised zones around the city, a big chunk of youth population will be in the education system and therefore withdrawn from the labour force. On the other hand, in the hinterland where agriculture is the main stay of life, a larger fraction of both young and the aged can be gainfully employed. Therefore labour force participation rate will tend to rise away from the city.

VARIATIONS IN LITERACY BY DISTANCE INCREMENTS



GRAPH: III. 3

VARIATIONS IN SEX DIFFERENTIALS IN LITERACY BY DISTANCE INCREMENTS



GRAPH: III .4.

The analysis is confined to male workers only since they are more consistent in definition and reporting in the Censuses.

Table III.6 furnishes the male labour force participation rates zone-wise for corridor and interstitial settlements.

The coefficient of correlation between labour force participation and distance is 0.88 which confirms the hypothesis that variations in labour force participation are directly associated linearlly with variations in distance.

The distance from city can explain about 20% variations in male labour force participation rates along the corridors and 77% among the interstitial settlements. The male labour force participation rises more rapidly along the interstitial sector than along the corridor sector.

The calculated 't' value of 2.40 for corridor settlements is significant at 5% level and the calculated 't' value of 6.80 for interstitial settlements is significant at 1% level.

B. Workers in Primary and Non-Primary Sectors

The next hypothesis is that the ratio of non-primary worker to primary worker diminishes with distance from the city. Towns and cities owe their existence to the growth of commerce and industry. The types of employment associated

TABLE - III.6

Correlation between Male Labour Force Participation Rate and Radial distance from city centre

Zonal number and Radial distance from city centre	Corridor settlements	Interstitial settlements	Aggregate
Male Labour Force Participation Rate			
I 0 - 4 miles	49	-	49
II 4 - 6 miles	47	-	47
III 6 - 8 miles	51	51	51
IV 8 - 10 miles	49	53	50
V 10 - 12 miles	54	52	53
VI 12 - 14 miles	49	53	50
VII 14 - 16 miles	48	55	51
VIII 16 - 18 miles	52	57	55
IX 18 - 20 miles	50	58	55
X 20 - 22 miles	52	57	56
XI 22 - 24 miles	52	59	57
XII 24 - 26 miles	52	58	56
XIII 26 - 28 miles	50	59	55
XIV 28 - 30 miles	53	57	56
a intercept	48.66	49.63	47.67
b regression coefficient	0.12	0.34	0.33
r coefficient of correlation	0.51	0.88	0.88
R^2 coefficient of determination	.2581	.7689	.7717
Calculated values of 't'	2.40*	6.80**	6.60*

* For 12 degrees of freedom the tabulated values of 't' at 1% and 5% levels of significance are 3.06 and 2.18 respectively.

** For 10 degrees of freedom the tabulated values of 't' at 1% and 5% levels of significance are 3.17 and 2.23 respectively.

with them can be described as 'Non Primary' and an important characteristic of urban population is provided by the occupations which they follow. Therefore with increasing distance from city, it is expected that the ratio between non primary worker and male primary worker would fall off. The cultivators, agricultural labourers, workers engaged in livestock raising, fishing and forestry and workers in mining and quarrying occupations are grouped into 'Primary sector'. Included in the non primary sector are those workers in manufacturing both household and non household sectors, construction, trade and commerce, transport and service sectors.

Table III.7 shows the ratio of male non primary workers to male primary workers i.e how many male non primary workers are there for every male primary worker. Female workers are ignored because of the unreliability of the data.

Apart from the industries which locate themselves outside the city preferably beyond the corporation limits and which cause an increase of non primary workers in the settlements around the city, there is also an element of commuting. The non primary sector of employment dominates in the city and in the immediate vicinity of the city where there are industries. The interstitial settlements beyond a limit of 12 miles are not at all affected and are essentially agricultural in employment structure of their population. The urban influences from Madras have penetrated along the rail road

TABLE - III.7

Correlation between Ratio of Male Non-Primary Workers to Male Primary Workers and Radial distance from city centre

Zonal number and radial distance from city centre	Corridor settlements	Interstitial settlements	Aggregate
Ratio of Male Non-Primary Workers to Male Primary Workers			
I 0 - 4 miles	60.1	-	60.1
II 4 - 6 miles	14.2	-	14.2
III 6 - 8 miles	12.9	2.8	7.0
IV 8 - 10 miles	17.4	1.0	4.1
V 10 - 12 miles	2.3	1.0	1.2
VI 12 - 14 miles	7.2	0.8	2.8
VII 14 - 16 miles	5.3	0.8	2.0
VIII 16 - 18 miles	0.8	0.2	0.3
IX 18 - 20 miles	1.6	0.1	0.4
X 20 - 22 miles	0.4	0.3	0.3
XI 22 - 24 miles	0.6	0.3	0.4
XII 24 - 26 miles	0.8	0.2	0.4
XIII 26 - 28 miles	1.6	0.1	0.5
XIV 28 - 30 miles	0.4	0.2	0.3
a intercept	29.68	2.09	25.02
b regression coefficient	-1.30	-0.08	-1.15
r coefficient of correlation	-0.70	-0.76	-0.62
R^2 coefficient of determination	.4895	.5824	.3806
Calculated values of 't'	3.51*	4.00**	2.80*

* For 12 degrees of freedom the tabulated values of 't' at 1% and 5% levels of significance are 3.06 and 2.18 respectively.

** For 10 degrees of freedom the tabulated values of 't' at 1% and 5% levels of significance are 3.17 and 2.23 respectively.

through a string of industries along the arteries of transport and here it is confined to a distance of 16 miles within which communication is possible by bus or train. It appears that railways are an important factor in weaning the rural population of its agricultural occupations. This is evident from the fact that the ratio of non primary workers to primary workers is considerably higher in the corridors than in the interstitial settlements of comparable distance from the city.

The coefficient of correlation of -0.62 between the ratio of non-primary worker to primary worker and distance confirms our hypothesis_they are negatively related.

The distance from city explains about 49% variations in the ratio along the corridors and 58% variations in the interstitial settlements.

Simple regression analysis has brought about the fact that the rate of decline in the ratio of non primary workers to primary workers is small in the interstitial sector when compared to corridor sector. Both along the corridors and also in the interstitial settlements, the computed 't' values are observed to be significant at 1% level.

C. Sex Ratio of Workers

Yet another hypothesis tested is that the ratio of women to men in labour force will decline in non primary

sector and at the same time rise in primary sector with increasing distance from city centre.

Customs and traditions restrict in a large measure industrial and allied occupations for women. But the hold of customs and traditions are weak in urban areas. Therefore the ratio of women to men worker in non primary sector will be large in the city and its immediate environs but will taper off towards the hinterland.

On the other hand in rural areas, few women are employed in any work outside the home or their farms. The women generally take part in light field work or similar pursuits which need little education and which do not require them to work shoulder to shoulder together with men who are not their relatives. Therefore in the hinterland the sex ratio of primary workers will be greater when compared with that of the city.

Table III.8 shows the sex ratio of primary workers and Table III.9 the sex ratio of non-primary workers.

Though there is a slight increase in the sex ratio of primary workers and a small decline in the sex ratio of non-primary workers with increasing distance from the city the relationship is not statistically significant. The computed 't' values both in the case of primary and non-primary workers are much lower than the tabulated values of 't' even at 5% level. The hypothesis is therefore rejected.

TABLE - III.8

Correlation between Sex Ratio of Primary Workers and Radial distance from city centre

Zonal number and radial distance from city centre	Corridor settlements	Interstitial settlements	Aggregate
Sex Ratio of Primary Workers			
I 0 - 4 miles	42	-	42
II 4 - 6 miles	79	-	79
III 6 - 8 miles	95	111	105
IV 8 - 10 miles	45	264	223
V 10 - 12 miles	500	390	409
VI 12 - 14 miles	169	233	213
VII 14 - 16 miles	250	303	289
VIII 16 - 18 miles	310	224	246
IX 18 - 20 miles	366	274	289
X 20 - 22 miles	197	278	258
XI 22 - 24 miles	307	267	277
XII 24 - 26 miles	186	246	234
XIII 26 - 28 miles	259	220	231
XIV 28 - 30 miles	228	270	261
a intercept	108.63	241.37	129.05
b regression coefficient	6.78	0.85	6.05
r coefficient of correlation	0.44	0.10	0.22
R^2 coefficient of determination	.1962	.0092	.0485
Calculated values of 't'	1.73*	0.30**	1.95*

* For 12 degrees of freedom the tabulated values of 't' at 1% and 5% levels of significance are 3.06 and 2.18 respectively.

** For 10 degrees of freedom the tabulated values of 't' at 1% and 5% levels of significance are 3.17 and 2.23 respectively.

TABLE - III.9

Correlation between Sex Ratio of Non-Primary Workers and radial distance from the city centre

Zonal number and radial distance from city centre	Corridor settlements	Interstitial settlements	Aggregate
Sex Ratio of Non-Primary Workers			
I 0 - 4 miles	94	-	94
II 4 - 6 miles	87	-	87
III 6 - 8 miles	70	88	74
IV 8 - 10 miles	97	183	115
V 10 - 12 miles	271	141	181
VI 12 - 14 miles	73	155	91
VII 14 - 16 miles	96	164	117
VIII 16 - 18 miles	66	155	104
IX 18 - 20 miles	106	78	98
X 20 - 22 miles	48	175	134
XI 22 - 24 miles	62	25	40
XII 24 - 26 miles	90	130	112
XIII 26 - 28 miles	65	138	77
XIV 28 - 30 miles	65	90	82
a intercept	121.45	163.01	111.74
b regression coefficient	-1.84	-2.01	-0.71
r coefficient of correlation	-0.29	-0.31	-0.19
R^2 coefficient of determination	.0836	.0951	.0359
Calculated values of 't'	1.06*	1.02**	0.66*

* For 12 degrees of freedom the tabulated values of 't' at 1% and 5% levels of significance are 3.06 and 2.18 respectively.

** For 10 degrees of freedom the tabulated values of 't' at 1% and 5% levels of significance are 3.17 and 2.23 respectively.

Absence of significant relationship may be attributed to several reasons. First the census data on female workers is suspect particularly when it comes to primary sector. For instance, in the hinterland many women may be economically active by helping their husbands or parents in agriculture, dairying etc. But the census authorities may overlook them as marginal unpaid family workers. On the other hand in the metropolis women may be willing to take up jobs in non-primary sector too. But they may not be able to do so because of the heavy backlog of unemployment among the males too.

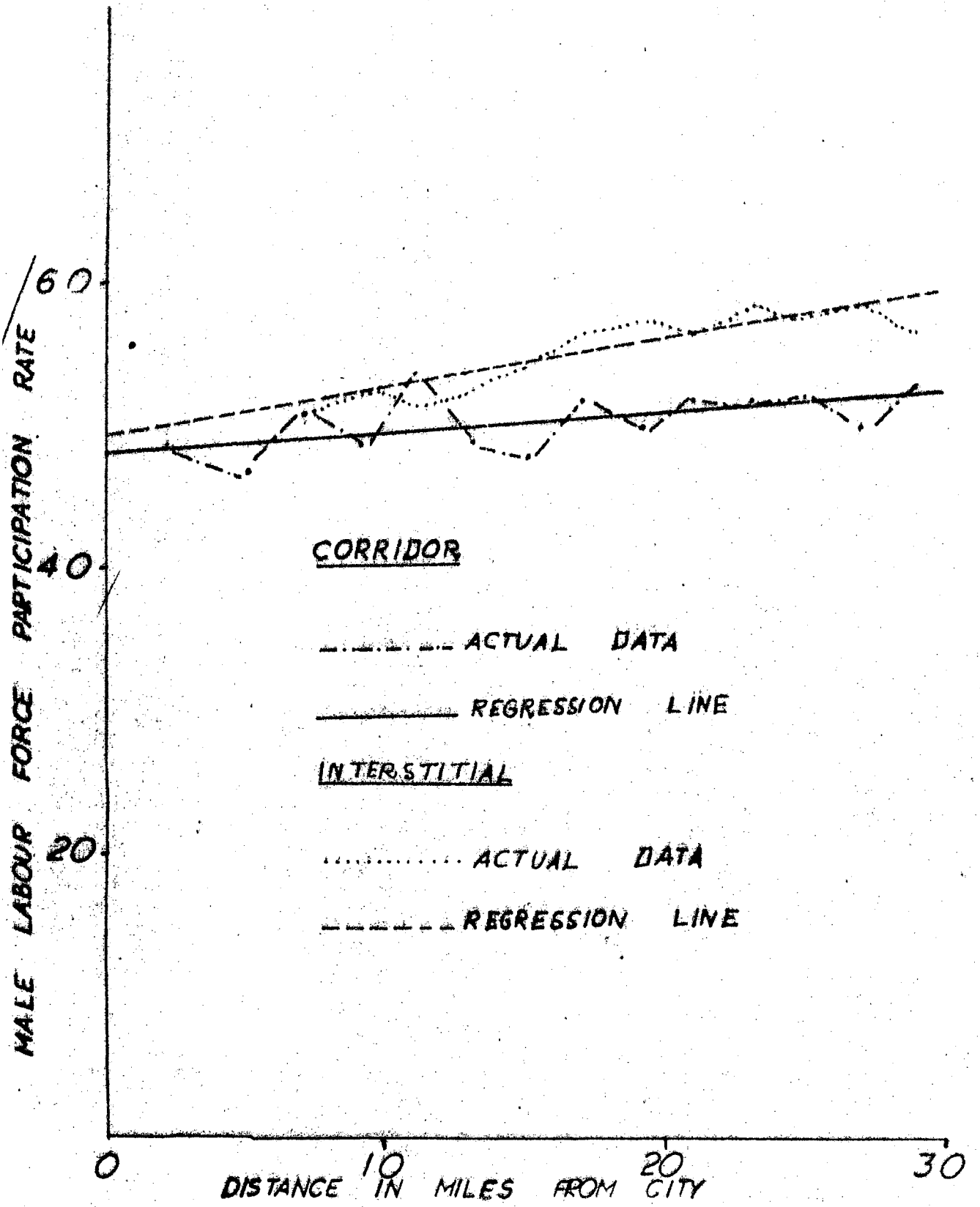
PART - IV

SOCIAL AMENITIES INTER-RELATIONS

The hypothesis here is that the standard of social amenities will decline with distance from city. As the societies grow from simple to complex they acquire new social amenities and the metropolis is the heartRof many new social amenities. But the social amenities which originate in urban milieu are not necessarily restricted to urban areas. They diffuse from city to the rural areas in the hinterland and tend to be adopted there. But this diffusion process is hampered by distance friction. Therefore the areas closer to city will possess higher level of amenities than those farther from it.

