Chapter - V

Centrality Based Hierarchy and Complementary Regions of Urban Centres
CHAPTER-V

CENTRALITY BASED HIERARCHY AND COMPLEMENTARY REGIONS OF URBAN CENTRES

Identification of settlements as the "Service Centres" is an important aspect in the regional planning. The hierarchical classification of service centres is the need of the hour in regional planning. Therefore, several geographers in India have made different attempts to identify service centres. The term "Service Centre" and "Central Place" are used as a synonym. Centrality is the measure of importance of a place in terms of its functional capacity to serve the needs of the people in the surrounding area. Centrality can be expressed qualitatively such as, low and high centrality, as well as quantitative by centrality values which are obtained by converting the functional base of a place into scores on the basis of frequency and importance of the function. There has been a concern among the geographers to establish a precise relationship between the size of settlement in terms of population and the range of services which it offers.\(^1\) Centrality, however, depends upon the intensity of central functions. The functions or services which an urban settlement performs not merely for itself, but primarily for the surrounding area which is dependent for many socio-economic needs on the centre, but is not a constituent part of it, are known as 'central functions' and the centres or places where these functions are performed, known as central places.\(^2\) A central place can be only that place where an exchange of central goods and services for population other than the local one exists, or in other words,

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where exists a certain central institution through which such an exchange is made possible. Thus a central place can be defined as a permanent human establishment, where an exchange of goods, services and necessities of socio-economic in nature, primarily and basically for population other than the local one, exist and which therefore commands as its region. As almost all central places perform certain essential functions, the regions they occupy vary in size according to their service capacities. The small market centres, the large market centres, the sub regional centres, regional centres, and large regional centres are all central places, but they vary in character and importance. The inter-relationship of central places of different order shows a series of inter-connections between unlike establishments.\(^3\) Walter Christaller\(^4\) considered the central place as a centre of central function performed for the surrounding area. These central functions follow a micro-schematic pattern. This system gives origin to functional organization of sub-regions of different order, functionally interbound together. As a result, the centrality of a place is defined by the amount of functions needed to serve the umland.

**Centrality and Nodality.**

In their attempts to measure the ‘centrality’, many researchers have in fact used ‘nodality’ as a substitute measure. Though there is no mistaking that conceptually, ‘nodality’ and ‘centrality’ are related, they are not exactly alike. Nodality stands for absolute importance, whereas centrality defines only the surplus of such importance. Nodality usually means the point of most convenient

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access, and with functional availability, it is a necessary concomitant of interaction. Nodality stands for the degree to which individuals interact at a particular place and the significance of nodality is usually expressed by the number of possible services rendered, goods produced etc.

Criteria of Centrality

A great variety of criteria for determination of urban centres has been used in different studies. Most of scholars agree that the size of population alone is not a satisfactory determinant of centrality. They emphasize the need for an index derived from the range of central functions present in almost all urban centres. Walter Christaller\(^5\) has made use of an extra (region serving) number of telephone connections existing at the centres for determining the centrality of service centres in south Germany. An assessment of central services and institutions existing at the centre has been one of the most popular and adequate indicators of centrality, and this method has been used by Dickinson for East Anglia.\(^6\) Similarly Smailes\(^7\) in his study takes an account of the essential functions and institutions of different degrees of urban importance such as bank, secondary schools, hospital, cinema houses and newspaper are important indicators of centrality. Dickinson\(^8\) in his another paper has made uses for per capita wholesale sellers for cities, in the United States. Carter\(^9\) has used almost the same method for

his tripartite gradation of service centres in Wales. Carol\textsuperscript{10} has also similarly taken the frequency of central services and institutions for Switzerland and S. Africa, and has recognized seven categories of centres. Trewartha\textsuperscript{11} considered empirically the functional attributes and agglomeration size for the American hamlets. Brush\textsuperscript{12} has pointed out that the status of trade centres was determined by the functions they performed by a combination of association of distinctive sets of functions. Berry and Garrison\textsuperscript{13} have considered all central functions to identify the centrality of urban places. The attributes were correlated with the population totals of the centres in which they were found to fix the threshold of functions. Another method for measuring centrality is the measurement of the area or region depending for various goods and services upon the centre. This method has been applied in a numerical way by Bracey for southern England.\textsuperscript{14} Green\textsuperscript{15} has measured the centrality of places in England and Wales and also in other parts of Europe by analyzing the bus services. Similarly Caruthers\textsuperscript{16} also followed the same method and classified the centres into hierarchical orders of England and Wales. Godlund\textsuperscript{17} has worked out the centrality of Swedish settlements on the basis of capacity for service and trade in urban settlements. He has used the total

\textsuperscript{10} Carol, H. And other German Workers (1953) "Spelt Jakob's Towns and Umlands", Economic Geography, Vol-34, pp. 362-369.
\textsuperscript{17} Godlund, S. (1956) "Bus Service in Sweden, Land Studies in Geography, Series B, Human Geography, No-17."
population in a settlement and number of persons employed in retail trade and services. Davies\textsuperscript{18} used a simple method for measuring the centrality in South Wales. He has calculated the location quotient for the function available in the area by calculating the functional index of a centre. The relevant score for each function is to be multiplied by the number of functional units of the function and the summation of all the values gives the functional index of a place. The functional index gives the aggregate importance of a place.

