CHAPTER - III

SPATIAL PATTERN OF SETTLEMENTS

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CHAPTER - III

SPATIAL PATTERN OF SETTLEMENTS

DISTRIBUTION OF SETTLEMENTS

Based on Population Size:

The growth and size of settlement may be dependent geographically, on a host of conditions like social, economic and political aspects which naturally vary from place to place and time to time. "Rural settlement is a complex entity, and its study pertains to the description and analysis of the distribution of buildings by which people attach themselves to the land".33 "As an occupancy unit it represents an organised colony of human beings, including the buildings in which they like or work or store things or use them otherwise and the tracts or streets over which their movements take place."34

The term village as a basic administrative settlement unit means usually a central, and in many case, scattered aggregate of residences, the inhabitants of which have certain relations


34. Singh R.L.(1961); "Meaning Objective and Scope of Settlement Geography", N.G.J.I.,7, P.12
and even some kind of union or bond of common government, as in traditional India. The village also means a revenue mauza with a number of clusters or hamlets separated from each other by parcels of agricultural or other lands within its recognised territorial limit. The main objective of the present chapter is to know the settlement pattern in terms of population size as well as their spatial distribution. It is considered here to make an analysis of the demographic structure of the area on the one hand and physical-socio-economic and cultural factors on the other, in an integrated manner in recognising and analysing the distribution and different types of rural settlements in the area.

Settlements are classed here on the basis of their population size for rural as well as urban. As per 1971 census the coastal area has 17,96,356 population (1981 census 21,92,824) population distributed in 846 settlements (rural + urban) of various sizes (Fig.4).

In the present context the following arbitrary groups of population have been classed in order to understand their implications (table No.1).

<table>
<thead>
<tr>
<th>I.</th>
<th>Very small rural settlements</th>
<th>25 to 200 population</th>
</tr>
</thead>
<tbody>
<tr>
<td>II.</td>
<td>Small rural settlements</td>
<td>201 to 500 population</td>
</tr>
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<td>III.</td>
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<td>501 to 2000 population</td>
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</tbody>
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IV. Large rural settlements  
2001 to 3000 population

V. Very large rural settlements.  
3001 to 5000 population

VI. Exceptionally large rural settlements.  
5001 to 10,000 population*

VII. Urban settlements (defined as per census 1971)

There are 17 hamlets with less than 25 population each. These exert very meagre influence in the coast and as such they are not accounted for detail study. There are 14 other hamlets which are uninhabited.

Among the rural settlements medium, large and very large settlements have considerable spatial implications in the region, as they represent 21.24%, 18.34%, 18.35% of the total population respectively. Then come exceptionally large settlements (13.27%) followed by small settlements (2.35%), and very small settlements (0.92%). As an exception, two settlements have more than 10,000 population (1.13%). By field work and glancing at the secondary data it is revealed that rural small scale industries like, tile making, coir industry, house-hold industry and fishing activities are widely taking place in the coastal Karnataka. These activities have given scope to migrate the people from very small and small settlements to medium and large settlements.

* This class also includes two settlements like Buntwal (10,172 population) and Vittal (10,216 population), identified as rur-urban settlements.
There are 17 urban settlements* in the regions. Out of which one is city i.e., Mangalore urban Agglomeration. It has a population of 3,06,078. There are 7 towns of Class-III like Karwar with 47,210 population followed by Udipi (33,413) population, Buntwal (31,378 population), Coondapur (28,315 population), Surathkal (25,998 population), Bhatkal (25,665 population) and Kumta (23,385 population).

In Class IV there are 7 towns: Malpe (17,985 population), Honavar (15,124 population), Byndoor (14,071 population), Saligram (13,200 population), Ankola (12,153 population), Mulki (12,098) population and Gangolli (11,957 population). Whereas there are only two 7th order towns in the region namely Badaga-Bettu (8,333 population) and Tonce-West (8,306 population). There are no Class-II and VIIth towns in the region.

During 1971 census 19 towns were identified in the coastal region. The Shirva town is declassified as a village in 1981 due to lack of urban characters. Another town Shivalli of 1971 is merged with Udipi town. Whereas Ankola, Buntwal, Baindur, Suratkal, Badaga-Bettu and Saligram settlements have been raised as towns in 1981 due to their urban characteristics. Five towns* of 1971 have been merged

* For urban settlements data is based on 1981 provisional census.

** Merged towns with Mangalore Urban Agglomeration(1981):
1) Derebail, (2) Fadavu (3) Kankanadi (3) Ullal and (5) Someshwar.
in Mangalore and two towns (Shivalli and Udyavar) with Udipi. The urban settlements with 17 in numbers (as per 1981 census) contribute 28.94% of population to the total population of the coast.

Population size-wise Analysis:

1) **Very Small Size Settlements (25-200 population):**

There are 132 very small size rural settlements out of 827 rural settlements of the entire region. These are accounting 0.92% of the coastal population. Kumta taluk with 44 settlements contributes 45.78% of population in this class. This is followed by Bhatkal taluk 27 settlements (27.46% population), Honavar 25 settlements (14.30% population), Ankola taluk 25 settlements (12.23% population), Karwar taluk 9 settlements (6.12% population) and Coondapur taluk 1 settlement (0.11% population). The talukas like Udipi, Mangalore and Buntwal have no settlements of this size. Due to slow growth of regional economy in the talukas like Kumta, Bhatkal, Ankola, the settlements of this size are not developing.

2. **Small Size Settlements (201 to 500 population):**

This small size is comprising of 84 settlements out of 827 rural settlements of the entire region. These are accounting 2.35% of coastal population. Kumta and Ankola talukas have 22 settlements each, of this size, with 32.80% and 32.23% population respectively. It is followed by Bhatkal 10
settlements (13.44% population), Honavar 15 settlements (9.33% population), Karwar 11 settlements (8.74% population), Udipi 4 settlements (1.05% population), Mangalore 1 settlement (0.97% population), Buntwal 1 settlement (0.95% population) and Coondapur 1 settlement (0.43% population). The share of small size settlements is less in many talukas except Kumta, Ankola and Honavar. These talukas have more share of this size settlement due to the lack of growth of regional economy and inadequate number and distribution of community amenities.

