CHAPTER VII

HINTERLANDS OF THE URBAN CENTRES AND THE SPREAD OF URBAN INFLUENCE AS MEASURED BY THE DISTANCE DECAY FUNCTION

In the present analysis, an attempt has been made to study the process of urban diffusion and to examine the nature of linkages and relationships in a city-oriented region. The initial development was polarised at the two nodes, Bombay and Poona, from where it has percolated along the transport axes, slowly integrating the intermediate region into the urban complex.

The study is divided into two sections. In the first part, zones of influence and space relations of the two metropoles and the other urban centres in the region have been delineated with the help of economic, demographic and administrative parameters. The relationship between the size of the centres and the areal extent and population size of their hinterlands has been analysed.

The second part of the study deals with the degree of flows between the regions as measured with the help of the distance decay curves. The assumption here is that the rate of spatial interaction is inversely related to distance from the city centre and is an expression of the extent of transformation of the intermodal region from a predominantly rural to urban economy.
Finally, based on the findings of the above study a generalised model of urban growth has been constructed which takes into account the impact of industry in promoting urbanisation in developing countries. The spatial processes of urban diffusion that have emerged in the region also provides basic guidelines which would be useful in formulating future strategies for area development planning.

A) HINTERLANDS OF THE CITIES IN THE REGION

METROPOLITAN AREAS OF THE TWO NODES AND THEIR REGIONAL RELATIONS

The city is the focal point of regional activity with the hinterland carrying on functions necessary to the metropolitan community as a whole. In the functional organisation of the city, regional relations are of special significance. A study of the rural - urban interaction and the interland gives an idea of the city - countryside interdependence and provides a basis for demarcating the metropolitan planning region.

In India, unlike in the Western countries, very little statistical material is available that can be applied to determine the economic fields of urban centres. For the region a combination of four major criteria (i) Administrative jurisdiction (ii) Commuting zone (iii) daily umland (iv) area of high population growth contiguous to the city, are used to delimit the metropolitan areas. Each of these criteria reflects the varied facets of the cities linkages with its surrounding region. Accessibility is an important factor, for the zone of effective and assured accessibility reveals the levels of the spatial ties between a city and its surrounding
region. The delivery of perishable commodities from the hinterland and the distribution of manufactured or processed goods from the nodal centres can be expressed by the daily umland, whereas, the areas of high growth contiguous to the city reflects the cities spreading zone of influence.

The Bombay Metropolitan Area

Before proceeding with the demarcation of the actual metropolitan region, it is necessary to clarify at the outset that Bombay being a primate city, exerts influences at several levels. At the supra-regional level it would include the entire country, and in this context Poona would be within its greater area of influence. In the present analysis Bombay's hinterland is essentially the area of most frequent and close interaction. Using above criteria (fig 7:1), an irregular shaped hinterland with three arm like extensions along the major arterial routes could be discerned. Between the two arms (A in fig 7:1) the wedge formed between Bhivandi and Bassein has been excluded due to the hilly nature of terrain which is sparsely populated. Added to this is the lack of transportation facilities which has further cut off this region from the cities main area of influence. In the East, the commuters zone extending right upto Karjat has been included in the metropolitan area. To the South of Malyan (B in fig 7:1), another hilly zone, which forms part of the Baba Malang hills has also been excluded. In both these cases, unfavourable terrain coupled with inaccessibility have limited the area of the city's influence. To the South, it covers the entire Trans-Thana creek region, extending right upto Panvel. The construction of the bridge across Thana creek and the efforts to develop the twin
THE METROPOLITAN AREAS OF BOMBAY & POONA.

Fig. 7:1
city of Bombay have not only led to the extension of the Southern limits but have also stimulated the growth around Panvel.

**Metropolitan Region of Poona**

Unlike the asymmetrical hinterland of Bombay the hinterland of Poona is more eccentric in shape. Except for the physical barrier of western ghats, there is little restriction for its spread in all directions. The overall zone of influence spreads almost evenly over a radius of forty miles along the major transport arteries. Towards the Eastern margin, a wider area is encompassed to include the supply regions for perishable commodities particularly, vegetables. The immediate environs of Poona in the West, due to physiographic limitations have greatly restricted the agricultural potential in this area. This has resulted in an enlargement of the area of daily trucking for perishables further eastwards, where good soils and better irrigation facilities have promoted market gardening.