**Choice of methods for calculating the centrality**

The centrality of all towns of coastal Karnataka is worked out by using the Godlund’s\textsuperscript{19} retail trade and service method and V.N.P Sinha’s\textsuperscript{20} modified method of Davies (by using the tertiary Services).

1. **Measurement of Centrality by Godlund Method**

In the absence of any functional data, Godlund has attempted a classification of Swedish settlements on the basis of the capacity for trade and service in the urban settlements. In this case, he uses the relationship between the total population in a settlement and the number of persons employed in retail trade and services. The regional mean index of centrality for Coastal Karnataka is worked out by the following formula:

\[
C = \frac{Tc}{Pt} \times 100
\]

Where :  
- \(C\) is the regional mean Index of Centrality  
- \(Tc\) is the number of persons employed in retail trade and services (total working population in tertiary function of a particular town)  
- \(Pt\) is the total urban population of the study region.

\textsuperscript{19} Godlund, S. (1956) op.cit.  
In this way, the centrality of every urban centre in the study area is determined by using 1991 census data. This is not done for 2001 census as relevant data is not available. All urban centres whose Index exceeds the regional mean are supposed to have a service area, while higher indices being naturally associated with important urban centres.

2. Measurement of Centrality as per Davies Method

(Used here as modified by V.N.P. Sinha’s)

In this method the score for every function is assigned on the basis of the frequency of distribution of the particular function. This method is analogous to the one used by Davies for South Wales. A score for a single unit of any function ‘t’ was determined by the following equation.

\[ C = \frac{t}{T} \times 100 \]

Where:  
\( C \) is the score of function \( t \).  
\( t \) is the one unit of function \( t \).  
\( T \) is the total number of functional units of function ‘\( t \)’ in the region.

The above said Davies formula is used here in the modified form by V.N.P. Sinha as following:

\[ C = \frac{T \times 100}{P} \]

Where:  
\( T \) denotes the number of persons dependent upon tertiary services of a centre.  
\( P \) the total regional tertiary population.  
\( C \) the desired centrality of the place.
Comparison of Population Size with the Centrality Scores

To make a comparison between population size of the urban centres and their centrality scores the methods given by Godlund and V.N.P. Sinha are used. In order to make them commensurable, the absolute centrality scores were used for calculating the Spearman’s correlation method between two methods and population size of urban centres, as given below:

<table>
<thead>
<tr>
<th></th>
<th>X₁</th>
<th>X₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y₁</td>
<td>0.9387</td>
<td>0.9387</td>
</tr>
</tbody>
</table>

Note: Y₁ is the population size of the urban centres  
X₁ is the centrality scores obtained by Godlund’s method  
X₂ is the centrality scores obtained by Sinha’s modified method of Davies.

This Spearman’s correlation method reveals that between the two methods, the Sinha’s method (modified method of Davies) of centrality scores show high positive correlation with population size of urban centre (r=0.9387) with 0.9387 level of significance. (see table 5.2 and fig no. 5.1 and 5.2)

The higher centrality scores indicate the greater of its position in the area. In all instances whatever the method employed, true central places always show higher centrality.

HIERARCHY OF URBAN CENTRES

The urban centres are functionally organized in a nesting pattern and are arranged in such a manner that lower order centres occur within the influence areas of higher order urban centres. The higher order urban centres occur at a greater distance than the lower order centres.
Table 5.1 Data for Godlund and Davies Modified Method (Modified by V.N.P. Sinha)

(as per 1991 Census)