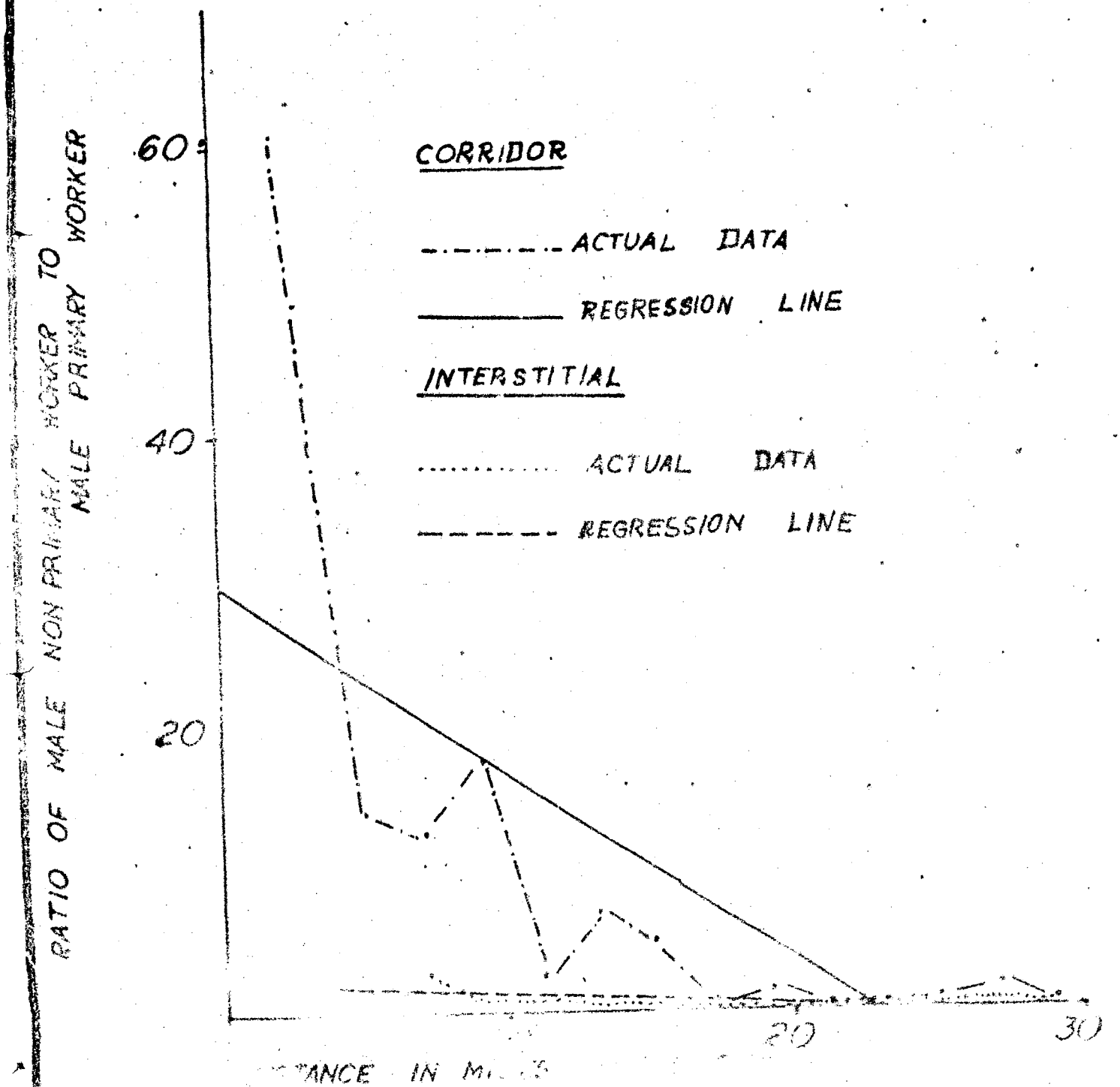
There is no fool-proof method of selecting the variable or giving weightage to those variables for measuring the

VARIATIONS IN LABOUR FORCE PARTICIPATION BY DISTANCE INCREMENTS



GRAPH : III.5.

VARIATIONS IN PRIMARY & NON PRIMARY WORKERS BY DISTANCE INCREMENT



the levels of development of social amenities. The town and village Directory of District Census Hand Books provide information about some of the amenities relating to health, education, communication, protected water supply, electrification etc. which have a more direct bearing on the quality of life. These amenities taken together would provide us with a good index of development of social amenities.

To express the level of development of social amenities in quantitative terms, an appropriate weight was given to each of the amenities, on the basis of two considerations - first, on the basis of their relative importance and secondly on the basis of common observation. An example will clarify the issue of relative importance of social amenities. If a settlement has one primary school, it will get say 2 points and if a settlement has a middle school, which is obviously a higher order facility that settlement will be awarded a value of 4. If the settlement had an High school as well, it will get eight points more. Suppose a settlment has two primary schools, it will get two points only and not four points, since we believe that if more than one unit gets located in a settlement, it does not anyway increase the level of social amenities enjoyed by the inhabitants of that settlement. The weights for the variables are given in Table III.11.

The aggregate score of social amenities was obtained by adding these weighted variable values for each settlement

in a given zone. This aggregative score for each zone was divided by the number of settlements in that zone to arrive at the index of social amenity of the zone.

Table III.10 shows the levels of development of social amenities at successive distance from Madras city. Invariably in all zones, the corridor settlements have scored higher values than the interstitial settlements. This brings out clearly the role of transportation networks in spreading growth impulses from city to the hinterland.

The coefficient of correlation between levels of development of social amenities and distance is -0.72 which confirms the hypothesis that variations in the development of social amenities are inversely associated linearlly with variations in distance.

Distance from city explains about 58% variations in social amenity score along the corridors and 67% in the interstitial settlements.

The computed 't' values for both corridor settlements and interstitial settlements are significant at 1% level.

PART - V

GENERALISED PATTERN OF METROPOLITAN INFLUENCE

It has become evident from the data that urban influence

TABLE - III.10

Correlation between Social Amenities and radial distance from city centre

Zonal number and radial distance from city centre	Corridor settlements	Interstitial settlements	Aggregate
Index of Social Amenities Development			
I 0 - 4 miles	86	-	86
II 4 - 6 miles	33	-	33
III 6 - 8 miles	38	23	29
IV 8 - 10 miles	45	15	19
V 10 - 12 miles	22	16	17
VI 12 - 14 miles	42	14	19
VII 14 - 16 miles	25	14	17
VIII 16 - 18 miles	19	9	12
IX 18 - 20 miles	26	10	12
X 20 - 22 miles	13	11	11
XI 22 - 24 miles	13	11	11
XII 24 - 26 miles	13	10	11
XIII 26 - 28 miles	14	7	8
XIV 28 - 30 miles	10	10	10
a intercept	59.09	21.14	48.15
b regression coefficient	-1.92	-0.48	-1.70
r coefficient of correlation	-0.76	-0.82	-0.72
R^2 coefficient of determination	.5841	.6734	.5211
Calculated values of 't'	4.17*	4.80**	3.69*

* For 12 degrees of freedom the tabulated values of 't' at 1% and 5% levels of significance are 3.06 and 2.18 respectively.

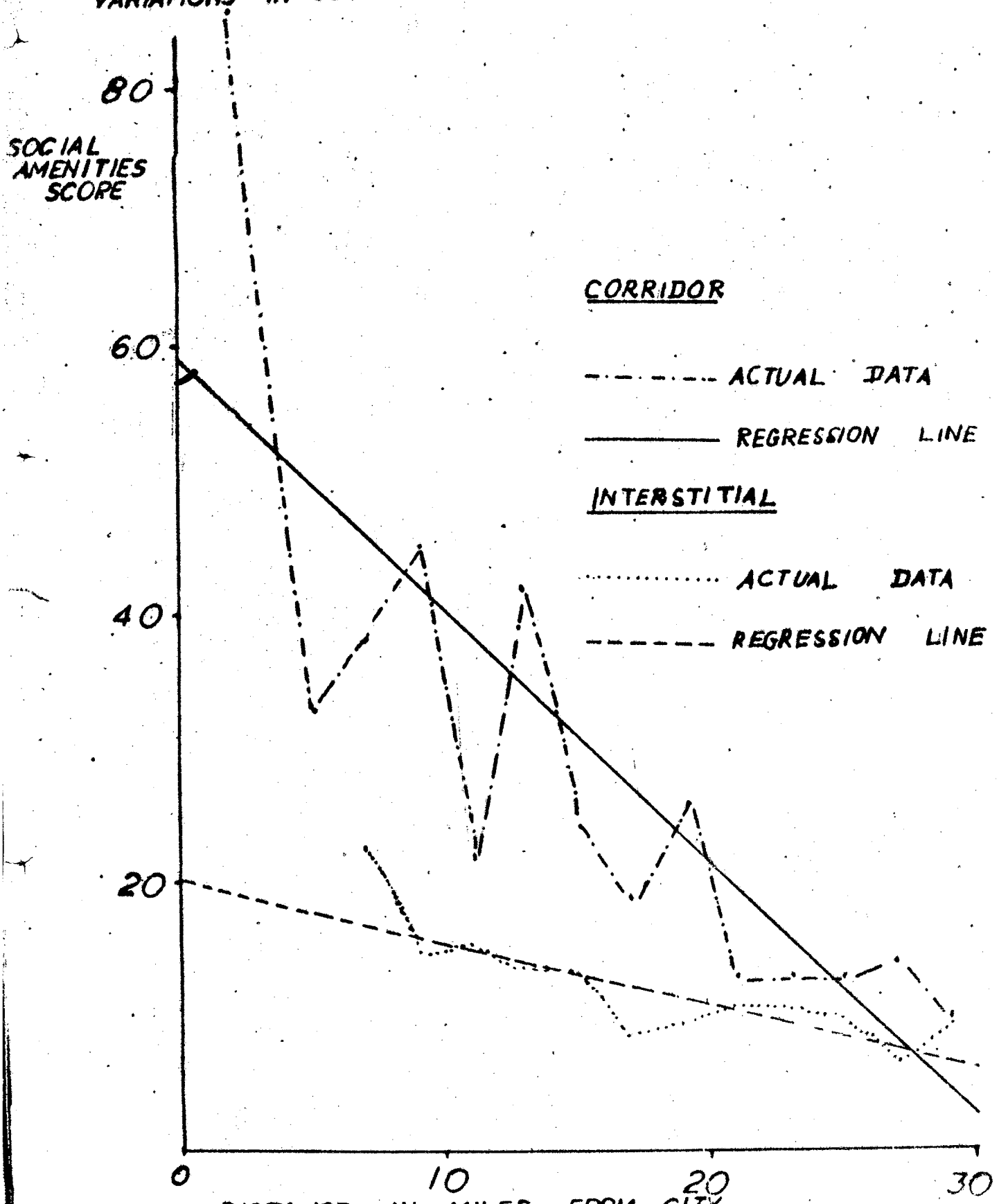
** For 10 degrees of freedom the tabulated values of 't' at 1% and 5% levels of significance are 3.17 and 2.23 respectively.

TABLE - III.11

Weighted Scores for the Social Amenities

Social Amenity	Weightage
Primary School	2
Middle School	4
High School	8
College	16
Maternity centre/Health centre Dispensary/Medical Practitioner	4
Hospital	8
Post Office	2
Telegraph Office	4
Phone	8
Protected Water Supply	8
Electric Power Supply	4
Kutcha Road	2
Pucca Road	4
Bus Stand	6
Railway Station	8

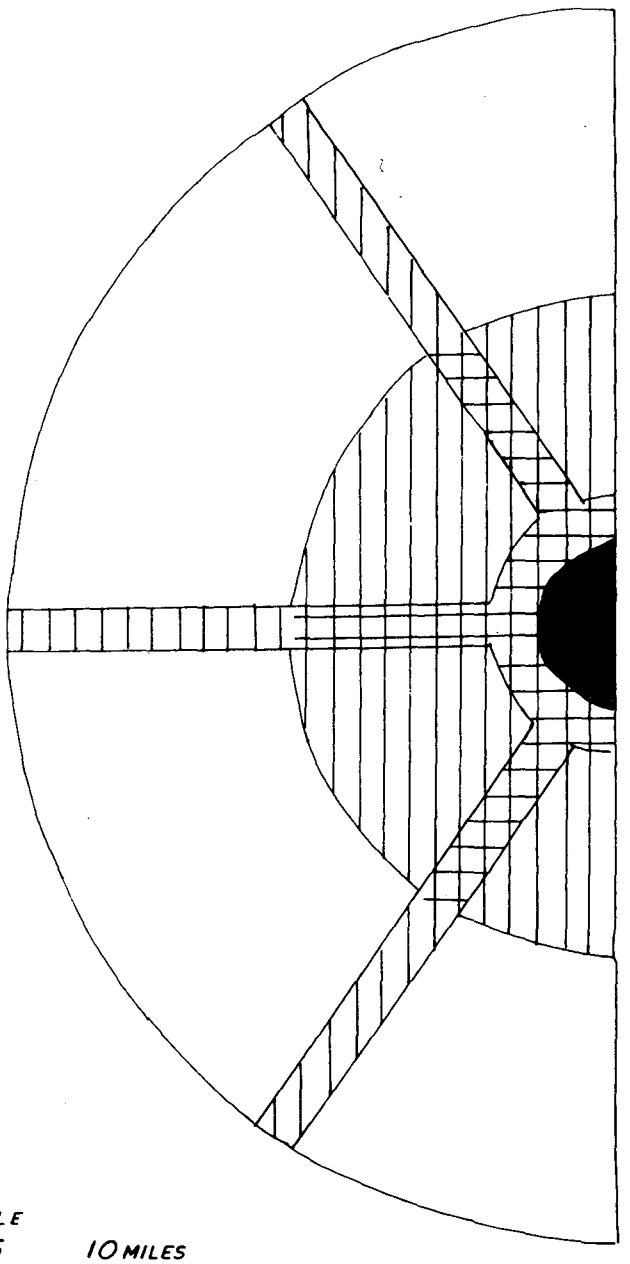
Note :- When a settlement was served by Pucca road and Kutcha road as well, it was assigned a score of four only and not six.