3. Medium Size Settlements (501 to 2000 population)

There are 325 rural settlements in this category with 21.24% of population. The distribution of medium size settlements in all the talukas is relatively more uniform except Bhatkal taluka. Percentage variation of population is also less among the talukas. Coondapur taluk has 56 settlements with 20.42% population, Mangalore taluk 45 settlements (16.05% population), Udipi taluk 37 settlements (13.87% population), Buntwal taluk 35 settlements (12.22% population), Honavar taluk 40 settlements (11.21% population), Kumta taluk 39 settlements (8.25% population), Karwar taluk 27 settlements (7.11% population), Ankola taluk 30 settlements (6.37% population) and Bhatkal taluk 16 settlements (4.50% population). Maximum settlements of this size are connected by roads.
4. **Large Size Settlements (2001 to 3000 population):**

There are 141 large size rural settlements out of 827 rural settlements of the entire coastal region. These contribute about 16.84% of the coastal population. Udupi taluk has maximum settlements (39) with 28.65% of population. But the Ankola taluk has minimum settlements (2) with 1.45% of population followed by Mangalore taluk 23 settlements (19.82% population), Coondapur taluk 27 settlements (19.05% population), Buntwal taluk 22 settlements (16.19% population), Honavar taluk 11 settlements (7.79% population), Kumta taluk 6 settlements (3.63% population), Karwar taluk 3 settlements (2.07% population), Bhatkal taluk 3 settlements (1.95% population). Here due to the development of secondary activities the situation almost similar to that of the medium size rural settlements prevail.

5. **Very Large Size Settlements (3001 to 5000 population):**

This class comprises of 93 rural settlements out of 827 rural settlements of the entire coastal region. These contribute 18.35% of coastal population. Discrepancies in the proportional shares of the settlements are observed in the talukas like Coondapur, Karwar, Bhatkal, Ankola and Honavar. These talukas consist of 10 settlements (11.04% population), 7 settlements (7.21% population), 6 settlements (4.53% population), 4 settlements (3.63% population) and 3 settlements (2.86% population) respectively. But the share of very large rural settlements
in Udipi, Mangalore and Buntwal talukas is quite high due to urban impact accounting respectively for 23 settlements (26.06% population), 21 settlements (23.90% population) and 18 settlements (19.80% population). Whereas Kunta taluk has one settlement with 0.97% population. Mostly in Udipi, Mangalore and Buntwal talukas very large settlements are located on the nodal points and river banks. But in other talukas settlements are located in irregular pattern.

6. Exceptionally Large Size Settlements (5001 to 10,000 population)

This size has 36 settlements in the entire region (out of 827 rural settlements) with 13.27% population. These settlements are unevenly distributed in the region. Udipi taluk consists of 10 settlements with 27.49% of population followed by Mangalore taluk 7 settlements (20.23% population), Buntwal 6 settlements (16.48% population), Coondapur 5 settlements (12.85% population), Kunta taluk 2 settlements (6.40% population), Karwar taluk 2 settlements (5.92% population), Anakala taluk 2 settlements (4.65% population), Honavar 1 settlement (3.87% population) and Bhatkal 1 settlement (2.11% population). Two settlements i.e. Buntwal and Vittal have 10,172 and 10,216 population each. They have 1.13% of population of the region. Exceptionally large settlements can be observed mostly on nodal roads, and river banks. Such settlements have been developed due to the concentration of household industries, small scale industries and availability of social amenities.
Therefore, Buntwal and Vittal settlements are classed as rur-urban centres. This study reveals that (1) along the coast there are more number of medium and large rural settlements. These account for 40.08% of total coastal population (466 settlements). (2) Urban settlements are comparatively lesser (17) than rural (846) settlements with 2.25% of population, but the proportion of urban population to the total population is 23.90%. (3) Talukas like Karwar, Coonda­pur, Udupi, and Mangalore, are comprising of less number of small size rural settlements. In Udupi, Mangalore and Buntwal talukas very small rural settlements are not at all noticed. Ankola, Kumta, Honavar and Bhatkal talukas have mere number of very small and small sized rural settlements. Whereas Karwar (9) and Coondapur (1) have very least number of 'very small sized' rural settlements.

Considering the above details it can be said that people might have been migrated to the medium, large and urban settlements because of non-availability of job opportunities, education facilities and medical facilities etc. in their respective settlements. * Therefore we find more number of settlements in the above groups. If this trend continues then in the future there may be lot of population

* Statement is based on author's field observation and sample studies.
congestion, unemployment problem, slum problem, medical problem, in the medium and large rural and urban settlements.

To solve these problems, the government authorities have to start small scale, and house-hold industries (like tile making, handlooms, fishing along the river banks, mining quarrying, boatbuilding, cashew and coffee processing, chemical fertilizers, rice and oil mills, metal works etc.) in the small and very small settlements instead of concentrating them in the urban centres. The medical, educational, communicational facilities and transportation linkages should be extended to the people of small and very small settlements in order to make the unemployed people of medium, large rural and urban settlements to be attracted to settle in such areas. If these suggestions are incorporated by the area-planners then spatial problems will be lessened to a considerable extent.