<table>
<thead>
<tr>
<th>Name of the Urban Centres</th>
<th>People engaged in Trade and Commerce</th>
<th>People engaged in Transport Storages and Communication</th>
<th>People engaged in Other Services</th>
<th>Total</th>
<th>Total Urban Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mangalore Urban Agglomeration</td>
<td>33119</td>
<td>15166</td>
<td>32722 = 81007</td>
<td>426341</td>
<td></td>
</tr>
<tr>
<td>Udupi Urban Agglomeration</td>
<td>9551</td>
<td>2235</td>
<td>9572 = 21358</td>
<td>117674</td>
<td></td>
</tr>
<tr>
<td>Karwar (CMC)</td>
<td>3071</td>
<td>1187</td>
<td>4533 = 8791</td>
<td>51022</td>
<td></td>
</tr>
<tr>
<td>Bhatkal (TMC)</td>
<td>3293</td>
<td>347</td>
<td>1961 = 5601</td>
<td>31478</td>
<td></td>
</tr>
<tr>
<td>Kundapura (TMC)</td>
<td>2188</td>
<td>556</td>
<td>1605 = 4349</td>
<td>28477</td>
<td></td>
</tr>
<tr>
<td>Kumta (TMC)</td>
<td>3293</td>
<td>347</td>
<td>1961 = 4471</td>
<td>26181</td>
<td></td>
</tr>
<tr>
<td>Baindur (TMC)</td>
<td>1838</td>
<td>654</td>
<td>1979 = 1345</td>
<td>16488</td>
<td></td>
</tr>
<tr>
<td>Honnavar (TMC)</td>
<td>1132</td>
<td>299</td>
<td>1071 = 2502</td>
<td>16192</td>
<td></td>
</tr>
<tr>
<td>Mulki (TMC)</td>
<td>977</td>
<td>403</td>
<td>1084 = 2464</td>
<td>14100</td>
<td></td>
</tr>
<tr>
<td>Saligram (TMC)</td>
<td>450</td>
<td>72</td>
<td>305 = 827</td>
<td>14020</td>
<td></td>
</tr>
<tr>
<td>Ankola (TMC)</td>
<td>665</td>
<td>386</td>
<td>869 = 1920</td>
<td>13509</td>
<td></td>
</tr>
<tr>
<td>Gangoli (NMCT)</td>
<td>846</td>
<td>129</td>
<td>436 = 1411</td>
<td>12332</td>
<td></td>
</tr>
<tr>
<td>Tonsewest (NMCT)</td>
<td>529</td>
<td>86</td>
<td>302 = 917</td>
<td>8160</td>
<td></td>
</tr>
<tr>
<td>Binaga (NMCT)</td>
<td>131</td>
<td>88</td>
<td>273 = 492</td>
<td>7281</td>
<td></td>
</tr>
<tr>
<td>Mallar (NMCT)</td>
<td>230</td>
<td>84</td>
<td>361 = 675</td>
<td>5776</td>
<td></td>
</tr>
<tr>
<td>Kadra KPC Project Colony (NMCT)</td>
<td>43</td>
<td>7</td>
<td>499 = 549</td>
<td>2563</td>
<td></td>
</tr>
<tr>
<td>Hasangadi KPC Project Colony (NMCT)</td>
<td>9</td>
<td>5</td>
<td>523 = 537</td>
<td>2117</td>
<td></td>
</tr>
</tbody>
</table>

|       | 139216 | 793711 |


Table No.5.2 Population Size and Centrality Scores of Urban Centres of Coastal Karnataka (1991)

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Name of the urban centre</th>
<th>Population size of the town</th>
<th>Centrality scores of Godlund method</th>
<th>Ranks</th>
<th>Centrality scores of Davies method modified by V.N.P. Sinha</th>
<th>Ranks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mangalore Urban Agglomeration</td>
<td>4,26,341</td>
<td>10.206</td>
<td>1</td>
<td>58.188</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Udupi Urban Agglomeration</td>
<td>1,17,674</td>
<td>2.691</td>
<td>2</td>
<td>15.342</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Karwar (CMC)</td>
<td>51,022</td>
<td>1.107</td>
<td>3</td>
<td>6.315</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Bhatkal (TMC)</td>
<td>31,478</td>
<td>0.706</td>
<td>4</td>
<td>4.023</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Kundapura (TMC)</td>
<td>28,477</td>
<td>0.548</td>
<td>6</td>
<td>3.124</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>Kumta (TMC)</td>
<td>26,181</td>
<td>0.563</td>
<td>5</td>
<td>3.211</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>Baindur (TMC)</td>
<td>16,488</td>
<td>0.169</td>
<td>11</td>
<td>0.966</td>
<td>11</td>
</tr>
<tr>
<td>8</td>
<td>Honavar (TMC)</td>
<td>16,192</td>
<td>0.315</td>
<td>7</td>
<td>1.797</td>
<td>7</td>
</tr>
<tr>
<td>9</td>
<td>Mulki (TMC)</td>
<td>14,100</td>
<td>0.310</td>
<td>8</td>
<td>1.777</td>
<td>8</td>
</tr>
<tr>
<td>10</td>
<td>Saligram (TMC)</td>
<td>14,020</td>
<td>0.104</td>
<td>13</td>
<td>0.594</td>
<td>13</td>
</tr>
<tr>
<td>11</td>
<td>Ankola (TMC)</td>
<td>13,509</td>
<td>0.242</td>
<td>9</td>
<td>1.379</td>
<td>9</td>
</tr>
<tr>
<td>12</td>
<td>Gangoli (NMCT)</td>
<td>12,332</td>
<td>0.178</td>
<td>10</td>
<td>1.013</td>
<td>10</td>
</tr>
<tr>
<td>13</td>
<td>Tonsewest (NMCT)</td>
<td>8,160</td>
<td>0.115</td>
<td>12</td>
<td>0.659</td>
<td>12</td>
</tr>
<tr>
<td>14</td>
<td>Binaga (NMCT)</td>
<td>7,281</td>
<td>0.062</td>
<td>17</td>
<td>0.353</td>
<td>17</td>
</tr>
<tr>
<td>15</td>
<td>Mallar (NMCT)</td>
<td>5,776</td>
<td>0.085</td>
<td>14</td>
<td>0.485</td>
<td>14</td>
</tr>
<tr>
<td>16</td>
<td>Kadra KPC Project Colony (NMCT)</td>
<td>2,563</td>
<td>0.069</td>
<td>15</td>
<td>0.394</td>
<td>15</td>
</tr>
<tr>
<td>17</td>
<td>Hasangadi KPC Project Colony (NMCT)</td>
<td>2,117</td>
<td>0.068</td>
<td>16</td>
<td>0.386</td>
<td>16</td>
</tr>
</tbody>
</table>
RELATIONSHIP BETWEEN CENTRALITY RANKS AND POPULATION RANKS OF URBAN CENTRES: 1991
COASTAL KARNATAKA