It appears incongruous while studying the hinterlands of the two nodes that the hinterland of Bombay does not appear much larger than that of Poona. It has already been stressed earlier that at the supra-regional level, Poona is included within the hinterland of Bombay. In demarcating the immediate hinterlands, it has been noted that it is not so much the areal extent of the hinterland which varies as much as the difference between the intensity of interaction between the two cities and their respective hinterlands. For example, a study of the commuting zones of the two cities reveals that 1390 local trains start from Bombay. Of these 23 terminate
at Karjat, 10 at Vasara on the Central railway and 102 at Virar on the Western railway. In the case of Poona, only 22 locals operate between Poona and Lonavia and only 4 locals operate between Poona and Daund. A similar contrast has also been noted while demarcating the daily umland and the zone of high growth. The settlements surrounding Bombay have much higher growth rates than in the case of Poona. Thus, as a city grows in size, not only does the areal extent of the hinterland increase, particularly in the case of the higher order hinterlands, but, the level of interaction between a larger city and its immediate hinterland is considerably greater than in the case of the smaller city.

THE HINTERLANDS OF THE INTERMODAL CENTRES

Though transport facilities and movement of the population help to determine the precise areal extent of the associations of a city with its hinterland, this is not applicable for the smaller urban centres in the region. Only in the case of centres located on the major highways, is it possible to demarcate the urban fields with the help of frequency of bus services, by joining places where there is a certain amount of traffic convergence. In the area, the larger centres are located only along the rail corridor, and a fundamental characteristic of the railways is polarization along an axis. This tends to give rise to a more linear ribbon like pattern of hinterlands for all the centres located along its route, irrespective of their individual centrality. In order to gain a more realistic picture of the areas of influence of the smaller centres, the demographic characteristics were preferred to the transportation indices which tended to obliterate the individual fields. The method used for the
BOMBAY - POONA INTERNOdal CENTRES WITH THEIR AREAS OF INFLUENCE.

Fig. 7.2

(HINTERLAND OF BOMBAY IS NOT SHOWN.)
present analysis is a combination of two demographic parameters:

(i) The areas of high growth contiguous to cities
(ii) The areas surrounding the urban centre where at least 50% of the working population is employed in non primary occupations. This will represent the villages whose population directly participate in the city's economic life.

Based on the above method, the hinterland boundaries of all the centres were demarcated except for the two nodes whose areas of influence have already been analysed. The Kalyan - Ulhasnagar - Ambernath and the Thana complexes consist of a cluster of contiguous towns, where like in Western countries, the urban mesh is so close, that hinterlands overlap and are truncated, therefore, treating them separately would distort reality. Hence these three townships have been treated as a single conurbation. Similarly, Pimpri-Chinchwad which is really an industrial suburb of Poona and is still organically a part of the original core, depending on it for most of its central place functions, has been included in Poona city. A curious feature of Pimpri-Chinchwad therefore, which has developed into a large industrial suburb, is the lack of forward and backward linkages with its hinterland. This is due to the time lag between the growth of the centre and the emergence of its central place functions, which is visible in its negligible area of influence. Except for the area from which the labour force is drawn towards Pimpri-Chinchwad the rest of its field is still amorphous.
In a similar context, towns specializing in defence services like Lohagun, Khadakvasla, Dehu and the resort town of Matheran are unique, in that, they have virtually no hinterland, for they have little interaction with their surrounding region, and thus stand out as point places.

Though the rest of the towns in the region form an integral part of the larger hinterlands of the two nodes, they have their own immediate hinterlands. In an overview the axial belt presents a dense cluster of large sized towns at both the extremities, with a sprinkling of isolated centres in the intermediate region. This has given rise to an overall dumbbell shaped pattern of hinterlands (Fig 7 : 2). Considered individually, most of the hinterlands are irregular in outline and have a marked tendency towards linearity, following the transport routes.