Spacing of Settlements:

The study of the spatial as well as temporal variation of distributional pattern of settlements is of utmost importance in regional studies. According to Perpillou, "Settlement is man's first step towards adopting himself to his environment. It is a concrete expression of human occupancy on the earth's surface. Certain lodgements and forms of dwellings are very closely connected with the details of relief, geographical

36. Perpillou, (1966); Human Geography, P. 406
structure and other physical features. The geographers consider first of all how the material environment has a paramount influence in the disposition and forms of Man's dwelling. The term "type" gives an idea of the "relationship between settlements within space," this means a set of relatively homogenous units defined by specific criteria. Number of Geographers have presented many methods for classifying human settlements with reference to the size: large, small and medium etc., site: valley side, road side, river side settlements and time: like pre-historic, ancient, medieval and modern settlements.

In the study area a researcher has observed that, most of the villages are scattered in the coastal plain. Along the entire coastline, the settlements appear in long stretch on either side of the main roads and river banks. The sites of the settlements were chosen along the sides of the rivers in order to conserve water for agricultural and domestic purposes. Country side, towards the east of the coast-line small hamlets are noticed consisting of about 100 to 500 dwelling houses, depending upon the fertility of the agricultural area and hill slopes.

Along the North Kanara coast linear type of settlements are noticed. Especially towards the south of North Kanara some settlements are dispersed because of rugged topography, whereas in south Kanara this type is not prominent. Generally throughout the coast all settlements are linear. These are noticed along National High Way-17, other main roads and on the banks of rivers like Kali, Netravati etc., some settlements are situated on the banks of the tributaries of the said rivers. In such settlements the occupational functions like agriculture, fishing, transportation etc., are commonly found.

According to Watson\(^3^9\)(1955), "Geography itself is a discipline in distance", and according to Cole and King\(^3^9\)(1968), "Geography is the science that is mainly concerned with the distribution of elements that occur on the earth-surface and with the variations of distributions through time and space."

Generally distributional pattern of the settlements is controlled by the physical and environmental factors. The physico-socio-economic conditions are usually responsible for the concentrations and dispersions of the settlements. Generally to describe the settlement patterns the following qualitative terms are being used like sparse, dispersed, agglomerated or dense. In some cases these terms do not express clearly the pattern of settlement distribution. To know all such geographical distributions and variations (settlements like mining, 38 and 39. Cole, J.P. and King C.A.M. (1968); "Quantitative Geography", Wiley, P.P. 176-192 & 473-562.
manufacturing and marketing centres etc.), the "Nearest Neighbour Technique" has been adopted.

The statistic 'R' gives an idea of the distribution of settlements in coastal Karnataka. Considering the region as a whole, the pattern of distribution of settlements shows an "approaching uniform pattern", (R value 1.2167). Suitable equations are also formulated to measure the size, distributions and dispersions of the settlements. Really the utility of this method is found more meaningful in locational and spatial analysis as well as in regional planning.

Methodology:

This "Nearest Neighbour Analysis" was modified and revised by N.B.K. Reddy. According to him the higher Rn-scale is '2.15' and it represents maximum dispersal and lowest Rn-scale is '0' and it represents an absolute concentration. Then is it not logical to expect a Rn-scale to represent a critical distribution in between these two extremes? This critical stage is conspicuous by its absence in the Rn-scale given by Clark and Evans and others. Regular dispersions and regular concentrations may occur due to certain exigencies or geographical conditions e.g. strategic considerations and favourable site conditions. Considering the guidelines suggested by N.B.K. Reddy for his revised-Rn-scale, the further modification of the scale is done here:

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41. Clark and Evans P.J.(1954)"Distance to nearest neighbour as a measure of spatial relationships in populations, ecology, 39, PP.445-455.
### Rn-Score Distribution Pattern

<table>
<thead>
<tr>
<th>Rn-Score</th>
<th>Distribution Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.51 and above</td>
<td>Dispersion</td>
</tr>
<tr>
<td>1.50</td>
<td>Uniform</td>
</tr>
<tr>
<td>1.20 - 1.49</td>
<td>Approaching Uniform</td>
</tr>
<tr>
<td>1.00 - 1.19</td>
<td>Random</td>
</tr>
<tr>
<td>0.51 - 0.99</td>
<td>Clustered</td>
</tr>
<tr>
<td>0.10 - 0.50</td>
<td>High-Concentration</td>
</tr>
<tr>
<td>0.00 - 0.09</td>
<td>Absolute Concentration</td>
</tr>
</tbody>
</table>

#### Nearest Neighbour Formula

\[
RN = \frac{Do}{De}
\]

- **Do** = Observed Distance
- **De** = Expected Distance

Expected Distance = \(1.07 \sqrt{\frac{A}{N}}\)

where:
- **A** = Area
- **N** = Number of settlements

**Application:**

Survey of India topographs (on 1 inch to a mile scale) have been used to derive a mathematical expression of the pattern of the settlements distribution along the coast. In the area there are 9 taluks spread into two districts. In all there are 846 settlements of which 827 are rural and 19 urban. A series of straight line measurements have been taken...
between individual settlements and their nearest neighbours.

By using the Nearest Neighbour Formula 'R' values have been obtained for the settlements of entire coastal talukas. According to the table No. 2 the 'R' value for the region as a whole is 1.2167 which shows the distributional pattern of the whole region as approaching uniform (Fig. 5). Whereas linear and dendritic patterns are associated with streams, banks, along the roads and rivers etc. Among 9 talukas, Karwar (1.0385), Kumta (1.0382) and Bhatkal (1.1581) have random settlement pattern. In talukas like Ankola (1.2302), Honavar (1.2723), Coondapur (1.3159), Udipi (1.2405), Mangalore (1.4242), and Buntwal (1.4043), the settlement pattern is "Approaching Uniform". Karwar, Kumta and Bhatkal talukas have the random pattern of settlements due to the rugged terrain, poor soils, and valleys. Other six talukas (Ankola, Honavar, Coondapur, Udipi, Mangalore and Buntwal) represent an "approaching uniform" pattern of settlements due to the close association of settlements with rivers (Neravati, Sharanavati, Gurupur etc.), and roads etc. with the above results it can be said that usually the pattern of settlements is mainly governed by population density, physical, cultural and economic factors.