V.N.P. Sinha’s Method
r = 0.9387

Fig No. 5.1
RELATIONSHIP BETWEEN CENTRALITY RANKS AND POPULATION RANKS OF URBAN CENTRES: 1991
COASTAL KARNATAKA

Godlund’s Method
r=0.9387

Fig No. 5.2
The hierarchy of urban centres presents some contrasting features in the spatial arrangement of central places and rank size relations which are directly controlled by the physio-cultural settling. The uneven topography, irregular distribution of agricultural lands and absence of mineral resources bring great contrast in the spatial distribution of service centres. As a result there is distortion in the normal hierarchy of urban centres which Christaller proposed in his study of central places in south Germany. The most uneven areas of the region possess irregular and dis-organized distribution of urban centres. The concentration of urban centres in a limited area disturbs the regular distribution.

The hierarchical concept postulates a 'stair-like' distribution of urban centres on the basis of their population size. But the idea of an urban hierarchy involves more than just a consideration of the population size of urban centres. It explicitly involves aspects of their functional structure. Urban centres generally perform three basic types of functions i.e., primary activity, secondary activity and tertiary activity. The tertiary functions are performed in varying amounts by all urban centres. Hence hierarchical concept based on the idea of central place which is centrally located in a homogeneous area which supports it to provide goods and services for that area. This central place performs a single central function or a group of central function. Under normal conditions the central places are arranged in a hexagonal form as suggested by Christaller. This ideal pattern may be distorted by local geographical factors such as industrial and mining concentration, distribution of transport nets and other physical and cultural features.
Except in a few cases, each higher level central place usually performs all functions available in small central places, and some additional centralised functions as well. The services and functions of central places can be divided into two parts. i.e., Secondary and Primary. The Secondary services and functions serve the self requirements of the population of the centre while the primary services and functions cater to the surrounding region. All service centres fall into either of these classes based upon the number of complexity of functions performed by them. The commerce, industry, transport and other services are the four more important urban functions of which transport is the least developed in some backward area. Commerce is the most evenly distributed urban function among all grades of service centres while administrative service is arbitrarily oriented owing to the preferential policies of government and does not conform to the central functional pattern.

A review of literature of centrality shows that hierarchy of urban settlements has been approached in various ways. The German Geographers concentrated their attention on the external classification of settlements as central places and their relationship to their service area. They followed the lead given by Von Thunen\textsuperscript{21}, Bobek\textsuperscript{22} and Christaller\textsuperscript{23} made a theoretical approach to the problem and suggested an uniform land surface for a ideal city growth in the

\textsuperscript{21} Von Thunen (1826) "Der Isolierte Staat which was translated as Isolated State", Pergaman Press, London.
centre. Brush's\textsuperscript{24} study of the urban hierarchy in south-western Wisconsin is based on an assessment of the business and services existing in all urban centres. Dickinson\textsuperscript{25} in his study used almost all important urban functions for determining the each centre's status and found out the four categories of hierarchical order. Smailes\textsuperscript{26} in his study of urban hierarchy in England and Wales took account of the essential functions of the various urban centres and recognized five categories of centres. Green\textsuperscript{27} and Carruther\textsuperscript{28} have distinguished five orders of central places. Seven-fold classification of central places has been proposed by Philbrick\textsuperscript{29} and Caroll.\textsuperscript{30}

More recently some Indian Geographers have dealt this problem. Dutt and Bannarjee\textsuperscript{31} have classified central places of West Bengal into six classes. O.P. Singh\textsuperscript{32} has classified the towns of Uttar Pradesh into different orders of hierarchy. Diddee\textsuperscript{33} has classified the central places of Upper Bhima basin into six classes. Deshmukh\textsuperscript{34} has classified central places of upper Krishna Valley into a six classes of hierarchy. The above mentioned various hierarchical methods indicate that there is no uniform scale for classification of urban centres.

\textsuperscript{24} Brush, J.E. (1953) op.cit. 
\textsuperscript{25} Dickinson, R.E. (1934) op.cit. 
\textsuperscript{26} Smallies, A.E. (1944) op.cit. 
\textsuperscript{27} Green, F.H.W. (1948) op.cit. 
\textsuperscript{28} Carruther, W.J. (1957) op.cit. 
\textsuperscript{29} Philbrick, A.K. (1957) op.cit. 
Choice of the Hierarchical Method for Present Study:

The hierarchy of urban centres of Coastal Karnataka is brought out in this section on the basis of functional scores. The great variation in the functions of the urban centres has made this researcher to adopt centrality of tertiary workers as a determinant factor, because almost all urban centres of the coastal region have significant population engaged in tertiary services than secondary. Although primary functions are significant in most of the towns it is not considered for analysis as it does not reveal urbanism. The Sinha's method (Modified Davies Method) of centrality index has been chosen for calculating the hierarchy of urban centres, because, it shows high degree of correlation \( r = 0.9387 \).