An examination of the hinterlands of the various centres in the area (Table VII : 1) reveals the wide discrepancies that exist both in the size of the population and the size of the area served. The areal extent and population size of the hinterland, though primarily related to size of the individual centres, also depends on other factors like:

(i) Spacing of centres
(ii) The functional character of the urban centres
(iii) Population density of the hinterland
(iv) Transport facilities available
(v) Level of economic development of the hinterland

Over 50 percent of the intermodal towns have an industrial base. Within the industrial centres wide variations in the size of the hinterlands are observed. The smaller
Table VII: 1

**Hinterland characteristics of the Internodal Towns**

<table>
<thead>
<tr>
<th>Towns</th>
<th>Population of Urban centres</th>
<th>Population of hinterland</th>
<th>Area of hinterland (sq. km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Ulhasnagar conurbation</td>
<td>345,276</td>
<td>61,772</td>
<td>29,949</td>
</tr>
<tr>
<td>2. Thana conurbation</td>
<td>207,352</td>
<td>76,492</td>
<td>42,757</td>
</tr>
<tr>
<td>3. Bhiwandi</td>
<td>79,576</td>
<td>65,469</td>
<td>28,920</td>
</tr>
<tr>
<td>4. Dombivili</td>
<td>51,108</td>
<td>28,136</td>
<td>8887</td>
</tr>
<tr>
<td>5. Bassein</td>
<td>30,594</td>
<td>31,008</td>
<td>7627</td>
</tr>
<tr>
<td>6. Lonavala</td>
<td>27,501</td>
<td>9060</td>
<td>12,697</td>
</tr>
<tr>
<td>7. Panvel</td>
<td>26,602</td>
<td>20,376</td>
<td>11,001</td>
</tr>
<tr>
<td>8. Khopoli</td>
<td>18,152</td>
<td>15,727</td>
<td>18,435</td>
</tr>
<tr>
<td>9. Talegaon</td>
<td>16,514</td>
<td>23,772</td>
<td>37071</td>
</tr>
<tr>
<td>10. Sandor-Manikpur</td>
<td>14,315</td>
<td>19,210</td>
<td>17,866</td>
</tr>
<tr>
<td>11. Virar</td>
<td>12,713</td>
<td>32,066</td>
<td>11,302</td>
</tr>
<tr>
<td>12. Uran</td>
<td>12,616</td>
<td>15,846</td>
<td>12,574</td>
</tr>
<tr>
<td>13. Kulgaon Badlapur</td>
<td>11,461</td>
<td>7307</td>
<td>5348</td>
</tr>
<tr>
<td>14. Bhayander</td>
<td>10,598</td>
<td>18,615</td>
<td>10,829</td>
</tr>
<tr>
<td>15. Nerul</td>
<td>8078</td>
<td>8992</td>
<td>11899</td>
</tr>
<tr>
<td>16. Karjat</td>
<td>5634</td>
<td>10,079</td>
<td>3257</td>
</tr>
<tr>
<td>17. Rasayani</td>
<td>2018</td>
<td>4035</td>
<td>3169</td>
</tr>
</tbody>
</table>
RELATIONSHIP BETWEEN THE POPULATION OF A CENTRE AND POPULATION OF ITS HINTERLAND

RELATIONSHIP BETWEEN THE POPULATION OF A CENTRE AND THE AREA OF ITS HINTERLAND
industrial centres have proportionately much larger hinter-
lands as compared to the larger and older established centres
like the Thana and Kalyan-Ulhasnagar conurbations. Even between
these two complexes, there are variations. Though both have
smaller hinterlands in relation to their sizes, Thana's hinter-
land is relatively larger than that of Kalyan-Ulhasnagar. This
is attributed to the fact that Thana has been able to retain
its primary position vis-a-vis the satellites that have develop-
ed around it. In contrast, Kalyan is completely overshadowed by
its two industrial towns Ulhasnagar and Ambernath. Therefore,
in the case of the Kalyan complex, where the concentration of
industrial activity is more intense, the hinterland is much
smaller than the case of Thana.