Here an attempt has been made to analyse the determination of the 'R' values. 'R' values are the possible correlations which may exist between pattern and size. On account of the considerable influence exerted by a few unusually large
Nearest Neighbour Statistic

 median size of population

0.50 100 150 2.00

 nearest neighbour statistic

 Fig-6
<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of the Taluk</th>
<th>No. of Settlements</th>
<th>Density of Settlements per sq. mile</th>
<th>Do Mean observed distance</th>
<th>De Expected Mean distance in Random distribution</th>
<th>Nearest Neighbour Statistic (R)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Karwar</td>
<td>60</td>
<td>0.0820</td>
<td>1.0012</td>
<td>0.9641</td>
<td>1.0385</td>
</tr>
<tr>
<td>2.</td>
<td>Ankola</td>
<td>88</td>
<td>0.0959</td>
<td>0.7102</td>
<td>0.5773</td>
<td>1.2302</td>
</tr>
<tr>
<td>3.</td>
<td>Kumta</td>
<td>123</td>
<td>0.2081</td>
<td>0.5514</td>
<td>0.5311</td>
<td>1.0582</td>
</tr>
<tr>
<td>4.</td>
<td>Honavar</td>
<td>98</td>
<td>0.1317</td>
<td>0.7567</td>
<td>0.6026</td>
<td>1.2723</td>
</tr>
<tr>
<td>5.</td>
<td>Bhatkal</td>
<td>65</td>
<td>0.1859</td>
<td>0.8124</td>
<td>0.7015</td>
<td>1.1581</td>
</tr>
<tr>
<td>6.</td>
<td>Coondapur</td>
<td>103</td>
<td>0.560</td>
<td>1.0509</td>
<td>0.7936</td>
<td>1.3159</td>
</tr>
<tr>
<td>7.</td>
<td>Udipi</td>
<td>116</td>
<td>0.1249</td>
<td>0.8548</td>
<td>0.6891</td>
<td>1.2405</td>
</tr>
<tr>
<td>8.</td>
<td>Mangalore</td>
<td>109</td>
<td>0.1944</td>
<td>0.9099</td>
<td>0.6389</td>
<td>1.4242</td>
</tr>
<tr>
<td>9.</td>
<td>Buntwal</td>
<td>84</td>
<td>0.1174</td>
<td>0.8198</td>
<td>0.7321</td>
<td>1.4043</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>846</td>
<td>0.1192</td>
<td>0.8157</td>
<td>0.6704</td>
<td>1.2167</td>
</tr>
</tbody>
</table>
In both the cases (Fig. 6 and 7) correlation coefficient is found to be negative and this is mainly because of the small size and varying dispersion pattern of the settlements.

Demarcation of Concentration:

In order to demarcate the concentration/clusters of the settlements the researcher has used the formula given by K.P.K. Reddy, i.e.

\[ \delta = \sqrt{A/N} \]

where

'\( \delta \)' = the distance of the separation between any two settlements

'\( A \)' = the area of the region

'\( N \)' = the total number of settlements in the area.

The demarcation of the concentration of the settlements can be observed very easily. A settlement appearing to be in a concentration is selected as a starting point and the successive settlements which are less than the distance ' \( \delta \) ' are included in the same concentration. The rest of the settlements which are situated outside the demarcated area are considered as dispersed, settlements. Thus along the Coastal Karnataka an attempt has been made to demarcate the concentration of settlements. Totally, there are 8 large concentrations (they are numbered on the map from 1 to 8 on the basis of spatial size), which are consisting of more than 10 settlements each and remaining concentrations (not numbered) have below 10 settlements.
each (only large concentrations are numbered). Number one concentration covers three talukas (Ankola, Kumta and part of Honavar). It has 190 settlements including one urban settlement i.e. Kumta. Other large rural settlements like Ankola, Gokarn, Bhavikeri, Shedgeri and Bomrunwa have more than 4000 population. This large concentration is due to combined impact of plantation based industries and due to several activities like commercial, fishing, mining and quarrying. Number 2 concentration has 181 (with seven urban settlements). Settlements in two talukas (Mangalore and Buntwal). This large concentration is due to the rapid growth of industries and better means of transport etc. The remaining concentrations contain settlements ranging the number between 35 to 77 each.

Really it is an interesting study area as most of the settlements are located all along the roads, National Highway and main roads, which include primary and secondary activities like, fishing, agriculture, mining quarrying and industries like boatbuilding, cashew and coffee processing, automobile works, soap industry, metal works, chemical fertiliser industries, rice and oil mills, tile works etc. Because of these activities the linear type of settlements are emerged. Urban settlements like Karwar, Kumta, Honavar, Bhatkal, Coondapur, Udipi, Tonsewest, Mangalore, Mulki, Ullal etc. have the activities like services, trade, commerce and transportation.
The transportation facilities have better developed around Mangalore. The settlements that are situated on the river banks and on the coast are engaged in fishing. Whereas in North Kanara coast few rural settlements have scattered because of the rugged topography. Some what compact rural settlements have noticed near by Netravati, Sharavati and Kali river beds because of their good alluvial soil. Big rural settlements like Baad, Bobruwada, Kalbag, Haldipur-I and III, Hebile, Gokarn, Ankola, Giliyar and urban settlements like Karwar, Coondasur, Udipi, Honavar, Mangalore, Ullal etc. are surrounded by compact pattern of settlements.