All 17 (as per 1991 census) urban centres in Coastal Karnataka have been categorized into five different orders (see Table No. 5.3 and Fig. No.5.3). In the hierarchical importance they are: Regional centre, Sub-regional centre, Intermediary centre, Small centres and local centre. The places distinguished on the above basis are real service centres as their centrality index depends entirely upon the hierarchy of the services they perform to serve the outside region.

The number of service centres falling in Regional centre, Sub-regional Centre, Intermediary centre, Small centres and Local Centres appear to follow the norm of 1, 1, 1, 13 and 1. It is evident that these numbers do not strictly confirm to any of the three principles advocated by Christaller.
Table 5.3 Growth Foci of Urban Centres of Coastal Karnataka (1991)

<table>
<thead>
<tr>
<th>Hierarchical order</th>
<th>Category</th>
<th>Hierarchical number of urban service centres (based on V.N.P. Sinha’s method)</th>
<th>Name of the urban service centre</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Regional Centre</td>
<td>1</td>
<td>Mangalore Urban Agglomeration</td>
</tr>
<tr>
<td></td>
<td>(Growth Pole)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Sub-regional Centre</td>
<td>1</td>
<td>Udupi Urban Agglomeration</td>
</tr>
<tr>
<td></td>
<td>(Growth Centre)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Intermediatory Centre</td>
<td>1</td>
<td>Karwar</td>
</tr>
<tr>
<td></td>
<td>(Growth Point)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>Small Centres</td>
<td>13</td>
<td>Bhatkal, Kumta, Kundapura, Honnavar, Mulki, Ankola, Gangoli, Baidur, Tonsewest, Saligram, Mallar, Kadra KPC Projects and Hosangadi KPC Project Colony.</td>
</tr>
<tr>
<td></td>
<td>(Market Towns)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>Local Centre</td>
<td>1</td>
<td>Binaga</td>
</tr>
<tr>
<td></td>
<td>(Service Town)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>17</strong></td>
<td></td>
</tr>
</tbody>
</table>

Christaller’s principles were as follows: $K_3$ (marketing) – 1, 2, 6, 18, 54, 162, 486; $K_4$ (transport) – 1, 3, 12, 48, 192, 768, 3072; and $K_7$ (administrative) – 1, 6, 42, 294, 2054, 14406, 100842. However, far flung small centres in the region are deprived of transport facilities. Thus, the number of centres, particularly at the
COASTAL KARNATAKA
HIERARCHY OF URBAN CENTRES
(As per V.N.P. Sinha's Method) (1991)

1. Mangalore urban Agglomeration
2. Udupi Urban Agglomeration
3. Karwar
4. Kundapura
5. Bhatkal
6. Kumta
7. Baidur
8. Gangoli
9. Mulki
10. Saligram
11. Ankola
12. Honavar
13. Mallar
14. Tonse West
15. Binaga
16. Hosangudi
17. Kadra

Regional Centre
Sub-Regional Centre
Intermediate Centre
Market Centre
Local Centre

Fig No. 5.3
lower successive levels, show much deviation from the demand of the traffic principle. Even they are not nearing to the ‘marketing principle’ because the number exceeds at all levels.

For determining the K-value the method of bifurcation ratio is used as following:

\[ K = \frac{K_1 + K_2 + K_3 - - - K_4}{n} \]

Where: K stands for the number of centres in particular hierarchical class.

Therefore: \[ K = \frac{1+1+1+13+1}{5} \]

\[ K = 3.40 \]

The result of above equation clearly indicates that in the study area the urban centres and their hierarchical class orders are governed by ‘K’ value of 3.40. This value indicates that it does not fit for any theoretical model of Christaller, because his transport principle hierarchical class value is K-3, market principle pattern value is K-4 and administrative principle is K-7. Hence, it shows noticeable difference from the theoretical number.

Analysis of Growth Foci

The transmission of developmental activity in space may be conceived as taking place through a selected number of growth foci. The growth foci are distinguished by certain special characteristics in their socio-economic functional composition.
1. Regional centre (Growth Pole)

In the study area, this class includes only the Mangalore urban agglomeration. This city has got a little south-western location in the study area and has developed a distinguishable set of tributary areas and having a population of 4,26,341 (as per 1991). It has marked by highly specialised secondary and tertiary activity, which, normally cannot be performed by other centres. It has concentration of whole sale and retail traders, branches of the important banks of India, university post-graduate campus, medical colleges, technical colleges, large civil hospital, regional bus junction, railway stations, air port, District R.T.O office, District Commissioner's office, superintendent of police, senior superintendent of post office, telephone exchange Mx-1, upper court, big sports stadium and port/harbour etc. It occupies the highest rank in hierarchy of urban centres.