The smaller industrial centres present an altogether
different relationship with their hinterlands. Without any
exception, all the hinterlands are larger than those of the
larger centres. This is because in the initial stages of indus-
trial development, the centre draws its entire labour force and
other supplies from its immediate hinterland which at this stage
appears more extensive in relation to the size of the centre.
Later, the centre itself builds up its own resident population
and grows at much faster pace than the hinterland itself. Centres
like Sendor-Manikpur, Virar and Talegaon have extra large
hinterlands. These urban settlements are located at a consider-
able distance from other urban centres. Besides, they are located
in predominantly rural areas. In addition, the agriculturally
productive nature of the surrounding environs of Virar and Sendor
have resulted in abnormally large hinterlands.
The remainder of the centres have a more diversified economic base and the population of the hinterlands that these places command, is on an average, twice the size of their population. In this class Lonavla stands out as an exception. Though it is predominantly a resort town, it has a fairly well developed transport and commercial base due to its strategic location along the major traffic corridor. This had led to the development of a limited hinterland, which though not concomitant to its size, is still larger than that of Matheran, the other resort centre in the region.

Unlike the strong correlation which has been observed between the size of a town and the population of its hinterland, the association with the areal size of the hinterland is weaker as seen in Table VII: 1. The larger extent of most of the hinterlands of many a small centre is mainly due to the low density of population. For example Khopoli located in an eminently rural setting has developed a large areal hinterland without the corresponding population.

B) DISTANCE DECAY RELATIONSHIP OF THE SETTLEMENTS FROM THE TWO NODES

Distance has an important bearing on the settlement structure of a city region. The spatial dominance of cities lessens as we move away from their centres. The degree of spatial interaction (flow between regions) is universally related to distance i.e. near regions interact more intensely than distant regions. Distance from a city not only determines the centripetal pull of the city, but also determines the degree of its interaction with the city region. However, the
exact form of the relationship between distance and interaction has been difficult to determine. On an arithmetic scale plotting distance against interaction normally produces a 'J' shaped curve in which flows decrease rapidly over shorter distance and more slowly over longer distances (Ellefesen, R.A.). In the distance lapse rate function, curves with a gentle slope indicate flows extending over a wide area, whereas, a curve with a sharp decrease indicate that flows are confined to a limited area.

The application of the distance decay function and gradient analysis has so far been limited mainly to intra urban studies (Brush 1968, Berry et al. 1963.) In the present study the variations in the patterns of certain parameters with distance from the two nodes along both the major arteries, road and railway, have been computed separately.

The parameters used for the distance decay analysis are of two major types, one reflecting a change in the demographic character of the hinterland, and the other depicting the changing nature of economic activity. The first group of variables include size and density of settlements, population growth, sex composition and literacy rates while the second group comprising of the economic parameters include the occupational structure of the settlements and the change in the pattern of land utilisation from agricultural to non-agricultural uses.

STRUCTURE OF THE DEMOGRAPHIC ATTRIBUTES AND THE DISTANCE DECAY FUNCTION

Spatial variations in the Size of the Settlements between the Two Nodes
DISTANCE DECAY FUNCTION FOR SIZE OF SETTLEMENTS ALONG THE BOMBAY-POONA RAILWAY.

Fig 7.4A

DISTANCE DECAY FUNCTION FOR SIZE OF SETTLEMENTS ALONG THE BOMBAY-POONA ROAD

Fig 7.4B
Internodal axis passes is one of low agricultural productivity. This has given rise essentially small sized settlements so that whatever development has taken place in the area is focussed around the two nodes. Therefore one would expect the larger sized settlements to be nearer the nodes, progressively decreasing in size as one moves towards the periphery of their areas of influence. The presence of the Western Ghat Divide at a distance of 70 km. from Poona further acts as an effective barrier between the two nodes and determines the orientation of the settlements on either side, towards their respective poles.

Plotting the size of settlements on distance scale (figs 7 : 4A and 7 : 4B) for both the road and railway, the expected 'J' shaped curve has emerged. The plot shows a steep initial drop from the two nodes after which the curve of distribution assumes a nearly level gradient. Within a distance of 40 km. from Bombay and only 20 km. from Poona, there is little relationship between the size of the urban centre and its distance away from the two nodes. Beyond this distance, town sizes are random ranging between 10,000 and 30,000. Lying at the lower end of the population size continuum, the rural settlements also follow the same trend as the urban centres except that the distance of influence is slightly extended up to 70 km. from Bombay and 40 km. from Poona. Thus the impact is seen more in the case of rural settlements, since they grow fast in response to the needs of the nodes.