With the help of the "Nearest Neighbour Technique" it would be possible to know the distributional pattern of the settlements in any region. General pattern of the settlements distribution along the coast is "approaching uniform". This is because of the even distribution of the modes of transportation, interlinking of urban settlements, service centres and uniform topography etc. Here an interesting point to be noted is that out 827 rural settlements only 44 settlements have the weekly markets. The market facilities are available only in the taluka headquarters, urban centres and large rural settlements. Therefore concentration of the settlements is not a sign of prosperity. To lessen the developmental gap between the rural and urban settlements the rural nodal settlements can be strengthened by way of
extending community amenities. While doing this exercise the dispersed settlements (isolated) must be taken into care.

Hierarchy of Settlements: (Rank Size Relationship 1971)

The "Rank size rule" is a technique to find out the relationship between settlements and their population hierarchy. In other words it is an investigative hypothesis, a theoretical model* or a norm to express the relationship of the observed empirical regularity in the settlements size. It represents a generalised picture of the hierarchy of the urban as well as rural settlements of a region. The "Rank-size relationship" states that if all the urban and rural settlements in an area are ranked in a descending order of population size, the population of nth settlement will be 1/nth size of the largest settlement and the population of the other settlements will be arranged according to the series 1, 1/2, 1/3, 1/4, 1/5, .......1/nth. When plotted on a graph this technique reveals the result as shown in figure-8.

In the present study log-log graph shows the rank and their population size of 846 settlements having population of more than 10. The graph shows Mangalore as the first ranking urban settlement with 1,65,174 population. The 346th settlement (Murkodi village) is the nth ranked settlement with 12 as its population. The exponential lines show theoretical rank and

* The "Rank size rule" is symbolic model in which the properties are expressed by equation. It represents the third stage of abstraction in which the loss of information is maximum, so that the representation becomes more abstract and general.
size of the settlements. According to these lines the population of 846th ranked settlement would have been 196 if considered from top to bottom and the Mangalore would have been 8,460 population if considered from bottom (846th settlement) to top. The rank size relationship is somewhat better in the case of urban settlements where population size ranges from 10,000 (Udyavar) to 1,65,174 (Mangalore). For rural settlements it is quite far from the reality of rank size rule.

**Transport:**

The Karnataka coast with a length of 320 kms. has been linked with National Highway-17. This Highway connects the entire western coast right from Gujarat coast in the north to Trivendrum in the south of the Kerala coast. Due to non-availability of the bridge across the river Kali, near Karwar the N.H.-17 was disconnected at both sides of the bank of the river Kali. Due to deep tidal water at the mouth of Kali river and hard basalt rock boulder on the right side of the Kali river it was not possible to construct the bridge across the Kali, till recently. Therefore the non-linkage of the N.H.-17 had hindered the growth of Karnataka coast in particular. Recently a strong bridge has been completed across the Kali and we have to wait for its impact on the transport-linked development activities. Mangalore in the southern part of the Karnataka coast, with N.H.-48 is connected with Bangalore. Several
district major roads of North Kanara district and South Kanara district connect the coastal region and make trade, transport and commerce as living function of the region. The observation of the route map and settlements show us that most of the villages are connected by local pacco road or kachcha road. The region being still under developmental stage has to wait to have better net work connections to link almost all villages through pacco roads. In South Kanara, apart from Karnataka state road transport, the private buses also make the transport service for passenger transport. Because of this fact, there is more spatial development in South Kanara coast than the North Kanara coast. The North Kanara coast which is enclaved by the eastern ghats being narrow and close to the coast is, rather less developed in road connectivity. It is long felt economic desire of the people to have railway link from Karwar to Hubli in the east. In spite of Karwar being a natural port it has been hindered in its port development and regional development due to non-availability of the railway line. It is unfortunate that though several commissions have recommended to link Karwar and Hubli by rail but yet it has not been implemented. The metalled roads are spread in 1100 square kms. area of the coast whereas unmetalled roads are in 250 sq. kms. The density of roads is 0.30 kms. per square km. Every 10,000 people possess 10 kms. of roads. (Fig. 9).
Out of 327 villages of the Karnataka coast 395 villages have been connected with paccia roads, 336 settlements have been connected with kachcha roads. The rest of the 96 villages in the coast are without any type of road connections. Such villages have to transit with other settlements only by cart tract or foot-path.

Along the coast the ships and launches move to a very limited distance for transport of fish and the other goods. Occasionally passenger ship as well as goods ship move along the coast to connect Mangalore, Karwar, Goa and Bombay. There is enough scope to gear up passenger transport along the coastal settlements. If it is developed the coast will have easy transport facility. In this connection the ports like Ankola, Honwar, Gokarna, Malpe, Kundu, Coondapur and Bhatkal need higher priorities for construction of ship anchors. It is high time to develop west coast of India by way of linking the entire coastal regions of Karnataka, Kerala, Maharashtra and Gujarat by railway line. This action will certainly give multiple scope for the development of Karnataka coast. Mangalore with broad-gauge and meter-gauge connections from Kerala and Southeastern Karnataka respectively enjoys better status in the transport system than Karwar and its region.
Route Development Model:

The growth of roads, railways, canals and the like is inextricably woven into the whole process of economic growth and regional development. One of the few attempts to bring together the broad regularities in the growth of internal transport lines has been by Taeffe, Morrill and Gould (1963). On the basis of specific study of the growth of transport in Ghana and Nigeria, with less intensive study of Brazil, British East Africa and Malaya, they proposed a four phase sequence of development of route pattern (Vide fig.10).

Phase A:— Consists of a scatter of small ports and trading ports along the coast of the hypothetical region being developed and each small port has a small inland trading field but there is little contact along the coast except through occasional fishing boats and irregular traders. This phase they identify in Nigeria and Ghana as running from the 15th century to the end of 19th century. In case of our region i.e., coastal Karnataka the route development models as suggested by Taeffe, Morrill and Gould holds good. All the four phases suggested by them are examined in the study area and the result is revealed as following:

In the 15th century, as per historical records of Karnataka, the Karnataka coast was engaged in certain trading activities through its small ports like Honavar, Mangalore, Karwar and Kumta. These centres were engaged in trading activities along the coast.