2. Sub-Regional Centre (Growth Centre)

There is only one centre i.e., Udupi Urban Agglomeration qualified to this category. It is less developed than the first order centre. Because of the pilgrimage centre rather than industrial centre, there is some kind of fear and hindrance and set back in the functional and spatial growth of Udupi and its near vicinity. Thus sub-regional centre stands as sub-servient to growth pole. The population of sub regional centre (Udupi) is 1,17,674 (as per 1991) and it acts on the centre of propulsive activities, mainly manufacturing, marketing and services for their hinterland. The composition of manufacturing activity must be of industrial hub
with diversified industrial structure although very few in number and types. This centre also has large collecting storages and processing facilities for agricultural/fish products, banking facilities, degree colleges, engineering college, homeopathic medical and dental college, Assistant commissioner office, civil hospital, telephone exchange MX-2, bus depot and K.S.R.T.C., Sub divisional office, Railway station, traffic police station, Lower court, chief engineer office and other servicing facilities.

3. Intermediary Centre (Growth Points)

In the study region only Karwar town is identified as intermediary centre (growth point). This is relatively small in comparison to the growth centres and growth pole and occupy small service area. The important economic activities of the growth point (Karwar) are fishing activities, harbour activities and processing of agricultural/horticulture products. Along with this the normal service functions like degree college, junior colleges and secondary schools, government hospital, departmental telephone exchange office, bus depot, railway station, tahasildar office, block development office, taluk court, head post office, daily market, public library, etc are existing.

4. Small Centres (Market Towns)

There are thirteen urban centres which come in this category. These urban centres include five taluk head quarters (Bhatkal, Kumta, Kundapura, Honavar and Ankola) and another eight non-taluk head quarters (Mulki, Gangoli, Baindur, Tonsewest, Saligram, Mallar, Kadra and Hosangadi K.P.C. Project Colony). In
these 13 centres, fishing, its storage, its sale and agricultural/horticultural marketing activities (with necessary-ware housing and storage facilities) are existing. Every urban centre of this category have degree colleges, more than one intermediate colleges, high schools, primary health centres, post and telegraphic offices, cinema and drama theatres, veterinary hospital, bus stand, limited number of banks, co-operative banks and police stations. The taluk headquarters contain all the usual facilities of taluk place.

5. Local Centres (Service Towns)

Service towns or local centres are the lowest level centres of activities serving population of less than 10,000. In the study area only one town i.e., Binaga is noticed in this category, because the lowest order centres are not considered while establishing hierarchical order of central places. In this local centre sub-post office, dispensary, high school, Govt. bus stop, weekly market, grocery stores, tailor shops, barber shops, co-operative and community centres, telephone call box, police out post and other basic facilities are available.

The appropriate number of each hierarchical order of growth foci and the interaction between them is pre-requisite for the regional development. The well developed, interrelated system of growth foci can bring the socio-economic changes in the society.

STRUCTURE OF COMPLEMENTARY REGIONS OF URBAN CENTRES:

The study of complementary regions is very essential from the point of view of regional planning. No part of the region should be left unserved by the
urban centres of the region. The entire region should be fully packed with interacting areas of centres, referred to as complementary regions. The centres, in respect of goods and services they supply to their respective market areas, dominate a set of complementary regions which mesh together in the landscape producing a clear 'nesting' pattern. It is likely that each service provided by a service centre (towns) will have its own particular service area, and the higher the status of the service the larger will be its service area. The service area of lower order services are packed within those of higher order services, completing the overall complementary region of a centre. The complementary region of a centre, therefore tends to consist of a number of service areas of individual services arranged roughly in concentric zones around the centre. From the point of view of empirical investigation it is intended to know how far the complementary regions of towns possess structured arrangements. The complementary regions of towns are also called in different names as 'sphere of influence', 'umland', 'Tributary area', 'service area' and 'hinterland'. First Christaller suggested the use of the term 'complementary region', as it include both the relationship of town to country and vice-versa. For the purpose of this analysis, the term complementary region is used to mean the service area of urban centres.

Criteria for Demarcating the Complementary Region

In empirical studies, geographers have considered various methods for delimiting the complementary region of urban centres. Dickinson\(^{35}\) has used

wholesaling, retailing, insurance, newspaper circulation, accessibility and other
criteria to delimit the metropolitan regions of U.S.A. Smailes\textsuperscript{36} has used various
functions like retail trade, schools, medical facilities etc., to study the zone of
influence of Ballymena town. Bracey\textsuperscript{37} and Green\textsuperscript{38} have demonstrated a
statistical application of bus service, as a single objective method to determine the
boundaries of urban sphere of influence. Park and Newcamb\textsuperscript{39} have used the
circulation of daily newspapers to indicate the zone of influence of metropolitan
centres. Apart from these empirical studies several authors have adopted the
quantitative approach to demarcate the area of the city dominance. Reilly\textsuperscript{40} put
forward his law of Retail Gravitation to determine the range and size of
complementary region taking into account the power of attraction generated by
the facilities and amenities provided. Reilly's formula is rather crude and simple.
In order to refine Reilly's method, Huff's\textsuperscript{41} devised a formula that enables
predictions of shopping habits. He asserts that the degree of mobility of different
customers varies greatly and may influence the distance they are prepared to
travel to satisfy a particular need. His model simply states the probability basis.