VARIATIONS IN SOCIAL AMENITIES BY DISTANCE INCREMENTS
80
60
40
20
SOCIAL AMENITIES SCORE
CORRIDOR
ACTUAL DATA
REGRESSION LINE
INTERSTITIAL
ACTUAL DATA
REGRESSION LINE
0
10
20
30
DISTANCE IN MILES FROM CITY

GRAPH: III. 7.

METROPOLITAN INFLUENCE OVER THE HINTERLAND

(SCHEMATIC)



INFLENCE ZONES

- METROPOLITAN CORE
- METROPOLITAN DOMINANCE
- METROPOLITAN SUB DOMINANCE
- RURAL HINTERLAND

SCALE

0 5 10 MILES

FIG : III . 1.

does not spread uniformly in all directions for reasons such as topographical constraints or the existence of a cheap public transport system. Secondly in Madras city as in many other modern cities economic and social activities do not focus on a single central city but several sub centres scattered over the city hinterland. Therefore the urban indices fluctuate slightly from zone to zone depending whether or not that zone has any major satellite town.

Despite these slight fluctuations, one can discern that a distinct pattern of population and social amenities development has emerged within the city hinterland. An inspection of the Figures in Tables III.2 to III.10 shows that the influence of the core city does not decline at constant rate all through the thirty miles. There are sharp breaks in the gradient of the hinterland. Along the corridors, the values of urban indices fall steeply at fourth mile and again at sixteenth mile. In the interstitial settlements also, a sharp fall in the urban indices is noticed, at sixteenth mile.

There are twenty six areal units (fourteen corridor segments and twelve interstitial segments) in the city hinterland. On the basis of intensity of Metropolitan influence, an attempt was made to group and classify these twenty six areal units into more broader and compact zones of metropolitan dominance, metropolitan sub dominance etc. Two things

were kept in mind while grouping the areal units. Firstly the aim was to ensure that the population in the emerging broader zones become as homogeneous as possible in terms of their urban acculturation. Secondly the assignment of any areal unit into one particular zone of influence, i.e., placing the like segments together and keeping unlike segments apart does not do any violence to the areal contiguity of the units considered. Accordingly the city and its hinterland were arranged into four main zones which is schematically illustrated in Fig. III.1.

1. Metropolitan core : This is defined as the incorporated area of the city and this area lies in the first concentric arc.
2. Zone of Metropolitan Dominance : The corridor settlements in concentric arcs number two to seven lie in this zone.
3. Zone of Metropolitan Sub Dominance : The corridor settlements in concentric arcs number eight to fourteen and interstitial settlements in concentric arcs number three to seven come under this zone.
4. Rural Hinterland : This is defined as the interstitial settlements located in concentric arcs eight to fourteen.

The problem now is one of the testing the significance of differences among these four zones and validating our

classification. For this purpose analysis of variance[1] has been used. The statistic formula has been computed to test the significance of differences in the urban indices between the zones. The results of these computations are shown in Table III.12.

In respect of all the seven urban indices of metropolitan dominance, the F ratios are much greater than the tabulated values of F ratios with 3 and 22 degrees of freedom at 1% level of significance. This has validated our classification and confirmed our hypothesis that the four zones are homogeneous within and are significantly different from one another from without.

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1. The total variations displayed by the 26 segments or observations are measured by its variance, i.e. the sums of the squares of deviations from arithmatic mean. This total variance was broken down into components associated with specific sources of variation.

   In other words, when broader zones are constructed from smaller units, there are two sources of variations. There is variation among the units within the zone (intra-zonal variance) and variations among the zones (inter-zonal variance). The inter-zonal variance was divided by the intra-zonal variance to give the variance ratio or F. If the two variances are equal, the value of this ratio is one and more F ratio rises above one the greater is the inter-zonal differentials. In broad terms, the variance ratio F describes how successful the grouping procedure has been in keeping like segments together and keeping unlike segments apart.

   Ref. : S. Gregory, Statistical Methods and the Geographer, Long - Man, 1973, pp. 152-163.

TABLE - III.12

ANALYSIS OF VARIANCE TABLE

Index of metropolitan influence	Source of variation	Sum of squares	Degree of Freedom	Mean square	F Ratio*
1. Density of Population	Inter Zonal	33993	3	11331.20	513.65
	Intra Zonal	485	22	22.06	
	Total	34478			
2. Sex Ratio	Inter Zonal	16584	3	5528.13	30.22
	Intra Zonal	4023	22	182.87	
	Total	20607			
3. General Literacy Rate	Inter Zonal	2227	3	742.37	24.91
	Intra Zonal	656	22	29.80	
	Total	2883			
4. Male-Female Literacy Equality Index	Inter Zonal	2394	3	797.89	21.96
	Intra Zonal	799	22	36.33	
	Total	3193			
5. Male Labour Force Participation Rate	Inter Zonal	258	3	85.87	33.15
	Intra Zonal	57	22	2.59	
	Total	315			
6. Ratio of Male non primary workers to male primary workers	Inter Zonal	3432	3	1143.93	142.81
	Intra Zonal	176	22	8.01	
	Total	3608			
7. Index of Social Amenities development	Inter Zonal	6477	3	2158.89	84.06
	Intra Zonal	565	22	25.68	
	Total	7042			

* The least highly significant value of F at 1% level of significance with 3 and 22 degrees of freedom is 4.82.

Another interesting point to be noted is that density of population has recorded an F ratio as high as 513.65 indicating thereby that it is the best indicator of metropolitan dominance at different distance zones. Next in importance is the relative share of primary workers and non primary workers in total labour force. The ratio of male non primary workers to male primary workers has an F ratio of 142.81, thus proving that it is also a good indicator of metropolitan dominance. The index of social amenities development also has a high F ratio of 84.06. The other indices namely sex ratio, general literacy rate, male-female literacy equality index, male labour force participation rate have more or less similar values of F ratios which are however significant at 1% level.

The Metropolitan Core

This is the incorporated area of Madras city and extends about a radius of four miles measured from Fort St. George which is the city centre. It is a zone of highest density of population - 19293 persons per sq. km. Other urban indices are also the highest in this zone - which are given below :

Sex ratio 904

General literacy rate 62%

Ratio of female literacy to male literacy rate 75

Male labour force participation 49

Ratio of male non primary worker to male primary worker .60

Social Amenities index 86

Zone of Metropolitan Dominance

This zone lies between fourth and sixth mile from city centre and along the corridors it extends upto sixteen miles. This zone contains the suburbs of Madras city which includes the fringe of the built up area and some adjacent municipalities. The settlements in this zone, though physically separate, are close enough to present the possibility of coalescing in time to become conurbation. The high values of urban indices indicate that in this zone, the contacts with Madras proper are intimate and for a large section of the population it is daily. It is obvious the people of this zone look to Madras city for shopping, employment, education, recreation etc. This zone is in effect an extension of the rapidly developing metropolitan core. The urbanisation indices are quite high and close to the indices of the city itself. In fact the overall sex ratio of this zone is lower than that of the core city. This appears to be the result of location of many industrial satellite towns in this zone. The range of variations in urbanization indices are given below. The overall urban indices for the zone is given within bracket.

Density of population 475 to 3248 persons per Km^2 (1872)

Sex ratio 874 to 927 (896)

General literacy rate 38 to 60% (57%)

Ratio of female literacy to male literacy rate 51 to 72 (68)

Male labour force participation rate 47 to 54 (50)

Ratio of male non-primary workers to male primary workers 2.3 to 17.4 (9)

Social amenity index 22 to 45 (34)

Zone of Metropolitan Sub Dominance

Surrounding the zone of metropolitan dominance is the zone of metropolitan sub dominance. It extends upto 16 miles from city centre and along the corridors it extends upto 30 miles. The inhabitants of this zone too depend on Madras city for some major facilities. The outer limit of this zone can be reached by about an hour's travelling time from Madras. As a result this zone also may be contributing some daily commuters to the central city. Here the urban indices have intermediate values. The range of variations in urbanization indices are furnished below and overall values for the zone as a whole given within bracket.

Density of population 316 to 1232 per km^2 (541)

Sex ratio 929 to 964 (947)

General literacy rate 35 to 48 (41)

Ratio of female literacy to male literacy rate 47 to 66 (53)

Male participation rate in labour force 50 to 55 (53)

Ratio of male non primary workers to male primary workers 0.8 to 2.8 (1)

Social amenities index 10 to 26 (15)

Rural Hinterland

Finally Madras is surrounded by what might be called its rural hinterland. It is the wider and more extensive area. All settlements in this zone are atleast 2 miles away from the three major lines of communication. Here the city is no longer the place of work or regular shopping of any significant proportion of the population. The people turn to nearby smaller towns like Taluk Headquarters etc. for satisfying their demands for urban functions. However, for every higher order functions, people still look to Madras city.

Beyond these limits the influence of Madras diminishes sharply and its role as a metropolitan centre is superseded by other centres except where it offers unique services as a centre of modern industries, as a port town facilitating trade and above all as the state capital of Tamil Nadu.

In the rural hinterland the urbanisation indices reach the lowest level and their range in values is furnished below, along with the overall values for the zone as a whole.

Density of population 179 to 270 per km^2 (229)

Sex ratio 961 to 983 (971)

General literacy rate 27 to 35% (31%)

Ratio of female literacy rate to male literacy rate 39 to 46 (42)

Male participation rate in labour force 57 to 59 (58)

Ratio of male non primary workers to male primary workers 0.1 to 0.3 (0.2)

Social amenities index .7 to 10 (10)

CHAPTER - IV

IDENTIFICATION OF SERVICE CENTRES

IV.1 Introduction

Central functions provide the 'sine quo non' for the continued existence of a city. It is they that hold the city and the surrounding populations in contact. In a large city hinterland, the individual settlements differ from one another in their functional relationship with the central city. All settlements perform certain functions and for other functions, they are dependent on settlements having them. A study of centrality and hierarchy of settlements is very important since it allows a clearer understanding of the relationships which exist between city and hinterland and between settlements at various levels in the urban hierarchy.

IV.2 Concepts and theory on functional inter-relationship among settlements

A theoretical framework for the study of the distribution of settlement is provided by the work of Walter Christaller It is easily observable that in any given region there are

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1. Walter Christaller, Central Places in Southern Germany, Translation by C.B. Baskin, (Chicago, 1957), pp. 230.

settlements of varying sizes ranging from a small hamlet performing a few simple functions such as providing primary education for a small contiguous area upto a large city with a large tributary area composed of the service areas of many smaller settlements and providing more complex services such as university and college education, large scale banking and the like. Services performed purely for a surrounding area are termed "central functions" by Christaller and the settlements performing them 'Central places'. The term 'Central Place' must be understood in a slightly different sense from 'urban place' whose chief functions are related to the occurence of particular natural resources or location along transportation routes connecting major sources of raw material with markets.

The centrality of a settlement can be described in terms of quality and quantity of central functions performed by the settlement. The central functions by their very nature are available in a few settlements but are availed of by a number of settlements. Thus the central functions are essentially non ubiquitons in nature. The quality of a central functions is normally affected by (i) the number of different types of functions offered and (ii) by the level at which they are offered. Just as not all the settlements perform all the functions in the same proportion, similarly every settlement does not perform all the functions at the same level.

The hierarchy of settlement is associated with the hierarchy of central functions. The latter could be determined by considering the individual central functions such as education, health, transport and communication, recreation and others separately and by distinguishing their component parts. A central function is composed of many sub functions and thus within a particular function, it is possible to identify levels at which it is being performed. For instance, educational service can be performed at primary school, middle school, high school, college and university level. On such a basis, it is possible to construct a scale of functional hierarchy. Thus the term settlement hierarchy denotes a ranking of settlements into successive groups on the basis of the functions performed by them. The idea of hierarchy is that there exists a discrete class of central places and associated group of functions organised together in a nesting pattern.

The three basic principles which Christaller selected to distinguish the hierarchical system in a region are -

(i) The marketing principle

(ii) The traffic principle

(iii) The administrative principle

In the marketing principle, the nesting of central places will occur according to K = 3 rule whereas in the other two principles it will be in accordance with k = 4 and K = 7 rules respectively.