42. Haggett P., Andrew D. Cliff and Allanfrey (1977); Locational Analysis in human Geography, pp. 92-94.
FOUR-STAGE DIACHRONIC MODEL OF NETWORK DEVELOPMENT
alon
within small extent of inland trading and far off sea
corrections especially with European countries. Therefore,
the phase-A is identical with initiation of route connec-
tions to the coastal centres.

Phase B: Consists of the emergence of a few major lines
of penetration, the growth of inland trading centres at the
terminals, and the differential growth of coastal ports with
inland connections. With the growth of the coastal ports the
local hinterland also expands and diagonal routes begin to
focus on the growing ports. This situation is very well identi-
cal to the growth of Mangalore and Karwar as the leading port
towns along the coast and these two have been connected by far
off hinterland centres like Hubli, Bellary, Belgaum, Sirsi,
with Karwar, and Hassan, Bangalore, Chikkamagalur, Shimoga and
Mysore with Mangalore.

Phase C: Consists of the growth of feeder routes and the
beginnings of lateral inter connection. The development of
feeder routes is accompanied by continued growth of the main
sea-coast terminal in a spiral of trade capture and expansion.
Intermediate centres grow up between the coastal and interior
terminals. In this connection, in the entire coastal region
and the western ghat areas of Hassan, Chikkamagalur, Shimoga,
Karwar, we find the development of urban centres and thereby
route connections to port centres i.e., Mangalore and Karwar. At the diagonal connection small and medium urban centres like Thirthhalli, Madagere, Sakaleshwar, Uppinangadi, Sagar have been emerged in the inland trading area of Mangalore, harbour, besides the major urban centres like Chikkamagalur, Mercara, Tumkur, Shimoga, Bhadravati, Hassan. All these have been developed because of better route development connecting the coastal region. Around Karwar; Hubli, Sirsi, Dharwad, Belgaum Gadag, Haveri, Byadgi, Ranebennur and several other centres of varying sizes and also the far off mining area of Bellary are linked to the Karwar port. In between Karwar and Mangalore i.e., along the coast the small port towns and other urban centres which were of still smaller order at the time of development of phase-B and phase-A have emerged in higher order in the phase-C, namely Udipi, Malpe, Coondapur, Bhaktal, Honavar, Kunta, Gokarn and Ankola. All these centres are linked towards the east by diagonal routes and the small places that are located at a distance of 50 to 60 kms., have resource capacity to emerge as medium centres as shown in the phase-C.

Phase-Di- Repeats the process of linkage and concentration and shows the emergence of high priority linkages between the most important centres. The best paved roads, the heaviest rail schedules and air line connections will follow these main street links between the centres. Again this phase is seen in our study area, of course only around Mangalore and to certain
Photo 9  A view of the Mangalore city.

Photo 10  A view of Mangalore Railway Station.
extent Mangalore has been connected by broad-guage and meterguage railway line connecting Kerala coast and Bangalore, Hassan and also Ooty region of Tamilnadu. An airline connection touches Mangalore connecting Bangalore, Bombay, Goa and Belgaum. But in case of Kanyak this phase is not yet emerged. Plans are being designed to bring such better route development structure to the region.

Relationship Between Settlements and Agriculture:

Out of the total geographical area of the study area nearly 24.36% of land is meant for agriculture. Agriculture towards the east of the coast is practiced on terraces of the slopes of western ghat. In such areas settlements are located around the agricultural land or in the valleys. Therefore such villages are isolated from the main land of the coast. As a result they lack in transport connectivity and other types of functions and amenities. The settlements located in the agriculture land of coastal plain are better off in matters of linkages and functions. As such, they are not static in their spatio-functional growth. It can be precisely said that settlements located in agriculture lands of north Kanara coast are generally, isolated except in case of Shatkal taluk, which is less rugged. This situation is visa-verse in case of south Kanara coast due to plain agricultural lands.
Relationship between Settlements and Fishing:

The location of settlements as fishing centres depends upon the nature of coast, fish availability in the sea and other infrastructural facilities available in fishing settlements. Keeping these aspects in view it can be said that all along the coast the settlements can thrive better since the coast has no prominent physical intrusions. Most of the fishermen are settled in major fishing centres of the coast like Karwar, Mangalore, Ankola, Kunta, Honavar, Bhatkal, Malpe, Udipi, Coondapur, Gokarn and Gangolli etc. These centres have better scope for fishing activity due to the availability of necessary infrastructural facilities. It is pitiable that the small fishing villages and huts look like deserted as they do not have enough facilities to thrive their fishing. Therefore, in order to uplift the isolated fishing villages and also to check the fishermen's migration from small centres to big fishing centres, this study calls for an integrated rural development.

Markets:

In India the basic facilities and services are not provided efficiently in all the villages. Therefore this situation calls for the organisation of weekly markets. The weekly markets act as periodic central places which serve the needs of the rural population periodically. They are the centres of distribution and collection of the goods and services. In India mostly these weekly market centres are
fairly distributed in agricultural areas where urbanisation is poor and topography is with less transport obstacles. Weekly market is an important rural economic institution in the agrarian economy of the country and these traditional weekly markets help considerably to the process of rural development.