The graph of settlement size along the railway shows a slightly different trend for the Bombay region. In the case of Poona the pattern is similar, as the road and rail run parallel to one another. In case of Bombay, there is sharp decline from Thana after which the curve rises again till it
reaches a peak at Ulhasnagar. The constraint imposed by the unfavourable nature of the terrain between Thana and Dombivili (marshy land) is reflected in a steep fall in the size of settlements. On the other hand, Bombay suburban trains by facilitating commuting, have given rise to the large industrial agglomerations at Dombivili, Kalyan, Ulhasnagar and Ambernath. The railway commutation has had the effect of further extending the zone of influence for Bombay upto a distance of nearly 60 km. Beyond the effective commutation field, the railways have failed to engender any growth, with the result that unlike the road which has had some impact on the size of the towns throughout its tract, the influence of the railways just peters off at the points where intense commutation stops.

**Spatial Variations in the Growth Rate of Settlements between the two nodes**

Plotting the graph for the growth rate of settlements along the Bombay – Poona axis (figs 7 : 5A and 7 : 5B) one observes that the general form of the curve is more U shaped. The distance of the waning influence from the two nodes remains more or less constant at 40 km. and 70 km. from Bombay along the road and railway respectively. In the Poona region, the zone of influence extends upto 40 km. This coincides with that observed for the size of settlements. The highest growth rates cluster around Bombay upto a distance of 60 km., beyond which the growth rate tend to oscillate around the mean figure (22 % for Maharashtra) till a distance of 75 km. is reached. Beyond this lies the area where the growth rates are well below the average and signifies out migration. The only settlements of high growth
in this area of out migration are those centred around Khopoli, the newly developed industrial break of bulk point. In the Poona region, the real area of out migration unlike the Bombay region is virtually absent due to the proximity of Poona and also because of the parallel nature of the road and railway which effectively link the settlements with Poona.

The distance decay curve for growth rate of settlements along the Bombay - Poona railway shows certain distinctive features. Unlike the roadway where the industrial centres showed maximum growth, in the case of the railway, it was the dormitory suburbs which showed very high growth rates. These were essentially the railway stations which were located in between the Bombay - Thana and the Ulhasnagar - Ambernath complex. The high employment potential generated by these two complexes led to a phenomenal growth of these dormitory suburbs.

Spatial Variation in Sex Ratio of Settlements Between the Two Nodes

A distinctive feature of the internodal zone is the presence of an overall pattern of high sex ratio, which is in keeping with the general trend of urban areas in India. This is due to the male selective nature of the migration. What is more significant here is that leaving aside a few isolated settlements, even the rural settlements have a high sex ratio, irrespective of their distance from the two nodes. The pattern of high sex ratio confirms the observation made while studying the pattern of migration in the area, where it was seen that the transport axes are the first step in the process of movement of people from the remote areas towards the urban
DISTANCE DECAY FUNCTION FOR SEX RATIO FOR SETTLEMENTS ALONG THE BOMBAY POONA RAILWAY

Fig 7 6A
DISTANCE DECAY FUNCTION FOR SEX RATIO FOR SETTLEMENTS ALONG THE BOMBAY-POONA ROAD
centres.

Along both the road and the railway, the gradient for sex ratio declines with increasing distance from the two nodes, though the slope of the curve for Bombay is much sharper in comparison to that of Poona. The pre-eminence of Bombay in the region, coupled with greater intensity of immigration towards that centre has greatly unbalanced the sex ratio. In the region urban sex ratios are as a rule more unbalanced than the rural sex ratios. The sex ratio for rural settlements lies within a band of values ranging from 975 to 1100 males per 1000 females, whereas, for the urban centres all the values are above 1100. Though all the settlements lie along the road or railway, distinctly higher sex ratio are associated with the presence of the railway stations and bus stops. The still higher sex ratios in the case of the railway stations is because nearly all these stations are towns, unlike the bus stops. In an overall analysis one can state that unlike the size and growth rate of centres, the variation in the sex ratio is not so pronounced with increasing distance from the two nodes.