\textsuperscript{37} Bracey, H.E. (1953) "Towns as Rural Service Centres: An Index of Centrality with Special Reference to
\textsuperscript{38} Green, F.H.W. (1950) "Urban Hinterland in England and Wales : An analysis of Bus Services",
\textsuperscript{39} Park, R.E. and NewCamb (1933) "Newspaper Circulation and Metropolitan Regions" Edited in
Metropolitan Community by R.D. McKenzie, Chicago.
\textsuperscript{40} Reilly, W.J. (1931) "The Law of Retail Gravitation" The Knicker Bocker, New York.
\textsuperscript{41} Huff, D.L. (1962) "Defining and Estimating a Trade Area" Edited in Analytical Human Geography, by.
P. Ambrose.
In India, R. L. Singh\textsuperscript{42} has calculated the zone of influence of Banaras city by considering food grain supply area, milk supply area, vegetable supply area and higher education service area. Ujagir Singh\textsuperscript{43} has given importance to vegetable supply area, milk supply area, higher education area, retail trade area, wholesale trade area, etc., for studying the umland of Allahabad. Mukerjee\textsuperscript{44} has considered social services: milk supply, vegetable supply, food supply, bus service, bank service area; social service field: education, medical facilities, police, post and telephone service; cultural service area: cinema, newspaper circulation for delimiting the umland of Modinagar. Dixit and Sawant\textsuperscript{45} while delimiting the hinterland of Poona have given due importance to commuting area by local train, commuting area by S.T. buses, commuting area by local buses, L.I.C. Area, post and telegraph division, zone of supply of perishable goods. Alam\textsuperscript{46} has delimited the hinterland of twin cities of Hyderabad-Secunderabad, considering twin cities as an Island and used the various parameters like firewood supply, milk supply, wholesale business, newspaper circulation and university catchment area.

Apart from these empirical methods a few Geographers in India have used mathematical model for delimiting the zone of influence. P.D. Mahadev and Jayashankar\(^{47}\) have used the mathematical model for delimiting the potential umland of Mysore city. In their model they have modified the gravity potential model and calculated the amount of interaction between the two major cities of Karnataka. Prakash Rao\(^{48}\) has used simple mathematical model and tried to demarcate the zone of influence of towns of Mysore, where he has calculated the radius of zone of influence of each town by considering the population size of the towns of Mysore State. The above reviewed various methods used in calculating the complementary region indicate that the use of empirical methods need intensive field work and also consume more time and labour. When large number of towns are to be studied, it becomes very difficult to collect the required information through field work.

**Choice of methods for present study:**

In the present study the complementary regions of 17 urban centres of Coastal Karnataka have been demarcated by using two methods (i) Reilly’s Gravity model and (ii) V.L.S. Prakash Rao’s method.

i) Reilly has worked out a theoretical breaking point between two settlements. The limit of trading areas between two centres A and B.


Table 5.4 Urban Sphere of Influence as per Reilly’s Gravity Potential Model  
(also called Break Point Theory)  
(as per 2001 Census data)

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Name of the urban centre</th>
<th>Population</th>
<th>Area of Influence in Sq. Km.</th>
<th>Population under urban influence</th>
<th>Villages</th>
<th>Urban centre</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mangalore Urban Agglomeration</td>
<td>5,38,560</td>
<td>1,200</td>
<td>4,14,397</td>
<td>150</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>Udupi Urban Agglomeration</td>
<td>1,27,060</td>
<td>1,020</td>
<td>3,10,849</td>
<td>75</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Karwar Urban Agglomeration</td>
<td>75,020</td>
<td>792</td>
<td>2,10,228</td>
<td>90</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Bhatkal Urban Agglomeration</td>
<td>42,171</td>
<td>770</td>
<td>1,75,076</td>
<td>85</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Kumta Urban Agglomeration</td>
<td>34,498</td>
<td>700</td>
<td>1,35,000</td>
<td>112</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Kundapura</td>
<td>28,595</td>
<td>690</td>
<td>1,75,087</td>
<td>112</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>Ankola Urban Agglomeration</td>
<td>26,135</td>
<td>400</td>
<td>85,860</td>
<td>95</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>Mudbidri</td>
<td>25,710</td>
<td>Under the influence of Manglore city</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>9</td>
<td>Honavar</td>
<td>17,833</td>
<td>495</td>
<td>45,408</td>
<td>75</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>Mulki</td>
<td>16,398</td>
<td>Under the influence of Udupi city</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>11</td>
<td>Saligram</td>
<td>14,959</td>
<td>385</td>
<td>40,489</td>
<td>28</td>
<td>0</td>
</tr>
<tr>
<td>12</td>
<td>Bajpe</td>
<td>8,032</td>
<td>Under the influence of Manglore city</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>13</td>
<td>Adyar</td>
<td>6,501</td>
<td>Under the influence of Manglore city</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>14</td>
<td>Mallar</td>
<td>6,052</td>
<td>Under the influence of Udupi city</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>15</td>
<td>Mullur</td>
<td>5,057</td>
<td>Under the influence of Manglore city</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>16</td>
<td>Yenagudde</td>
<td>4,537</td>
<td>Under the influence of Udupi city</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Urban Sphere of Influence: An Application of Gravity Model