IV.3 Method of Analysis

In the present study all the central functions like education, medical, transport and communication, credit facilities, recreation and others are considered to construct the composite score for each settlement. Informations on central functions were culled out from the Town and Village Directories published by the Census Organisation. The component parts of each function have been noted with their existence in the centre and their assessment has been made.

As stated earlier, a central function is not very homogeneous in nature and consists of several sub functions. For example, educational facilities are provided by primary schools high schools, colleges and other institutions of higher learning. It is not proper to give equal weightage to these functions while constructing a composite score as they are often even qualitatively different. To minimise arbitrariness and subjectivity, weights to different sub functions were assigned on the basis of the principle that greater the scarcity, the greater is the importance in terms of centrality and therefore higher the weightage[2].

---

2. The formula for determining the weightage can be expressed mathematically as follows :

$$W_i = \frac{N}{F_i} \quad \text{and} \quad C_j = \sum_{i=1}^{K} W_i \, x_{ij}$$

F_i - total number of units offering the ith function/ sub function in the city hinterland
N - Total number of settlements in the city hinterland
W_i - Weightage to the ith function/sub function

(cont.)

If a settlement has two or more units offering the same function or sub function, the weightage was multiplied by the number of units offering that function in the settlement. Suppose a settlement has three banks, this settlement will be awarded 26.97 points i.e for each bank it will get 8.99 which is the weightage for banking function. This method has been adopted because when more than one unit gets located in a settlement that enhances the centrality of the settlement, making its hinterland more dependent on that central place.

On the basis of the above considerations, the major functions, sub functions and their weightages are given in Table IV.1.

Once the composite scores were obtained for each settlement, the next step was to classify the settlements into different levels of hierarchy. Any quantitative approach presents certain technical difficulties. After a number of trials with different approaches, a very simple method was decided upon for categorising the settlements in terms of five levels of hierarchy - metropolis, service centres, partially dependent settlements, dependent settlements and

---

foot note 2 cont. :

K - Total number of functions/sub functions
C_j - Composite score of centrality for jth settlement
x_{ij} - Number of units offering the ith function/sub function in the jth settlement

Ref. : Dr. L.S. Bhat, Micro Level Planning : A case study of Karnal Area, Haryana India (K.B. Publications, New Delhi, 1976), pp. 60.

TABLE - IV.1

Weightages for Central Functions

Function and sub function	Number of units offering the functions	Weightage
Education		
Primary school	1014	0.74
Middle school	449	1.66
High school	271	2.75
College	30	24.87
Medical		
Dispensary/maternity and child welfare centre/Health centre/ medical practitioner	239	3.12
Hospital/Nursing Home	112	6.66
Transport & Communication		
Post office	326	2.29
Telegraph office	127	5.87
Telephone	75	9.95
Bus stand/Bus stop	61	12.23
Railway station	27	27.63
Recreation		
Cinema halls	81	9.21
Credit Facilities		
Co-operative societies	442	1.69
Banks	83	8.99
Others		
Library/Reading Room	211	3.54

totally dependent settlements. The classification was based on the gaps in composite score.

IV.4 Results of Analysis

The table IV.2 shows the total number of settlements grouped into different hierarchical classes according to their centrality score. The hierarchical levels shown in the table are not sharply defined steps in a ladder from level I to level V. The distinction between settlements in the lower level and the higher level is better described as a gradient or a slope. There is not probably much difference between the lower settlements in level II (according to the composite index ranking) and the higher settlements in level III. However it should be stressed here that the ranking of these settlements is less significant than the characteristics of the settlements in each level as a group.

However, two significant things emerged from the analysis of the composite scores. (1) First it has been observed that functions tend to cluster around certain levels of functional hierarchy. That is a settlement having a high school is more likely to have a post office and a co-operative society as well than a settlement which does not have a high school. Thus service institutions tend to hang together in a manner what Dickinson calls as 'trait complex'[3] (2) Another significant

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3. Robert E. Dickinson, The city Region in Western Europe (Routledge and Kegan Paul Ltd., London) pp. 47 - 59.

TABLE - IV.2

Distribution of Settlements by Hierarchical Class

Hierarchical level	Category of Centre	Centrality score point	No.of central functions performed	Total no. of settlements**
I	Metropolis	> 500	All the 15 functions	1
II	Service Centres	50-500	9 to 15	20
III	Partially dependent settlements	10-50	5 to 8	84
IV	Dependent settlements	1-10	2 to 4	283
V	Totally dependent settlements	< 1	Nil or 1	358

** Out of 807 settlements in the city-hinterland 5 settlements are uninhabited, fifty are merged with neighbouring settlements and for six settlements data on central functions are not available.

feature which can be seen from Table IV.2 also is that with an increase in the level of hierarchy (or composite score) the settlements show a decline in number.

Madras Metropolis

Madras is the functional node of the region and occupies the apex position in the hierarchy. It holds a primate status over the hinterland centres and has dwarfed the lower order settlements leaving a hiatus between Ist order and the next order settlements. It has a centrality score of 5034 while the next most important centre in the hinterland, Tambaram has scored just 357 points. Madras has full extensions in all functions and hundrefold duplication of the same function. There are 330 primary schools, 261 middle schools, 178 high schools and 23 colleges in the city. It has 84 dispensaries and 73 hospitals. 122 post offices and 65 telegraph offices are located within the city. Besides these, there are 39 banks, 240 co-operative societies and 62 cinema theatres.

Service Centres

Twenty settlements have qualified for being called service centres. These settlements provide functions which the lower order settlements do not have such as bus stand, railway station, telegraph facilities, banks, cinema halls. In this class, 13 settlements have hospitals and 4 settlements have colleges as well. Since these settlements are fewer in number, they command a relatively larger tributary area becaus

of their wide ranging functions. The names of the service centres are Villivakkam, Thiruvottiyur, Ambaltur, St. Thomas Mount, Alandur, Kathirakkam (U), Meenambakkam, Avadi, Pallavapuram, Poovirundavalli, Tambaram, Madavaram, Ponneri, Thiruninavoor, Sri Perumbudur, Thiruvallur, Minjur, Kathivakkam (R), Palayagummidipoondi, and Singaperumalkoil. Except the last mentioned four settlements, all others are towns. It must however be noted that there are sixty two towns in the hinterland and forty six of them could not make the grade to service centres. The towns which are disqualified for being considered as service centres are mostly class VI towns. They lack high school, hospital, banking, entertainment facilities etc. and are usually near Madras city or some other larger towns which have usurped many of their central functions. With the exception of Arni and Pulicat which are small agricultural towns, the disqualified towns are contiguous to Madras city or some other big towns. Because of the shadow effect of the city and other towns, these towns could not acquire sufficient number of central functions commensurate to their size and urban status. Besides this, these towns do not enjoy a tributary area of their own because of their being spatially contiguous to Madras city or some other dominant town. On the other hand, rural settlements like Kathivakkam (R), Minjur, Palaya Gummidipoondi and Singa Perumal Koil are located 10 miles to 30 miles away from Madras city and are not spatially contiguous to any town. This has helped them to develop a tributary area of their own

by acquiring many central functions which normally do not belong to rural areas and to ascend the pyramid of settlement hierarchy.

Partially Dependent Settlements

This category includes eighty four settlements. These settlements have either a dispensary or maternity and child welfare centre, a telegraph office, reading room etc. in addition to some or all of the facilities of the lower order settlements. 57 settlements of this class have either a dispensary or maternity and child welfare centre or health centre or a medical practitioner. Telegraph offices are found in 50 settlements and reading rooms in 62 settlements.

Dependent Settlements

Next to totally dependent settlements, this category has the largest number of settlements i.e. 283 in number. By and large these settlements have besides a primary school, a middle school or high school, a post office and co-operative society. To be more precise, of the 283 settlements in this category, 101 have middle schools, 34 have high schools, 122 have post offices and 195 have co-operative societies.

Totally Dependent Settlements

Of the total 746 settlements taken for the study, 358 settlements have come under this category. Primary education is the most ubiquitous of all central functions, their

weightage in the centrality score being just 0.74. If the 1014 primary schools in the region when evenly distributed among all the 746 settlements, every settlement must have atleast one primary school. Unfortunately that is not the case. There is greater concentration of primary schools in the towns and the primate city Madras. A consequence of this is that 151 settlements in this category have to go without even a primary school. The remaining 207 settlements have however one primary school each. The settlements in this category are totally dependent on some other settlements for many of the basic amenities of life. The maximum number of settlements occur in this category and they occupy the lowest rung in the hierarchy of settlements.

IV.5 Comparison with theoretical hierarchy of Settlements

The hierarchical structure of settlements situated in the city-hinterland has been examined in detail and the results presented in Table IV.3 for comparison with Christaller's central place model.

There is a proliferation of service centres numbering twenty which is much greater than the model calls for. There are 4.4 partially dependent settlements for every service centre and it has some resemblance to Christaller's K = 4 traffic principle. Similarly there are 3.4 dependent settlements for every partially dependent settlement and this closely approximates to Christaller's K = 3 marketing principle. Totally dependent settlements occupying the last rung

TABLE - IV.3

Comparison of Number of Settlements in Madras city hinterland with other representative hierarchies

Hierarchical Class of Settlement	Actual no. of settlements	Actual K value	Expected Number of settlements by Christaller's model K = 3	K = 4	K = 7
Metropolis	1	20.0	1	1	1
Service centre	20		2	3	6
Partially Dependent settlements	84	4.4	6	12	42
Dependent settlements	283	3.4	18	48	294
Totally dependent settlements	358	1.3	54	192	2058

in the hierarchy do not confirm to any of the central function principle.

A close look at map - fig. 1 shows that even the semblance to Christaller's principle noticed in the case of middle hierarchical classes is more apparent than real. The settlements of different hierarchical classes are not organised in a nesting pattern over space. There is greater concentration of higher order settlements near the core city and disproportionately large number of lower order settlements in the peripheral area. The following Table IV.4 will make the position clear.

TABLE - IV.4

Distribution of Settlements by hierarchical Class and by Zone

Hierarchical class of settlements	Zone of metropolitan dominance		Zone of metropolitan sub dominance		Rural Hinterland	
	No. of settlements	%age distribution	No. of settlements	%age distribution	No. of settlements	%age distribution
1. Service Centres	12	22	7	2	1	0.2
2. Partially dependent settlements	16	29	52	19	16	4
3. Dependent settlements	10	18	98	35	175	43
4. Totally dependent settlements	17	31	123	44	218	53
Total	55	100	280	100	410	100

The table IV.4 demonstrates the uneven distribution of different orders of settlements among the three zones. The zone of metropolitan dominance which immediately surrounds the core city is heavy at the top with greater share of higher order settlements and fewer lower order settlements. On the other hand rural hinterland is heavy at the bottom with fewer higher order settlements and a large number of lower order settlements. The zone of metropolitan sub dominance has a pattern that lies some-where between these two extremes.

The departure from the norm may be attributed to several reasons. Our analysis is based on the data of Census organisation which takes cognisance of institutionalized central functions only. It is quite possible that the needs of the villagers in the rural hinterland are still served by traditional forms of medicine, finances, personal service, education, the availability of which reduces their dependence not only on the city but also on the other service centres.

Moreover, it must be noted that Christaller's central place model is found to work best in semi industrialised agrarian regions. But Madras city and its immediate environs are highly industrialised. It appears that the distinct socio-cultural and economic characteristics of the Madras metropolitan area definitely tell upon the norm and cause deviation.

IV.6 Functional specialisation of service centres and city

The city and the settlements designated as service centres perform central functions to the smaller settlements in the hinterland. Besides, these vital services are not performed in the same proportion by all the service centres or the city. Many of the service centres render service not only for the rural population around them but also for each other and tend to specialise in certain functions. This means that their orbit of exchange of services is expanding far beyond the adjacent territory leading to greater territorial interdependence. Thus in a study of city-hinterland relationship, a concern for the individual service centre is not only warranted but also necessary to explain why a particular service centre possesses certain unique functional characteristics and not others. The most practical method of classifying the service centres on the basis of their specialised function is by analysing the occupational structure of each service centre.

IV.7 Method of Analysis

Nelson's[4] method of standard deviation which is quite simple and widely understood has been used in this study. The classification of service centres is based on 1971 census

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4. Howard, J. Nelson, 'A Service Classification of American Cities', Economic Geography, Vol. 31 1955, pp. 189 - 210.

data on population.[5] First the percentage of workers engaged in each industrial category was worked out for all the 20 service centres and also for Madras city. These percentage values formed the basic data for analysis and classification. The importance of a function in a service centre was then evaluated relative to the status of that function in all the service centres in the hinterland. For this purpose, the mean of these percentage values and their standard deviation were computed for each of the industrial category.

The standard deviation from the mean was used as the criterion for recognizing the most important function of the service centre. If the positive deviation from the mean percentage value is more than 1 S.D., only for one industry, that service centre has one predominant function. This was referred to as monofunctional service centre. Some service centres had positive deviations of more than 1 S.D. from the mean in two industries. These were classified as bifunctional service centres. Those service centres which had positive deviation of more than 1 S.D. in three functions were classified as trifunctional service centres.

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5. The Census has classified the workers into 10 industrial categories. They are (i) cultivators, (ii) agricultural labourers, (iii) live stock, forestry, fishing, hunting and plantations and allied activities, (iv) mining and quarrying, (v) household industry, (vi) manufacturing other than household industry, (vii) construction, (viii) trade and commerce, (ix) transport and communication and (x) services.

   In this study categories I and II have been clubbed together as "agricultural" thereby reducing the total number of industrial categories to nine.