In our study area out of 327 rural settlements, 44 settlements have weekly market function. Apart from these all the urban centres in the coastal Karnataka also perform weekly market activity. The rural weekly market centres are in the population range from 1000 to 8000. These centres are located on the roadside or on crossroads which facilitate their influence to the surrounding hamleted villages. As far as the urban market centres are concerned there are no problems of their organisation and functioning. But in case of the rural markets it is necessary to strengthen them in order to develop the interaction among the villages and market centres. In backward areas settlements cannot hold various functions and facilities because of the poor threshold population and absence of necessary infrastructure, in such areas the places holding weekly markets provide these functions and services periodically. There is one generalisation that "if there are few number of weekly markets in the region that indicates as the sign of the economic development". But this statement may not hold good

* From the paper abstracts of "Weekly markets and regional development", Dept. of Geography, Madurai Kamaraj University, Madurai, 1983.
in case of coastal Karnataka due to its distinct location and surroundings, such as the Arabian sea in the west and western ghats in the east as two barriers for the rigorous interaction of the people for the various functions among the settlements. Out of the 44 rural settlements the highest number of weekly markets are in Udupi taluk, which has 110 villages. In case of Kumta taluk, though it has the highest number of villages (122), yet it is strange to observe that there is not even a single weekly market, and it may be because of hamleted type of settlement pattern that are either linear or in a close clusters. The people of this taluk usually depend on Kumta (urban centre) market. General pattern of the distribution of weekly markets in the rest of the talukas is as following: Coondapur-13 (out of 101 settlements), Buntwal-8 (out of 84 settlements), Mangalore-3 (out of 102 settlements), Bhatkal-1 (out of 64 settlements), Kurwar-1 (Out of 59 settlements). The talukas like Anzola, Honavar and Kumta do not possess rural weekly markets. The villages of these talukas have lesser population threshold and poor infrastructural facilities to hold weekly markets. The villages of these talukas necessarily depend upon urban markets. In case of Mangalore taluk, due to the developed means of transport interaction between Mangalore city and the entire taluk, the people of rural side almost depend on weekly market and daily market held at Mangalore city. Due to the Physical barriers like rivers and hills in Karwar taluk there is no
Photo 11 A view of weekly market at Udupi.

Photo 12 A view of busy road of Mangalore City (Kankanadi).
scope to hold weekly markets and therefore the settlements of this taluk also depend upon Karwar town market. Thus it is needless to say that there is an urgent need to establish a better pattern of network of roads in the entire coast which will lead to the strengthening of marketing function in rural side.

Ports:

Karwar Ports play a very significant role in the economic development of the region. The traffic handling facilities in the port, the nature of the hinterland, the means of transport and communications, industry and commerce and the population etc. in the hinterland are the principal factors which can promote the growth of the port. The Karwar port is being developed on the mouth of river Kali and is protected in the south and north by the headlands composed of basalt rocky promontory projecting into the sea. It is a roadsted port. The Government of Karnataka State has planned to develop the Karwar port as an 'Intermediate all weather Port.'

The port has at present an annual cargo handling capacity of 3,00,000 tons of ore and about 30,000 tons of general cargo. The average daily cargo handling capacity is about 1900 tons. The traffic at the port varied between 3000-4900 tons during 1950-57. With the commencement of the export of iron ore from the Karwar port the traffic rose
to 32750 tons in 1957-58. It was increased to 223,000 tons in 1961-62. Within a decade the increase in traffic was fifty times greater than the initial stage. The iron ore was about 88,000 tons and it has gone up to 220,000 tons in 1960-61. It is estimated to export about 0.5 million tons of iron ore within a few years. Besides iron and manganese ores, the port exports sweet potato, timber wood, fish & oil cakes. The import includes machines, kerosene oil, oilseeds etc. The hinterland of Karwar Port includes North Kanara, Dharwar, Belgaum, Bijapur, Raichur, Gulbarga, Shimoga, Bellary and Chitrardurga districts of Karnataka of which North Kanara, Dharwad and Belgaum districts form the core of it. Thus the hinterland occupies the entire northern regions of the State, with an area of 116,350 sq. Kms. which is about 60% of the total area of Karnataka. The hinterland of Karwar Port is very rich in mineral wealth and agricultural production. Bellary region is endowed with iron ore which contains 65-66% of iron. It is estimated that the Bellary region has got about 300 million tons of iron ore reserves. Iron ore is also available in North Kanara, Bijapur and Belgaum districts. During 1965-66 about 4.22 million tons iron ore and 10.5 million tons by 1970-71 were exported from Karwar port. Manganese ore is available in Bellary, North Kanara, Chitrardurga and Shimoga districts. It has been estimated that the reserves of Bellary region are about 8 lakh tonnes and they contain about 40% of manganese. About 1.5 million tons of sulphur reserves are available in Chitrardurga district. Limestone is available in Shimoga, Chitrardurga, and Bijapur and Belgaum districts.
Shimoga and Bijapur reserves are very large and they contain about 50% lime. The bauxite—the ore of aluminium is found in Belgaum and Shimoga districts. It has been estimated that the reserves of Belgaum and Shimoga districts. It has been estimated that the reserves of Belgaum and Shimoga districts are about 6.7 lakh and one lakh respectively and they contain 30.50% of $\text{Al}_2\text{O}_3$. All these minerals are useful for the industrial growth of the hinterland. When there will be full swing of industrial development in the hinterland of Karwar, its effects on Karwar port will be glaring and thereby certain, economic development of the coast can be achieved.

Depending on the forest wealth, a few industries are coming up in the hinterland area. The paper mill at Bandeli is one such example, which is the third largest plant in the whole of India. Its annual capacity is about 10,000 tons. The whole western ghats are covered by the evergreen forest and the forest gradually decreases towards the eastern interior lands. The hinterland of the Karwar port at present is not well developed industrially but has bright future because of the availability of raw materials, hydel power, man power and animal strength.

The following cities are the leading centres of industries in the hinterland:— 1. Belgaum— It is famous for hand loom clothes and engineering works. The aluminium plant is working with an annual initial capacity of 30,000 tons.