Spatial variation in the density of population of settlements between the two nodes

The difference between urban and rural densities is at once apparent in the graph (fig 7 : 7A and 7 : 7B). The detailed pattern of decay curve reflects the size of the settlements. Urban centres in the area have densities which are much higher than rural settlements at similar distances. Leaving aside the rural settlements in the Thana - Ambernath zone, no where do rural densities exceed two persons per acre
DISTANCE DECAY FUNCTION FOR DENSITY OF POPULATION FOR SETTLEMENTS ALONG THE BOMBAY-POONA RAILWAY
DISTANCE DECAY FUNCTION FOR DENSITY FOR POPULATION ALONG THE BOMBAY-POONA ROAD
The distribution of rural densities shows an even pattern throughout the length of the axes, unlike the towns which display a distinct gradient with increasing distance from either node. The inclusion of both rural and urban settlements together has produced much noise, thereby, obliterating the clear cut pattern which might otherwise have emerged. The town densities also reflect the degree to which a town is over or underbound. For e.g. the highly inflated densities in the case of Dombivili and Karjat are due to the fact that they are highly underbound. On the other hand, Khopoli and Ambarnath whose densities are almost akin to the rural settlements are examples of over-bounded towns. Population densities of settlements are not so much a function of distance from the nodes as is apparent from the sharp urban-rural gradient.

**Spatial variation in the Literacy Ratio of Settlements Between the Two nodes**

In the region, like the rest of the country, literacy is higher in urban centres than in rural settlements. Except for minor variations, there is little difference in literacy rates of all the towns in the area. Nearer the two nodes, the literacy rates of the towns are slightly higher as they function as dormitory suburbs for the white collar workers employed in Bombay and Poona. The other class of towns which have higher literacy rates are the administrative centres such as Karjat and Panvel. In this context it may be pointed out that Vadgaon, though a village, has very high literacy due to its being a tehsil headquarters. The industrial towns in the comparison have lower literacy ratios. This is mainly a reflection of the
DISTANCE DECAY FUNCTION FOR LITERACY FOR SETTLEMENTS
ALONG THE BOMBAY-POONA RAILWAY

DISTANCE DECAY FUNCTION FOR LITERACY RATIO FOR PLACES
ALONG THE BOMBAY-POONA ROAD
large amount of unskilled labour recruited by the industries.

In the case of rural literacy more than the distance from the node, it is the presence of the educational facility at the settlement or the location of an urban centre in its vicinity which affects the literacy ratio. This gives rise to a pattern of series of troughs and peaks throughout the axes, with the peaks formed by the urban centres.

**STRUCTURE OF THE ECONOMIC PARAMETERS AND THE DISTANCE DECAY FUNCTION**

**Employment in Primary Occupations**

Since an inverse relationship exists between the degree of urbanisation and employment in agriculture, the reciprocals of the percentage of population employed in agricultural activities has been plotted in fig. VII : 8A and VII : 8B. Urban centres by their very definition have at least over 75% of their total working population engaged in non-agricultural occupations. The dichotomy between urban and rural centres is vividly reflected in the plot. Of the various parameters examined so far, nowhere has the distance factor appeared as critical as in the case of agricultural activities. For Bombay, a sudden break is observed at 50 km. along the road and 60 km. along the railway axis. Perhaps, beyond these points the agricultural land use is not affected and as this zone is beyond the commuting zone, the secondary and tertiary activities are negligible. In the Poona region the break in the gradient is visible at a distance of 40 km. Another unique characteristic of the curve is that irrespective of the size and category (urban or rural) of settlements, a definite decline with increasing distance from the nodes is observed.
In the region, Ulhasnagar, Dombivili and Parsik stand out as exceptions with higher values than those of Bombay. The growth of these settlements has been attributed mainly to exogenous forces like the rehabilitation of displaced persons from Pakistan especially in the case of Ulhasnagar. The acute shortage of housing space in Bombay has led to the phenomenal development of Parsik and Dombivili.

**Secondary Occupations**

More than any other attribute, manufacturing shows the greatest extension of the influence of the two nodes. The areal extent in the case of Bombay penetrates up to a distance of 50 km. along the road and as much as 80 km. along the railway. In the Poona region too, the influence is felt up to 50 km.