In some service centres, the positive deviation was 2 or 3 S.D's from the mean. This showed the greater degree of specialisation in that particular function. Therefore the service centres were further classified according to the degree of variation from the mean as follows.

i. Service centre of low specialisation : Mean + 1 S.D.

ii. Service centre of moderate specialisation : Mean + 2 S.D.

iii. Service centre of high specialisation : Mean + 3 S.D.

The results of the classification are given in the following three tables.

TABLE - IV.5

Distribution of Service Centres by Functional Type

Functional Type	No. of service centres
Mono functional	13
Bi functional	7
Tri functional	1
Total	21

TABLE - IV.6

Distribution of Service Centres by their predominant function and degree of specialisation mono functional service centres

	Predominant function	Service centre of low specialisation Mean + 1 S.D.	Service centre of moderate specialisation Mean + 2 S.D	Service centre of high specialisation Mean + 3 S.D.	Mean values for the function	Standard deviation
I	Agriculture	-	1 Sri Perumbudur	-	15.34	16.76
II	Live stock, fishing etc.	1 Madavaram	-	-	3.87	6.89
III	Mining and quarrying	-	-	-	-	-
IV	Household industry	1 Pooneri	2 Thiruninnavoor Singa Perumal Koil	-	1.26	1.01
V	Manufacturing other than household	4 Villivakkam Thiruvotiyur Ambattur Pallavapuram	-	-	26.14	14.29
VI	Construction	1 Alandur	-	-	3.19	1.78
VII	Trade & commerce	-	-	-	16.10	4.98
VIII	Transport & communication	-	1 Meenambakkam	-	11.59	5.99
IX	Services	1 Avadi	1 St. Thomas Mount	-	22.24	8.69

TABLE - IV.7

Distribution of Bi functional and Tri functional Service Centres

Functional combination	No. of service Centres	Name of service centres
Bi functional		
i. Agriculture & House-hold Industries	2	Minjur, Palayagummidipoondi
ii. Livestock, Fishing and Construction	1	Kathivakkam town
iii. Livestock, Fishing and Services	1	Kathwakkam village
iv. Household Industries and Trade	2	Poovirundavalli, Thiruvallur
v. Services and Construction	1	Tambaram
Tri functional		
Trade, Transport and Construction	1	Madras city

IV.8 Results of Analysis

The study has revealed that 13 service centres are mono functional, 7 bi functional and 1 tri functional. A detailed account of the service centres by their functional specialisation is given in Appendix I. Fig. IV.1 shows their spatial distribution. A few tentative generalisations can be made from their spatial pattern in so far as it relates to city's influence on their functional specialisation.

The core city's functions are diversified and more broad based in non primary sector than any other service centres. Its specialisation is in trade and transport. To a lesser extent, it is also a centre of manufacturing and services.

In constrast, the centres in the zone of metropolitan dominance show a tendency towards specialisation in manufacturing. Examples of this type are Villivakkam, Tiruvotiyur, Ambattur and Pallavapuram. All these towns are industrial sub urbs of Madras city. Besides, nearness and greater accessibility to the core city, give rise to the emergence of residential sub urbs like Tambaram and dairy centres like Madavaram.

A little farther away in the zone of metropolitan sub dominance, the centres tend to specialise in household industries. Thiruninnvoor, Singaperumal Koil, (uni functional

category), Pallaya Gummidipoondi, Poovirundavalli, and Tiruvellore (bi functional category) lend weight to this conclusion.

Farthest away, in the rural hinterland, the only service centre namely Sriperumbudur has a strong agricultural base.

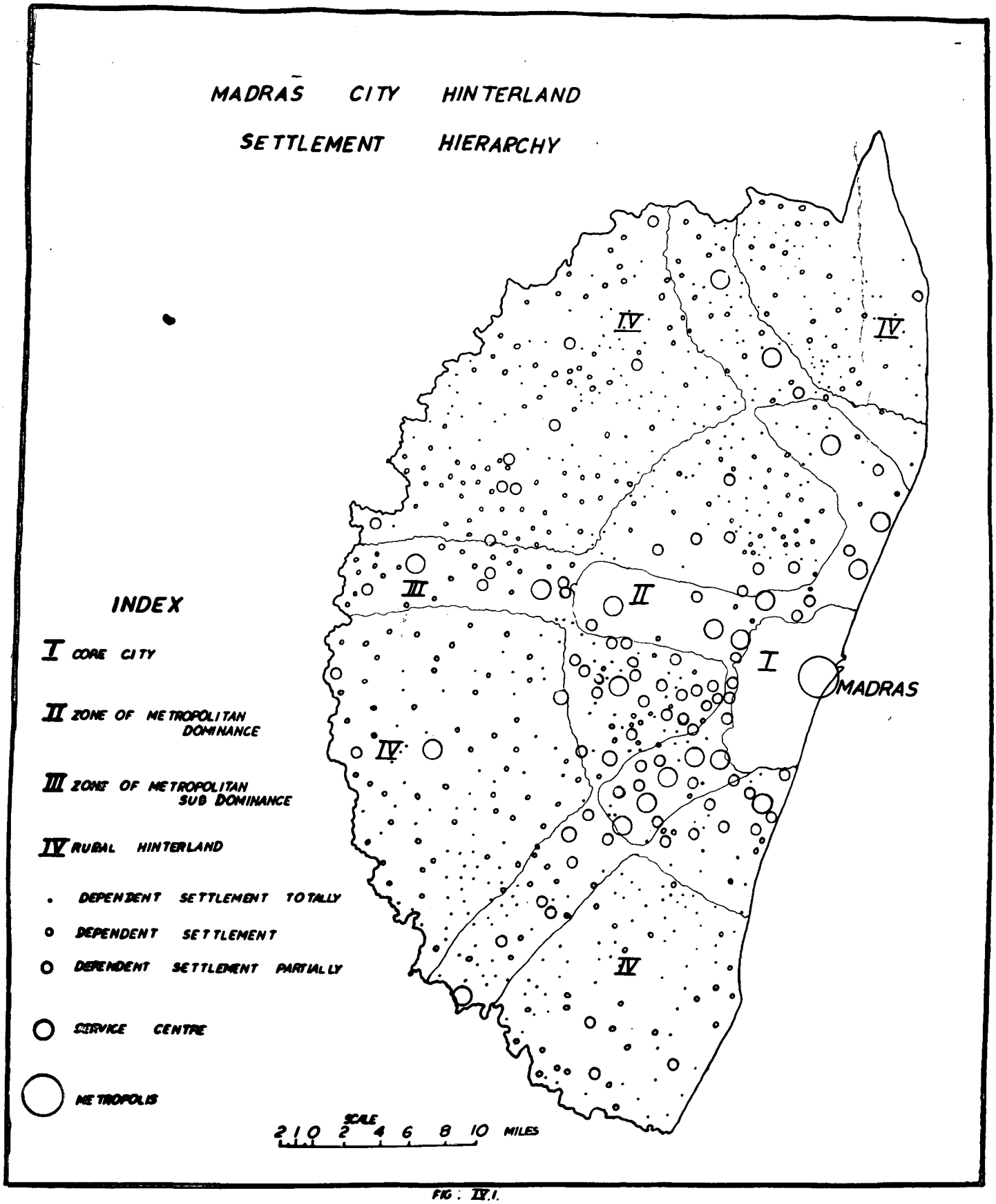
MADRAS CITY HINTERLAND
SETTLEMENT HIERARCHY
INDEX
I CORE CITY
II ZONE OF METROPOLITAN DOMINANCE
III ZONE OF METROPOLITAN SUB DOMINANCE
IV RURAL HINTERLAND
DEPENDENT SETTLEMENT TOTALLY
DEPENDENT SETTLEMENT
DEPENDENT SETTLEMENT PARTIALLY
SERVICE CENTRE
METROPOLIS
SCALE
2 1 0 2 4 6 8 10 MILES
MADRAS

FIG : IV.1.

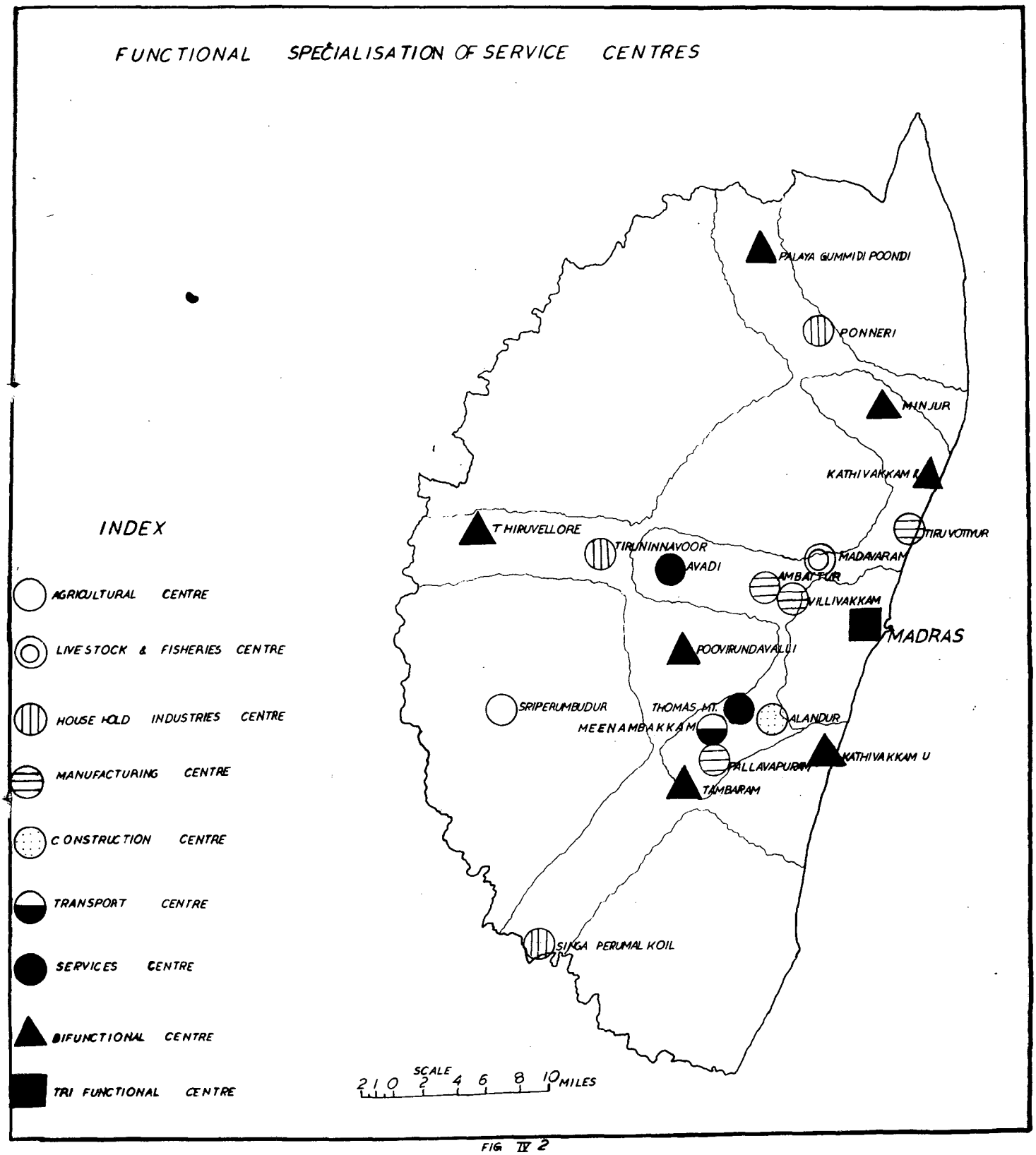
FUNCTIONAL SPECIALISATION OF SERVICE CENTRES
INDEX
AGRICULTURAL CENTRE
LIVESTOCK & FISHERIES CENTRE
HOUSE HOLD INDUSTRIES CENTRE
MANUFACTURING CENTRE
CONSTRUCTION CENTRE
TRANSPORT CENTRE
SERVICES CENTRE
BIFUNCTIONAL CENTRE
TRI FUNCTIONAL CENTRE
PALAYA GUMMIDI POONDI
PONNERI
MANJUR
KATHIVAKKAM
THIRUVELLORE
TIRUNINNAVOOR
AVADI
THIRUVOTTIYUR
MADAVARAM
AMBATTUR
VILLIVAKKAM
MADRAS
POOVIRUNDAVALLI
SRIPERUMBUDUR
THOMAS MT.
MEENAMBAKKAM
ALANDUR
PALLAVAPURAM
KATHIVAKKAM U
TAMBARAM
SINGA PERUMAL KOIL
SCALE
2 1 0 2 4 6 8 10 MILES

FIG IV 2

CHAPTER - V

SPATIAL PATTERN IN SETTLEMENT HIERARCHY

V.1 Introduction

The preceding chapter has described how a system of service centres and other lower order settlements exist in the metropolitan hinterland and how some of the service centres have developed unique functional attributes in a metropolitan setting. In the ideal case, the spatial distribution of settlements of different orders should display a nested hexagonal form, with each settlement at a certain level in the system serving a set number of settlements at the next lower level. Such perfection in spatial organisation is never achieved partly because the real world is not as simple as suggested in the assumptions of Christaller's model. In part it is because of the model's failure to deal with dynamic processes including the time lag between population growth and development of central functions and locational inertia etc. It is also true that the theory is only partial representation of urban functions since it ignores the industrial role of urban centres focussing only on tertiary activities.

Therefore the question arises whether there is any identifiable pattern in the spatial distribution of settle-

ments in a metropolitan hinterland. This question assumes importance because a metropolitan hinterland possesses unique physical make up largely result of man's interaction, a distinct metropolitan economy and society and its service centres have developed unique functional attributes. This chapter therefore searches for uniqueness in the spacing of settlements of different orders in the hierarchy and the areal extent of tributary areas of settlements designated as service centres.