The prosperity of the port depends primarily on the efficiency of transportation. The Karwar port is not yet connected by railway line with its virgin hinterland, which is one of the most serious drawbacks of the port which should be taken up urgently. But the roads play a very important role in connecting the port and its hinterland. The National Highway No.4 runs in the hinterland and connects the important towns like Belgaum, Hubli-Dharwad, Harihar-and Chitradurga. The West coast National Highway No.17 passes through all along the coast connecting Bombay-Karwar and Mangalore. The port is connected with the Maidan-Region by two roads:


The water transport is not developed in the coastal region. Locally only a few streams are used to transport the bulky materials upto 10-12 kms. length from Karwar port. There are no passenger boats.
The prosperity of the Karwar Port depends mainly on the wealth of the hinterland. The mineral resources, the forest wealth, water power, means of transport and communications etc. should be fully utilised in developing the economic conditions of the hinterland, which in turn can make the port prosperous. It is high time to develop Karwar as an all weather port. The linking of Karwar with Hubli city by railway line should not be delayed furthermore. The existing roads should be improved by way of widening and building bridges in the ghat. Thus the development of Karwar as a natural harbour will certainly impact on regional economic growth of Karwar, its coastal neighbour hood and far off hinterland.

Mangalore: It is only the city on coastal Karnataka with 306078 population as per 1981 census. It is located on the mouth and confluence of the two rivers namely Netravati and Gurupur. Many foreign travellers of historical past have mentioned Mangalore as flourishing port having trading activity with eastern and western countries. To day Mangalore is being developed not only as an all weather major port of India but also as a seat of University, industry, trade and commerce. The area close to the east of coastal belt i.e. "Western Ghats" is rich in iron ore deposits and forest products. Iron ore mined at Kudremukh (located in western Ghats) is being exported through Mangalore port. In the far vicinity of Mangalore the industrial development is taking place at rapid rate, especially in around
Bangalore (State Capital). This industrial complex has greater trading connectivity with Mangalore port. The need for chemical fertilisers in Karnataka has given scope to establish a chemical fertiliser factory at Mangalore, as this factory has to depend on certain raw materials imported from other nations. The port was developed in stages depending upon the development of traffic and industrialisation in its hinterland. Since 1975, Mangalore port is functioning as an all weather major port with several facilities like heavy cargoes, ship repairs etc. Thus today Mangalore port and Mangalore city to gether look like a well developed urban complex. The city with amalgamation of several villages has established urban influence over 10 to 20 Kms. We find several commuters between Mangalore and Udupi, Coondapur, Suratkal, Malpe and from some places of Kerala coast and from neighbouring district of Mangalore, which speaks of the growing nature of urban functions of Mangalore. The fish caught on the coast of Mangalore and its neighbouring coast is processed at Mangalore through cold storages and other mechanised operations. Thus fishermen, fish traders and fish processors are seen along the Mangalore coast. The city has an unique composition of three ethnic groups of population namely Hindus, Muslims and Christians all being equal in numbers. Mangalore has the facility of passenger ship transport towards Kerala coast and Goa and Bombay. The city has been linked with
meterguage railway line from Bangalore and broad guage rail from Kerala coast. It has also air link with Bangalore. Thus Mangalore city, its coastal hub and surroundings look like an urban continums.

**Malpe:**

Malpe is situated at the mouth of Udyavar river. It is a natural port and has the population of 17,985. This place has a fascinating natural scenery. Another interesting feature of the Malpe is that centuries old columnar lava rocks maintained by Geological survey of India in St. Mary's Island (4 to 5 kms from Malpe) and three other island near Malpe port. The three rocky Islands to the west of Malpe port (Daria-Bahadurgad (North), Daria-Gadara-Kallu (Middle), and Kari-Illada-Kallu (South) have carved Malpe as a natural port. As far as port is considered it is emerging as an important fishing centre based on modern lines of mechanised fishing. Here 44.35% of the people are engaged in primary occupation and followed by tertiary (32.52%), and secondary (23.13%). This shows that fishing is more dominant and other two activities are supporting to this primary activity.

Really Malpe, is changing into a fully equipped fishery harbour in Karnataka Coast. After the completion of this new harbour, an additional catch of 40,000 tonnes of fish a year can be expected. In view of its favourable location, in 1976, the United Nations Development Programme at the request of the Karnataka Government accorded priority for a deep sea fishing harbour project.
During 1979-80 the catch of the fish off the south
Kanara Coast was 1,60,000 tonnes, 2/3 of which was from Malpe.
Mainly from this port fish, fish-meal, coir products etc. are
being sent to places within country and outside the country,
rice, salt, clay etc. are brought from the other places
through Malpe. At this extent some plans are being suggested
for the development of this port.

Malpe and Udipi can be made into one micro-regional
unit, because they are in close proximity of 4 kms. Most of
the people are coming from Udipi for fishing and Malpe people
are moving towards Udipi for educational, medical, commercial
and recreational purposes. Like this, there is constant inter-
action between Malpe and Udipi for several activities. Therefore,
these two centres can be developed into one unit. Transport
facilities, community amenities, dwelling etc. can be provided
considering these two towns as one block. If Malpe is deleted
from this Unit then it will be remained as only a fish catching
centre instead of developing as a regional port. Thus there is
an urgent need to consider Malpe and Udipi as one unit of
micro-region.

There are 9 more small port settlements like, Ankola,
Kunta, Honavar, Bhatkal, Shiroor, Gangolli, Coondapur, Suratkal,
and Ullal which once upon a time acted as ports. Today these
settlements have lost their characteristics of port activities.
Our survey indicates that there is enough scope to develop these
centres for marine fishing. In this direction this study recom-
mends to strengthen the fishing activity through mechanisation.
So that, there can be socio-economic change of these centres besides the development of immediate neighbourhood settlements of such centres.
Photo 13 A view of fish port at Malpe. Notice iron ore heaps ready for export to Japan.

Photo 14 A view of Karwar port, notice iron-ore heaps ready for export to Japan.
Photo 15 A view of Chemical Fertilizer Industry at Mangalore.

Photo 16 A view of blocks of quality rocks along the Mangalore port, ready for export to Iran and Japan.