The highest points in the distance decay curve do not coincide with the two nodes but are located at the specialised industrial complexes in their vicinity. The distance decay curve for manufacturing does not show a smooth decline from the two peaks as is seen in the case of the primary occupations. It has several minor peaks associated with the smaller industrial centres located in the intermediate region. The nature of the peaks around these intermediate nodes varies greatly along the two modes of transport. Narrow constricted peaks depicting highly localised areas of influence are commonly associated with the centres along the road. In the case of the railway centres, peaks of greater wave length have been observed. This variation in the structure of the peaks for centres along the road and railway reflects the
DISTANCE DECAY FUNCTION FOR % OF WORKERS EMPLOYED IN MANUFACTURING FOR SETTLEMENTS ALONG THE BOMBAY-POONA RAILWAY

DISTANCE DECAY FACTOR FOR % OF WORKERS EMPLOYED IN MANUFACTURING ALONG BOMBAY-POONA ROAD
relative efficiency of the two modes of transport. The railways especially the fast, high frequency suburban trains in the hinterland of Bombay have had a tremendous impact in enlarging the areal extent of the hinterlands from where the workers are drawn. Commuters are also willing to travel longer distances by railway as the railway season tickets are about three times cheaper than bus fares. During the course of the authors field work it was noticed that on an average commuters are not willing to pay more than Rs. 1/- per day for travel, thereby, restricting the distance travelled by bus. The ease and comparative economy of commuting by railway has resulted in the subsequent growth of the percentage of population employed in manufacturing in the settlements located along the railways for considerable distances. On the other hand, for industrial centres located along the road, the zone of influence is restricted and is invariably less than 5 km.

Tertiary Occupations

This class includes all the non-agricultural occupations excluding manufacturing. There is no clear cut break or decline away from the nodes as in the case of the other occupational categories. However, most of the settlements tend to cluster around much lower value after a distance of 60 km. from Bombay along the railway and 50 km. along the road. For Poona, the decline shown is similar to the other attributes (40 km.). The absence of a steep gradient followed by a sharp break between the nodes is on account of the inclusion of wide ranging activities, which consist of, besides Trade and Commerce, other services like transport and communications, administrative, professional and clerical workers, defence services, domestic
DISTANCE DECAY FUNCTION FOR % OF WORKERS EMPLOYED IN TERTIARY SERVICES FOR SETTLEMENTS ALONG THE BOMBAY-POONA RAILWAY

DISTANCE DECAY FUNCTION FOR % OF WORKERS EMPLOYED IN THE TERTIARY SECTION ALONG THE BOMBAY-POONA ROAD
servants and other wage earners. The distance decay curve along the railway axis highlights the railway stations which stand out as prominences through out its length. The dense cluster from Bombay to Ulhasnagar is due to the concentration of white collar workers employed in Bombay city. But this is absent in the case of roadways. The contrast in the pattern between the road and rail however is essentially for the smaller centres which show much higher values along the railways. This is not only because of the access to the place of work facilitated by the railways due to easy accessibility, but is also because the potential for employment generated by the railways is much larger for these intermediate centres than the roadways. The intensity of railway traffic in the region, together with the nature of the topography and high rainfall require a large maintenance staff. As seen while discussing the functional classification of towns, all centres having a high transportation index namely Kalyan, Matamanivali, Virar, Nerul, Marjat and Lonavala are railway stations. In contrast, for road transport, maintenance staff is required only at the central bus station. Little or no employment is generated at the intermediate terminals, which is often no more than a post at regular intervals along a bus route.

Change in Land use Pattern from agricultural to non-agricultural Uses

The distance decay curve shows a distinct negative exponential relationship. There is a sudden break at a distance of 70 km, along the road and 80 km along the railway from Bombay after which most of the settlements show virtually no change in the land utilisation pattern from agricultural to non agricultural uses. This attributes, unlike the other
DISTANCE DECAY FUNCTION FOR CHANGE IN LAND USE FOR SETTLEMENTS
ALONG THE BOMBAY-PONNA RAILWAY

DISTANCE DECAY FUNCTION FOR CHANGE IN LAND USE FOR SETTLEMENTS
ALONG THE BOMBAY-PONNA ROAD

Fig 7.12A

Fig 7.12B
parameters that have been considered so far reflects the actual magnitude of the transformation process of settlements from eminently agricultural to non agricultural uses. As a city grows, not only does the actual built up area of the city increase, but the high land values in the city push out the residential functions. The dispersal of residences takes place along the transport axes from where commuting is feasible. Industry too has dispersed and relocated outside the city limits where cheap land and labour was available, and often to avoid Municipal taxes. Modern technical developments too have resulted in the movement of industry out of the city. Continuous material flow systems on a single level (rather than several stories) increases the demand for space and consequently results in the growth of industries in the suburbs. Thus, the change in the land use from agricultural to residential and industrial uses at distances of 70 and 80 km. from the central city is associated with high land values at the core and the progressive decline in the values as one moves towards the periphery.