V.2 Inter Settlement Distance

The distance separating settlements sets limits relative to the mode of transportation and communication, on the flow of goods and services between them. Besides, the distance separating service centres, gives us an idea of the effectiveness of services being discharged by centres to continuous areas around them. An analysis of the inter settlement distanc has been done by computing spacing index[1] in miles for all

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1. The formula for spacing index can be expressed

$D = 1.0746\ d^{-1/2}$ where D is the theoretical distance between settlement points in a hexagonal arrangement and d is the density of settlements per unit area (square mile).

The formula can be expressed otherwise as follows

$D = 1.0746 \sqrt{\frac{A}{N}}$ where D is the theoretical distance between settlements, A is the total area of the hinterland and N is the number of settlements in the hinterland.

Ref. Ranab P.B. Singh, Pattern Analysis of Rural Settlement - Distribution and their types in Saran Plain : A Quantitative Approach, N.G.J.I., Vol. 20, 1974, pp. 109-127. Reprinted in R.L. Singh et al (ed.) Readings in rural settlement geography - (National Geographical Society of India, Varanasi)

settlements and for settlements in different hierarchical class. The spacing index indicates the locational arrangement of settlements with reference to one another under conditions of an even spatial distribution. This hypothetical mean distance between settlements was compared with the mean of actual distances of settlements from their nearest neighbours.[2] The results are shown in Table V.1.

TABLE - V.1

Actual and Hypothetical Mean Distance between Settlements and their nearest neighbours

Hierarchical class of settlements	No. of settlements	Actual mean distance between the settlement and its nearest neighbour	Hypothetical mean distance under condition of an even distribution
Metropolis	1	-	-
Service Centres	20	4.62	8.81
Partially dependent settlements	84	2.16	3.94
Dependent settlements	283	1.11	2.04
Totally dependent settlements	358	0.77	1.42

2. For computing the mean of actual distances, a series of straight line measurements were taken between each settlement and its nearest neighbour. The nearest neighbour in this context should be one that occupies the same or higher level in the hierarchy. In addition it was often the case that two settlements of the same and higher order were located closer to one another than they were to any other settlement of the same or higher order. In such situation, the same distance was naturally considered twice.

The figures in Table V.1 indicate what the mean (average) distance between settlements and their nearest neighbour of the same or higher order would be under a condition of an even spatial distribution of settlements throughout the hinterland. Comparisons of the actual and hypothetical mean distance figures reveal that the latter exceed the former in all levels of hierarchy. There is also correspondence between spacing and the level of the hierarchy of settlements. The higher order settlements are more widely spaced than the lower order settlements. The fact that the service centres are located at about 4.6 mile interval leads to the conclusion that the basic distance factor was the time and effort required to get to any service centre by bicycle or on foot.

V.3 Degree of Dispersion or Clustering of Settlements

The spacing index does not tell the whole truth about distribution pattern of settlements. It does not help us in distinguishing three kinds of basic distribution of points (settlements in an area) namely (i) uniform (ii) random and (iii) cluster. We need a single index for any given pattern running on a continuous scale i.e. from one extreme where all the settlements are clustered to the other extreme where all the settlements are distributed uniformly. King's[3] method

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3. The technique was originally developed by plant ecologists Clark & Evans (1954) who were concerned with the distribution of plant species over the earth. The near neighbour analysis indicates the degree to which any observed distribution of points deviates from what might be expected if the points were distributed in a random manner within the

(contd.)

of analysis of urban settlements of the U.S. provides a precise quantitative approach. His method of near neighbour analysis has been applied for the study of distribution pattern of settlements and the results are given in Table V.2.

Footnote 3 cont.

same area. Now a random distribution of points is defined as a set of points on a given area for which any point has had the same chance of occuring on any sub surface as any other point, that any sub area has had the same chance of receiving a point as any other sub area of that same size and that the placement of each point has not been influenced by that of any other point. Now the ratio of the observed mean distance RA to the expected mean distance RE is termed the near neighbour statistic Rn. This ratio RA/RE has a range in value from 0 when there is complete clustering through 1 which represents a random distribution upto 2.15 which is expressive of uniform spacing analogous to Christaller's hexagonal arrangement. Hence the ratio for various categories of settlements can be compared with one another and it thereby provides a meaningful and precise expression of the pattern of distribution. The Rn value can be derived from the formula :

$$Rn = \frac{RA}{RE} \quad \text{where}$$

$$RE = \frac{1}{2\sqrt{\frac{N}{A}}} \quad \text{where}$$

N - number of settlements in the area

A - Area

The standard error of the expected mean distance is

$$\sigma RE = \frac{0.26136}{\sqrt{N^2/A}}$$

If the value of Rn falls between 0 and 1 or between 1 and 2.15, the distribution pattern can be explained as approaching cluster or approaching uniformity respectively provided that the value of RE is significantly different from RA. Otherwise the pattern should be considered as random and the difference between RA and RE is attributable to the chance factors only.

(cont.)

TABLE - V.2

NEAR NEIGHBOUR TECHNIQUE INDEX

Hierarchy of Settlement	RA	RE	Rn	SE	Z*	Pattern of distribution
Metropolis	-	-	-	-	-	-
Service Centres	4.62	4.17	1.11	0.46671	0.96419	Random
Partially dependent settlements	2.16	1.85	1.17	0.09367	3.30949	More regular than random
Dependent settlements	1.11	0.96	1.16	0.02537	5.91249	- do -
Totally dependent settlements	0.77	0.66	1.17	0.01218	9.03119	- do -

* The significant departure from random at 1% level and 5% level are 2.58 and 1.96 respectively

The figures in the table V.2 indicates that precise spatial pattern of service centres exhibit considerable disturbance. Deviation in spacing tends to be less for lower order settlements. The totally dependent settlements, dependent settlements and partially dependent settlements exhibit a marked tendency of uniformity in spacing. Such uniformity at lower level may be attributed to the uniformity of the surface.

The spatial distribution of service centres indicates randomness. The Fig. V.1 shows that the service centres are strung at short intervals along the three important routes radiating from the metropolis. The pattern confirms our general knowledge that in a highly industrialised area like Madras metropolitan region, the central place scheme is generally distorted by industrial concentration in satellite towns in response to market demand and transport network alignment besides by the emergence of dormitory towns around the core city.

V.4 Tributary Areas of Service Centres

Service centres do not grow up of themselves. Their

Footnote 3 cont.

$$\nabla Z = \frac{RA - RE}{RE}$$ is a standard normal variate and is used to test the significance of the difference between RA and RE.

Ref. : King, L.J., 'Quantitative Expression of Urban Settlement Patterns in the US', Berry and Marble Ed. Spatial Analysis, (Prentice Hall, 1969), pp. 159-171.

tributary areas set them up to do tasks that must be performed in central places. Every service centre or central place performs central functions for a surrounding territory known as tributary area.

Delimitation of the tributary area of service centres has been attempted on the basis of the mid-distance between the centres of the same order or higher order. Thiessen[4] Polygons are drawn to mark the areal extent of the tributary areas of each service centre and this has been shown in map fig. V.1. A superimposition of this map, over fig. IV.1 has yielded the results given in Table V.3.

The Table V.3 gives the average size of tributary area and the average number of lower order settlements in each tributary area for the three zones.

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4. Thiessen Polygons were originally used by the U.S. Weather Bureau in generalising the rainfall of a given water catchment from a network of meterological recording stations. The following steps are involved in drawing the boundaries of the Polygons.

   a. First lines are drawn joining a given centre to each adjacent centre.

   b. Each of these inter centre lines is bisected to give the mid point of the line.

   c. From mid point of the line, a boundary line is drawn at right angles to the original inter centre line to give a series of polygons.

   The validity of the method lies in two assumptions -
   1. The first is that the area within the intersecting boundary lines of the polygon lies nearer to the enclosed centre than to any other centre. This is a simple geometric property of the Thiessen Polygon.

(contd.)

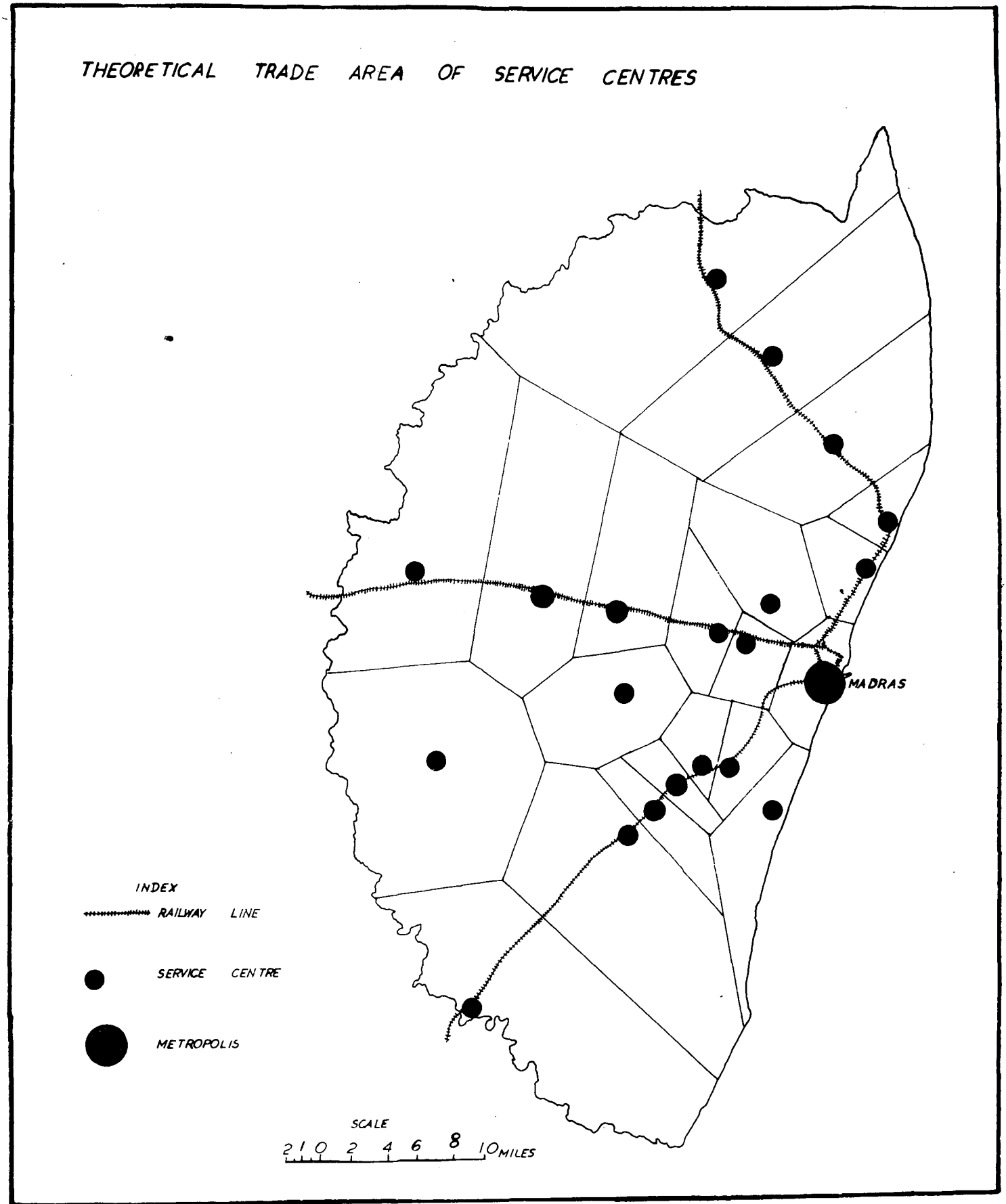
THEORETICAL TRADE AREA OF SERVICE CENTRES
MADRAS
INDEX
RAILWAY LINE
SERVICE CENTRE
METROPOLIS
SCALE
2 1 0 2 4 6 8 10 MILES

FIG: V. 1.

TABLE - V.3

Average size of Tributary Areas and Average Number of lower order settlements by zone

Zone	Name of service Centre	Average size of tributary area in sq. miles	Average no. of lower order settlements in the tributary area
Zone of metropolitan dominance	Villivakkam, Thiruvotiyur, Ambattur, Madavaram, St. Thomas, Alandur, Kathivakkam (R), Meenambakkam, Avadi Pallavapuram, Minjur, Tambaram	39.4	18
Zone of metropolitan sub dominance	Kathivakkam (U), Poovirundavalli, Poonneri, Thiruninnavoor, Palayagummidipoondi, Singaperumal Koil, Thiruvallur	111.1	63
Rural Hinterland	Sriperumbudur	139.0	67

The service centres are closely packed in the zone of metropolitan dominance near the overall nodal point. But away from the core city, in the zone of metropolitan sub dominance and in the rural hinterland, the service centres are located farther apart. As a result the average size of tributary area in the zone of metropolitan dominance is just 39.4 sq. miles whereas it is 111.1 sq. miles in the zone of metropolitan sub dominance and 139.0 sq. miles in the rural hinterland.

The service centres located on the peripheral area in rural millieu have to cater to a large number of lower order settlements whereas the service centres in the zone of metropolitan dominance have fewer/lower order settlements dependent on them. The lower order settlements in the peripheral area particularly those in rural hinterland are however very small in population size and mostly hamlet type of settlement. On the other hand, the lower order settlements in the zone of metropolitan dominance, though fewer in number are large in terms of population size and most of them are class V or class VI towns.

The changing size of tributary areas, near the core city confirms the operation of agglomeration economics. Such

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Footnote 4 contd.

2. The second assumption is that a service centre dominates all the area that lies geometrically nearest to it.

Ref. : Peter Hagget, Locational Analysis in Human Geography (Edward Arnold, 1965), pp. 247.

distortion in hexagonal pattern is termed by Peter Hagget[5] as 'Distortion by Agglomeration'. Near the core city, the population density is high and within a small tributary area, there is sufficient population threshold to support the central functions, and therefore service centres emerge in close proximity to one another. Therefore the tributary area shrinks in size, the nearer their location to the core city.

Another interesting feature of the tributary areas of the service centres relates to their shape. The service centres which are not on any major transport routes have tributary areas resembling hexagons. On the other hand service centres on the transport routes do not approximate to ideal circular or hexagonal shape but are elongated at right angles to the main transport lines.

To sum up, in a metropolitan setting the hexagonal form appears to lose its significance as a spatial form. The nearness to the core city and the orientation of transport routes assume greater importance in controlling the size, shape and also the number of lower order settlements coming into the orbit of each service centre.

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5. Peter Hagget, Locational Analysis in Human Geography (Wdward Arnold, 1965), pp. 92.

CHAPTER - VI

SUMMARY AND CONCLUSIONS

The purpose of this chapter is to recapitulate the specific findings and general conclusions arrived at by the study of Madras city's inter-relationships with hinterland.

Madras is a primate city in the surrounding area. The analysis of the demographic and socio-economic indicators reveals that its hinterland extends about thirty miles and beyond this territory its urban influence fades out.

An analysis of the population data of the hinterland shows more or less typical concentric zones surrounding the core city, successive zones revealing less urban acculturation as one goes outward from the city. But this change is not uniform or consistent in all directions. First the presence of cheap public transport system - sub urban railways - greatly affects this relationship. The settlements situated on the corridors have more pronounced urban characteristics than those interstitial settlements situated at the same distance from the city. Besides, in the study area, all economic and social activities do not focus on one single city, but on several sub centres scattered over the area. Therefore, the

urban indices fluctuate slightly from zone to zone depending whether or not that zone has any major satellite towns.

Despite these fluctuations, there is a discernible trend in the urban indicators chosen for analysis. First of these indicators relates to demographic characteristics. The location of a city is both cause and effect of pattern of population distribution. This is reflected in the decline of population density with distance from the central city. Another demographic indicator examined is the sex ratio. Because of the male selective migration to the city and its immediate environs, the city population and the populations of its neighbouring settlements are expected to be more masculine than the hinterland population. The study has confirmed the hypothesis that the sex ratio gets more balanced with distance from the city.

Indicators of socio-cultural relationship were examined next. Because of its greater advance in social organisation and the techniques of social services, the city exerts influence on the hinterland population and this influence tends to decline when the distance friction increases. In our study, the general literacy level of the population declines with distance from the city. Moreover, the differentials between male and female literacy also tend to rise with distance.

Thirdly, the indicators of economic interdependence between city and hinterland were studied. With increasing distance

from city, the labour force participation of the population increases. Along with the trend is noted that the relative importance of primary sector increases while that of the non-primary sectors falls off in the economy. The data have not, however, supported the hypothesis that the sex-ratio among workers will also change with distance.

The last of the indicators of urban influence is social amenities. The study has shown that the level of development of social amenities declines with distance from the city.

On the basis of the degree of impact of the metropolis as revealed by the above indicators, the city and its hinterland were delineated into four broader zones - the core city, the zone of metropolitan dominance, the zone of metropolitan sub-dominance and the rural hinterland. The core city distinguishes itself from the other zones by its greater urban characteristics Next to the core city, the zone of metropolitan dominance shows the maximum influence of the city. The zone of metropolitan sub-dominance reflects the influence of the city rather in a subdued manner. The rural hinterland retains all its rural characteristics.

The study has brought out that there exists a hierarchy of central places in the city-hinterland, though their spatial arrangement is greatly disturbed in a metropolitan setting. They range from the smallest totally dependent settlements to the largest metropolis including a hierarchy of functional

characteristics associated with each hierarchical class. There is thus definite clustering of central functions around each hierarchical class as 'trait complex'. It is also observed that as the rank of a hierarchical class rises, the number of settlements belonging to that class decreases. Thus the study has led to partial verification of Christaller' central place theory. When subject to further scrutiny, the schematic central place models of Christaller is not satisfactory and too simple to portray the cob web of relations existing between the city and hinterland settlements. The different hierarchical classes of settlements are not arranged in a nesting pattern as envisaged in the models nor their distribution over space is even. The zone of metropolitan dominance has a greater share of higher order settlements whereas the zone of metropolitan sub dominance and rural hinterland have to contend with fewer higher order settlements and disproportionately a large number of dependent settlements The distinct socio-economic characteristics of the metropolis appear to distort the spatial arrangement and cause deviation from the norm.

On the basis of centrality score twenty settlements in the hinterland were identified as service centres. The shadowing effect of the city was observed when more than forty towns situated close to the city could not achieve the status of service centres. The towns without sufficient central functions are mostly class VI and spatially contiguous either

to Madras city or another major town. Obviously the city and the major towns have usurped many of the central functions of the smaller towns which are their neighbours. However, paradoxically the zone of metropolitan dominance, which bears the brunt of the city's shadow effect, has many more higher order settlements than the other far away zones namely, zone of metropolitan sub dominance and rural hinterland. The city appears to exert two counteracting influences on the zone of metropolitan dominance. While it encourages the emergence of towns, it smothers the development of central functions in them.

Nearer the location of a service centre to the city, it is more likely to be a manufacturing centre also. These manufacturing centres are really the industrial suburbs of the core city. Unlike these centres, the central city of Madras has a more diversified functional base, with greater accent on trade and transport. The service centres away from the city but lying in the zone of metropolitan sub dominance tend to specialise in household industries. The only service centre located in the rural hinterland has agriculture as the predominant function.

Among the other spatial relationships examined are spacing of settlements, dispersion or clustering of settlements, size and shape of the tributary areas of central places designated as service centres. The inter settlement distance is small in

the case of lower order settlements and greater in the case of higher order settlements. But their distribution indicates that lower order settlements tend to locate at uniform distance, whereas the higher order settlements particularly service centres tend to cluster around the city or along the important transport lines, thus leading to random distribution.

In the zone of metropolitan dominance, the service centres are closely packed at short intervals along the three important transport lines and as a result their tributary area is small in extent. These service centres serve only a small number of large size dependent settlements. On the other hand in the zone of metropolitan sub dominance and rural hinterland, the service centres are located farther apart and therefore they are able to command a larger tributary area. Besides, they perform central functions to a large number of small size dependent settlements. Near the core city, the population is very dense and this agglomeration appears to cause variations in the size of tributary areas at different zones. In the inner zone, a relatively small tributary area, contains sufficient population threshold to support many central functions, while this is not the case in the outer zones.

The service centres which are on major transport routes have tributary areas which are elongated at right angles to the transport lines. In contrast, the tributary areas of the

service centres in the interstitial sectors have some resemblance to hexagons.

The study has thus brought out that physical proximity and accessibility provided by transport lines are two important factors which determine the degree of dependence between city and its hinterland. They also, to a large extent, control the functional interdependence between settlements and give rise to distinct patterns in the arrangement of settlements over space.

By studying a sufficiently large number of individual city-hinterlands, as has been done for Madras, we can form inductively some generic principles underlying spatial relationship. The pattern and magnitude of city hinterland relationship may vary with the size and character of cities under study. This will, in turn, lead us to the recognition that the individual city-hinterland may be viewed both as a unique phenomena and as variant of a general theme.

One important result of the present study is the revealation that generality of the principle of city-hinterland relationship extends over many kinds of data - demographic, social, economic and infrastructural.

The urban influence of Madras city extends about thirty miles only as is evident from the trends in urban indices. Thus the areal extent of the influence of Madras city is reall small. This is in contrast with the metropolises of the

western world whose urban influence is felt well over 300 miles from the central city.[1] This reflects that the organizing and integrative influence of the metropolis over its hinterland is much stronger in the western world.

Marked variations in the slopes of the gradients are also noticed. For instance, the overall gradient of population density is steeper in Madras because of the greater friction of the space in human interaction which is little different from those in the western countries. In western cities, the transport system is more flexible because of the advent of automobile age and increasingly large number of people take up residence in the sub-urban fringe.[2] The poorer and less mobile social groups of Madras cannot afford sub-urban life on the western pattern and live at relatively higher density in the central city. This is reflected in the steep gradient of population density which falls precipituously from 19293 persons per sq. km. in the central city

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1. Bogue's study of the relationships between metropolis and hinterland for 67 U.S. metropolitan communities revealed that density of population, proportion of urban non farm population and other urban indices showed the dominance of metropolis outward to distances more than 300 miles from the central city.

   Ref. : Judah Matras, 'Population and Societies' (Prentice Hall 1973) p. 103-105

2. Muth has shown that b values for 36 American cities ranged between 0.7 and 1.2 which reveal the gentle gradient of western cities.

   Ref.: Petter, Hagget & Richard, J. Chorley, 'Socio-economic models in Geography', (Methuen 1976), pp. 344-345.

to 2462 persons in the immediately next sub-urban zone. Certainly, this steep gradient may not be confined to Madras alone but appear to be a general pattern in many Indian cities.

There is rural-urban difference in the sex composition of population. In the west, the urban communities are predominantly female and rural communities are predominantly male.[3] In Madras, it is the other way round. The higher sex-ratio noticed in the western cities is attributed to better occupational and social advantages which cities make available to women. Thus it is the pull of the western cities that make the females to migrate to cities in large numbers than the males. In Madras, it is the push factors operating in an indigent hinterland that make the men to leave behind their wives and children in the villages and to swell the ranks of migrants to the city. The generality of city hinterland relationship is that people migrate to cities from surrour ding rural areas. But male selective cityward migration is unique to Indian cities while female selective cityward migration is unique to western cities.

There are important historic reasons why cities are located where they are and what they do. Many of the western cities owe their origin and growth to the forces let loose

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3. Thompson & Lewis, 'Population Problems', (T.M.H., 1976), pp. 78 & 79.

by industrial age. Therefore the central city specialises in manufacturing industries, while its sub-urbs flourish as dormitory towns.[4]

On the other hand, the growth of Madras city in the first phase was due to the commercial interest of the British. In the hey days of colonial rule, it was a port oriented town, which met the requirements of imperialist exploitation, by serving as a focal point of a suction mechanism for export-import oriented commodity flows. During the post independence period, which marks the second phase, its growth was due to its being the administrative capital of Tamil Nadu. The main function of Madras city has all along been trade, transport and administration. Therefore the central city of Madras has a huge tertiary sector which accounts for 66% of the labour force of the city and a weak manufacturing sector accounting for just 26% of the labour force. Unlike the central city, its sub-urbs Tiruvotiyur, Ambathur, Villivakkam, Avadi and Pallavapuram to name a few - have a relatively larger proportio of their workers in secondary sector particularly in non-household manufacturing industries. Thus the specificities generated by the historical process have led the central city of Madras to specialise in tertiary activities and sub-urbs to specialise in manufacturing activities.

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4. Lewis, Mumford, 'The City in History' (Pelican Book, 1966), pp. 549-597.

In brief, the city-hinterland relationship of Madras city is unique in its own way. Likewise every city's relationship with its hinterland is unique in its specific details, though each resembles another in its general dependence on the surrounding area, which is called its hinterland.

APPENDIX - I

SERVICE CENTRES AND THEIR FUNCTIONAL SPECIALISATION

I Monofunctional service centres

A. Agricultural centres :

Sri Perumbudur : This is the only monofunctional service centre to have agriculture as the dominant function. This is the administrative headquarters of Sri Perumbudur taluk and situated in rural hinterland.

B. Livestock and dairying centre :

Madavaram : This is the only service centre under this category. This town is in the zone of metropolitan dominance. The importance of the town to Madras city is due to its milk colony and the central dairy located there. Eleven per cent of the total labour force of this town is in livestock and dairying sector. A large share of milk and dairy products consumed in Madras city, comes from this town.

C. Mining and Quarrying centre :

Mining and quarrying centres are conspicuous by their absence in Madras hinterland.

D. Household industry centre :

There are two centres under this category - Thiruninnavoo

and Singaperumal Koil, both located in the zone of metropolitan sub-dominance.

Thiruninnavoor : This is a class V town and has moderate specialisation in household industries, with 3% of the labour force engaged in that sector.

Singaperumal Koil : This is a rural settlement. It has moderate specialisation in household industries with 3% of the labour force so engaged.

E. Manufacturing centres :

Villivakkam, Thiruvotiyur, Ambattur and Pallavapuram have emerged as manufacturing centres. All of them are towns. It is significant to note that all these towns are in the zone of metropolitan dominance.

Villivakkam : This town is contiguous to Madras city and in fact is the industrial suburb of Madras city. A large number of industrial units manufacturing light engineering goods are located here. Fifty two per cent of the labour force in this town is in manufacturing sector.

Thiruvotiyur : As an important industrial centre, it has a large number of factories engaged in the production of a variety of engineering goods, motor cycles, scooters, heavy vehicles, sheet glass etc. Manufacturing workers form 49% of the labour force. This is also an industrial suburb of Madras city.

Ambattur : This is also a thriving industrial centre and forms part of the sub urban industrial complex of Madras city. Important industrial units producing bicycles, cycle spare parts, motor and giant tyres, cycle tyres etc. are located here. It has a large industrial estate also. Manufacturing workers constitute 53% of the labour force in the town.

Pallavapuram : As an important industrial centre, this town specialises in the production of a variety of leather goods, electrical equipments etc. About 40% of the workers are in manufacturing sector.