Summing up, an analysis of the hinterlands of the internodal centres reveals that the functional character of the central cities is the major factor which influences the extent of their hinterlands. Other factors crucial in determining the extent of the hinterland are:

(i) Spacing of centres
(ii) Nature of the hinterland
(iii) Population densities of the hinterland
(iv) Transport facilities available.

The hinterlands of industrial centres unlike those of Other Services do not grow in proportion to their own size
after large scale development has occurred at the centre. Their growth is linked with the employment capacity of the industrial units located within their limits and there is a time lag before service industries develop to cater to the needs of the industrial workers. The absence of central place functions in these centres greatly restricts the extent of their hinterlands. This is seen in the absence of backward and forward linkages between the urban centre and the surrounding countryside. Hence the potential of industry in Regional planning as an agent for stimulating and spreading growth remains rather limited.

The levels of interaction of the two nodes along the major road and rail arteries are defined with the help of the distance decay function. As, is the case with most developing countries, in the study region also, there is rapid decline in the gradients of the various socioeconomic parameters within short distance from the city centres. For e.g. the zone of intense interaction for Bombay does not exceed 70 km., whereas, for Poona it extends upto 40 km. It must be emphasized that the extent of zone of interaction is dependent on the mode of transport. Historically, when the early modes of transport relied upon the natural power of animals or human muscle power for the movement of people and goods, the extent of the city's influence on the countryside was extremely limited, rarely extending beyond a few km. The development of motive power has greatly extended the range of city's influence. Of the two modes - the motor car and the railway, the latter is more significant in a developing economy. Its importance is even greater in the study region where the suburban network is well developed. The railway provides
relatively rapid movement of large numbers of people as well as goods. Besides, its carrying capacity being greater, it is also cheaper than road travel. The cost factor is of immense significance in an economically backward country. It has been observed while studying the socio-economic parameters along both the axes in the region that the zone of interaction is consistently greater along the railway than along the road.

In developed countries there is an increased dependence on cars and trucks at the expense of the railroad. The vast importance of contemporary road transport is a reflection of its unrivalled convenience to the user. They provide a comprehensive door to door or origin to destination service and have a more extensive route network than the railways. All important towns are linked by inter-communicating road systems and most of them have a linking coach service. In these countries therefore, the zone of interaction of an urban centre is much greater along the roadways.

On the basis of the inferences gathered from the above analysis a simplified three stage model of urban expansion for metropolitan areas in developing countries is visualised. Stage I marks the growth of the primate city, in this case Bombay, which consists of a localised high density cluster in a totally undeveloped rural setting dominated by subsistence agriculture. At this stage links between the city and its hinterland are minimal.

Stage II is the critical or "take-off" stage and is characterised by the development of transport links between the city and its region. This is marked by two geographical characteristics'
first the exchange of products between the city and its hinterland. Second, the promotion and growth of the dormitory suburbs with the initiation of commuting. The phenomena of commuting create a daily tidal flow of workers into and out of the city, the city centre still being the focus of all development. With the growth of transportation, the process of differential growth of centres in the region begins. The major transport junctions grow more rapidly as compared to the other settlements in the area.

Stage III - The secondary centres which have grown primarily to cater to the needs of the primate city acquire some important functions and develop as growth centres in their own right. These start functioning as subsidiary growth poles in the region. The cities get integrated into a unified economic system and the settlement pattern evolves from an essentially primate to a hierarchical one. The continuation of this process leads to increasing suburban sprawl and the destruction of the intervening rural landscape. This leads to the evolution of a conurbation of cities, somewhat in the nature of a Megalopolis comparable to the one which has evolved in the North - Eastern seaboard of the United States of America.
REFERENCES