F. Construction centre :

Alandur : The town is in the zone of metropolitan dominance. Juxtaposed as it is to Madras city, this town seems to provide Madras city with construction workers. Six per cent of the labour force is in construction activities. Besides, this town has an industrial base of its own, with 31% of the labour force employed in the sector.

G. Trade and commerce centre :

No monofunctional centre has passed the eligibility test for qualifying as a trade centre.

H. Transport centre :

Meenambakkam : This is the only monofunctional centre

in this category. Both are in the zone of metropolitan dominance.

Avadi : It has a large number of educational institutions and service sector alone accounts for 31% of the labour force. It has a strong industrial base also with 38% of the labour force in that sector. After the setting up of the clothing factory and the Tank factory both in public sector, Avadi has emerged as another satellite town of Madras city.

St. Thomas Mount : Of all centres, it has the largest proportion of workers in service sector (44%). This may be due to the location of a large number of educational institutions, hospitals and credit institutions in this town.

II Bi functional service centres

A. Agriculture and household industries centres

Minjur and Palayagummidipoondi have come under this category. Both are rural settlements and therefore have a large share of workers in agriculture and household industries. While Minjur is 13 miles away from the core city in the zone of metropolitan dominance, Palayagummidipoondi is 25 miles away from the core city in the zone of metropolitan sub dominance.

B. Livestock, fishing etc. and services centres

Kathiwakkam, a village in the zone of metropolitan

dominance, comes under this category. Being a coastal village, the inhabitants of this settlement look to fishing as an important means of livlihood. Livestock and fishing sector accounts for 17% of the labour force and service sector 31% of the labour force.

C. Livestock, fishing etc. and construction centre

Kathivakkam, a town situated in the zone of metropolitan dominance has come under this category. This is a coastal town and fishing is the mainstay of life. In this town 38% of the labour force is in livestock and fishing sector showing a high degree of resource oriented specialisation. Eight per cent of the labour force is in construction sector which amounts to moderate specialisation.

D. Household industries and trade centres

The towns Poovirundavalli and Tiruvallur both in the zone of metropolitan sub dominance come under this category. Poovirundavalli has 2.5% of the labour force in household industries and 23% in trade sector. In Tiruvallur town also 2.5% of the labour force is in household industries sector. Besides Tiruvallur is the administrative headquarters of Tiruvallur taluk.

E. Services and construction centres

Tambaram : Lying in the zone of metropolitan dominance, Tambaram is known for its famous educational institutions,

T.B. Sonatorium, Air Force Station etc. There is also a sub urban electric train service for the benefit of commuters to Madras city. As a result Tambaram has become a dormitory town for white collar workers serving in the Secretariat and head offices of many business houses located in Madras city. Therefore service sector alone accounts for 39% of the working population of this town. Five per cent of the workers are in construction work.

III Tri functional service centres

Trade, transport and construction centre :

Madras, the metropolis has the unique distinction of being a tri functional centre. The workers in primary sector agriculture, livestock and dairying and mining and quarrying all put together - pale into insignificance before 6.9 lakh workers employed in non primary sector. The city has considerable number of workers in all the industrial categories belonging to non primary sector. The city has emerged as a specialised centre of trade and commerce (24% of labour force transport and communication (19% of labour force) and construction (5% of labour force). This does not imply the absence of service sector as it accounts for 23% of the labour force. Thus Madras city has a large tertiary sector accounting for 66% of the total labour force. In comparison with this, the manufacturing sector of the city is weak as it accounts for just 26% of the labour force.

BIBLIOGRAPHY

1. Alam, Shah Manzoor, " Hyderabad and Secunderabad Twin Cities : A Study in Urban Geography" (Allied Publishers, Bombay, 1955), p. 159.

2. Anantha Padmanabhan, "Functional Classification of Urban Centres in Madras State", Bombay Geographical Magazine, 1965 Vol. XIII, pp. 85-95.

3. Anderson, R. Theodore & Jane Collier, 'Metropolitan Dominance and Rural Hinterland', Rural Sociology, Vol. 21, 1956, pp. 34-47.

4. Aslam, Mahmood, Statistical Methods in Geographical Studies, (Rajesh Publications, New Delhi, 1977), p. 167.

5. Aurousseau, M., 'Recent Contributions to Urban Geography', Geographical Review, Vol. XIX, 1934 pp. 444-455.

6. Bansal, S.C., 'Town-country Relationship in Saharanpur City Region : A Study in Rural Urban Interdependence Problems, (Sahranpur Sanjay Prakashan, 1975), p. 171.

7. Berry, B.J.L. and Marble D.F. ed., 'Spatial Analysis : A Reader in Statistical Geography, (Prentice Hall 1969), pp.269-289.

8. Berry, B.J.L, 'The Impact of Expanding Metropolitan Community upon the Central Place Hierarchy' A.A.A.G., Vol. 50, No. 2, June 1960, pp. 112-116.

9. Bhat, L.S., 'Micro Level Planning : A Case Study of Karnal Area, Haryana India', (K.B. Publications, New Delhi, 1976), p. 137.

10. Bradnock, R.W., 'The Hinterlands of Madras and Bangalore' Indian Geographical Journal, Vol. XLIV, No. 1, June 1974, pp. 10-16.

11. Bryn, G.W., 'Metropolitan Regional Analysis', Progress in Geography, Vol. 4, International Review of Current Research (Edward Arnold, 1972), pp. 257-290.

12. Christaller, W., 'Central Places in Southern Germany' Trans. C. Baskin (Prentice Hall 1966), p. 230.

13. Dennis, Richard, J. 'Distance and Social Interaction in a Victorian City', Journal of Historical Geography, No. 3, July 1977, p. 217-221.

14. Dickinson, Robert, E. 'The City Region in Western Europe' (Routledge & Kegan Paul Ltd. London), p. 47-59.

15. Dikshit, K.R. et. al. 'Hinterland as a Region : Its Type, Hierarchy, Demarcation and Characteristics illustrated in a case study of the hinterland of Poona, N.G.J.I., Vol. XIV, Part I March 1968, pp. 1-22.

16. Dixit, R.S., 'On the Delimitation of the Umland of a Metropolis Kanpur : A case study', National Geographer, Vol. XII, No.1, June 1977, pp. 77-92.

17. Ellefesen, Richard, A. 'City-Hinterland Relationship in India with special reference to the hinterlandsof Bombay, Delhi Madras, Hyderabad and Baroda' Roy Turner (ed.), India's Urban Future (Oxford Univ. Press Bombay) pp. 94-104.

18. Gananathan, V.S., 'Some Aspects of Rural-Urban Relationship in India', Indian Geographer, Vol. IV, No. 2, Dec. 1959, pp. 29-36.

19. Gibbs, Jack P. (ed.) Urban Research Methods (Van Nostrand Co Inc 1961), p. 621.

20. Gopalakrishnan, 'Umland of Planned City Chandigarh', N.G.J.I., Vol. XVI, Part I, March 1970, pp. 31-46.

21. Green, F.L.W., 'Urban Hinterlands in England and Wales : An analysis of bus services' Geographical Journal, Vol. 116, 1950, pp. 64-68.

22. Green, Howard L., 'Hinterland boundaries of New York City and Boston in Southern New England' Economic Geography, Vol. XXI, 1955 pp. 283-300.

23. Gregory, S. 'Statistical Methods and the Geographer' (Longman 1933), pp. 152-163.

24. Hagget, Peter, 'Locational Analysis in Human Geography' (Edward Arnold 1971), p. 339.

25. _____ 'Socio Economic Models in Geography' (Methuen & Co. Ltd.), p. 468.

26. Harris, C.D., 'A functional Classification of Cities in the United States', Geographical Review, Vol. XXXIII, January 1943, pp. 86-99.

27. Hoselitz, Bert F. 'Cities of India and their Problems' A.A.A.G., Vol. 49, 1959, pp. 223-231

28. Johnson, James H. "Urban Geography : An Introductory Analysis (Pregamon Press 1960), pp. 76-102.

29. Johnson, R.J., 'Spatial Structures', (Methuen & Co. Ltd.), 1973, p. 133.

30. King, C.A.M. & Cole, J.P., 'Quantitative Geography : Techniques and Theories (John Wiley and Sons Ltd. 1969), p. 692.

31. King, L.J., 'Quantitative Expression of Urban Settlement Patterns in the U.S', Berry & Marble (ed.) Spatial Analysis (1969), p. 159-171.

32. Lal, Hira. 'Gradients of Urban Influence on the Rural Settlement Concentration with special reference to Bareilly', R.L. Sing (ed.) Rural Settlements in Monsoon Asia (N.G.S.I., Varanasi), pp. 265-272.

33. Mahadev, P.D. & Jeyasankar, D.C., 'Concept of a City Region : An approach with a case study' Indian Geographical Journal, Vol. XLIV, 1969, pp. 15-25.

34. Matras, Judah, 'Population and Societies' (Prentice Hall 1973), p. 562.

35. Mayer, H.M. & Kohn, C.F. ed., Readings in Urban Geography (University of Chicago, 1967), p. 625.

36. Mishra, Harikesh N.H., 'Hierarchy of Towns in the Umland of Allahabad', Deccan Geographer Vol. XIV, 1976, pp. 33-46.

37. Mukerji, A.B., 'The Umland of Modinagar', N.G.J.I, Vol. VIII, Part 3 & 4, 1962, pp. 256-269.

38. Mumford, Lewis, 'The City in History' (Pelican, 1966), pp. 549-597.

39. Nangia, S., 'Delhi Metropolitan Region : A Study in Settlement Geography', (K.B. Publications, New Delhi, 1976), p. 209.

40. _____ 'Gradient Analysis in Delhi Metropolitan Region', Analytical Geography, Vol. I, No. 1, Dec. 71, p. 48-56.

41. Nelson, Howard J. 'A Service Classification of American Cities', Economic Geography, Vol. 31, 1955, pp. 189-210.

42. Pawnall, L.L., 'The Functions of New Zealand Towns', A.A.A.G., Vol. XLIII, No. 11, Dec. 1953, pp. 332-350.

43. Prakash Rao, V.L.S. 'Towns of Mysore State' (Indian Statistical Institute, Calcutta, 1964).

44. Premi, M.K. 'Urban Outmigration : Its Pattern and Characteristics of Outmigrants' Occasional paper no. 3 of 1976, C.S.R.D., J.N.U., New Delhi, p. 48.

45. Sen, L.K et. al. 'Planning Rural Growth Centres for Integrated Area Development : A study in Miryalguda Taluka, (N.I.C.D., Hyderabad 1971), p. 245.

46. Singh, Ranab P.B., 'Pattern Analysis of Rural Settlements : Distribution and their types in Saran Plain : A Quantitative Approach, N.G.J.I, Vol. 20, 1974, p. 109-127. Reprinted in R.L. Singh (ed.) Readings in Rural Settlement Geography, (N.G.S.I, Varanasi).

47. Singh, R.L. 'Benares : A Study in Urban Geography' (Benares Nand Kishore 1955), p. 184.

48. _____ 'Bangalore : An Urban Survey', N.G.S.I, 1964, p. 165.

49. Singh, Lal. "The Umland of Agra", N.G.J.I., Vol. II, Part III, 1956, pp. 149-152.

49a. Raza, Moonis & Atiya Habeeb, 'Characteristics of Colonial Urbanization : A case study of the Satellite "Primacy" of Calcutta, Occassional Paper No. 1 of 1976, CSRD, JNU, New Delhi, p.48.

50. Singh, Ujagir. 'Umland of Allahabad', N.G.J.I., Vol. II, Part I, March 1961, pp. 37-51.

51. Smailes, A.E. 'The Geography of Towns' (Hutchinson Univ. Lib. 1970), pp. 129-149.

52. _____ 'The Analysis and Delimitation of Urban Field', Geography, Vol. 31-32, 1946-47, pp. 152-161.

53. Smith, David M. 'Patterns in Human Geography' (Penguin Education 1975), p. 373.

54. Spate, O.H.K. 'India, Pakistan and Ceylon : The Regions' (Methuen & Co. Ltd. London 1972), pp. 739-748.

55. Srinivaschari, C.S. 'Growth of Madras City', Journal of the Madras Geographical Association, Vol. 14, 1939.

56. Subramanyam, N. 'Some Aspects of the Growth of Greater Madras', Journal of the Madras Geographical Association, Vol. 13, 1938, pp. 22-31

57. Sundaram, K.V., 'Urban and Regional Planning in India' (Vikas Publishing House Pvt. Ltd. 1977), p. 432.

58. Thompson & Lewis. Population Problems , (Tata Mc Graw Hill 1976), p. 114-169.

59. Tyagi, Ramesh Chandra, 'Location of a Hierarchy of Centres in the National Capital Region' (Unpublished Ph.D. thesis submitted to Meerut University).

60. Veerandra Nath, 'The Concept of Umland and Its Delimitation', Deccan Geographer, Vol. I, No. 1, July 1962, pp. 33-44.

***

Reports and other Publications

1. Census of India, 1971, Series 2, Andhra Pradesh, Part II-A, General Population Tables.

2. Census of India, 1971, Series 19, Tamil Nadu, Part II-A, General Population Tables.

3. Census of India, 1971, Series 30, Pondicherry, Part II-A, General Population Tables

4. Census of India, 1961, Vol. IX, Madras Part I(A)(i) General Report

5. Census of India, 1971, Series 19, Tamil Nadu, Part X A, District Census Hand Book, Village & Town Directory, Chingleput District

6. Census of India, 1971, Series 19, Tamil Nadu, Part X B District Census Hand Book, Village & Town wise Primary Census Abstract, Chingleput District, Vol. I & Vol. II

***