W.J. Reilly in his law of retail gravitation put forths that the movement of people, goods, services or information between two towns depends on the size of the town and the distance between them. According to him the bigger the towns the greater is the movement between them, further the towns are apart, the less the movement between them. Specifically, the movement between two towns is directly proportional to the number of population and inversely proportional to the distance between them. In 1949 P. Converse modified Reilly’s law to predict the breaking point which demarcates theoretical boundary between the two market areas. This may be calculated from the following formula -

\[
D_j = \frac{D_{ij}}{1 + \frac{P_i}{\sqrt{P_j}}}
\]

Where:
- \(D_j\) breaking point between town \(i\) and town \(j\) in kilometers.
- \(D_{ij}\) distance between town \(i\) and \(j\).
- \(P_i\) population of town \(i\) (large town)
- \(P_j\) population of town \(j\) (small town)

By using the above formula (modified formula of Gravity Model, called as break point theory) this researcher has worked out the urban sphere of influence (complementary regions) of each of the Coastal towns of Karnataka. The population data of 2001 census is considered for the settlements around each Coastal town.

1) Manglore City (Urban Agglomeration)

The city of Manglore being the primate urban centre in the Coastal region has been very well developed in its port activity, industrial growth, trade and
commerce and various types of services. Having 538560 urban population the city of Manglore serves not less than 1200 Sq. Kms of an area, as shown on the map (see fig. no. 5.4). This area of urban influence consist of nearly 150 villages and 6 small urban centres, consisting of in all 414397 total population. The sphere of urban influence of Manglore city exceeds its taluka boundary and penetrates into other talukas of Dakshin Kanada district and the district of Chikmagalur and Kodagu and also nearby area of Kerala State.

2. Udupi City (Urban Agglomeration)

The city of Udupi having 127060 urban population is able to serve an area of 1020 Sq. Kms, as shown on the map, which consists about 75 villages and 4 small towns. This area of urban sphere of influence consists of 310849 population belonging to 75 villages and 4 urban centres. Udupi city is known for religious and cultural functions due to historical famous temple of Sri Krishna. The city has transactions in its surrounding area not only for religious and cultural activities but also for trade, commerce and services.

3. Karwar town (Urban Agglomeration)

The Karwar town is a district head quarter for the district of Uttar Kannada. Being class II urban centre it possess 750200 urban population. It is a natural port and a centre of trade, commerce and services and therefore it serves an area of 792 Sq. Kms as per Gravity Model. This area of urban influence consists of 90 villages and 210228 rural population. The urban sphere of influence of Karwar town goes beyond it’s taluka boundary in the east, south, south east and also it enters into the territory of Goa in the north.
4) Bhatkal town

Bhatkal town having 42171 urban population is class III urban centre. As per Gravity Model it serves 770 Sq. Kms area which consists of 85 villages having 175076 population. It’s urban sphere of influence even exceeds it’s taluka boundary.

5) Kumta town

Kumta town having 34498 urban population is a class III town. It serves an area of 700 Sq. Kms consisting of 112 villages with 135000 population. The sphere of influence of Kumta town enters into Honavar taluk also, but at the same time some of the northern parts of Kumta taluk are not under the influence of Kumta town, as such areas are under the influence of nearby big town like Ankola.

6) Kundapur town

Kundapur town with 28595 population is class III town. As per Gravity Model it serves an area of 690 Sq. Kms consisting of 175087 population spread in 112 settlements. Kundapur is located on the sea coast and is a taluka headquarter. This town belongs to Udupi district and is located at a distance of 35 kms to the north of Udupi city. The urban sphere of influence of Kundapur town not only covers most of the parts of Kundapur taluk but also covers some parts of Hosanagara taluk of Shimoga district.
7) Ankola town (Urban Agglomeration)

This town is located in the Uttara Kannada district, along the sea shore. Being class III town it possess 26135 urban population. The area of urban sphere is spread to the extent of 400 Sq. Kms consisting of 95 settlements and 85860 population. The northern parts of Ankola taluk are under the influence of Karwar town, while southern half of Ankola taluk and fringe margin of western part of Sirsi taluk are under the urban influence of Ankola town. To the south of Ankola taluk, some parts of Kumta taluk are also under the urban influence of Ankola town.

8) Mudbidri town

This being class III town is located at a distance of 20 Kms to the north east of Manglore city. This Mudbidri township has 25710 population. This town is under the influence of Manglore city as Manglore is the biggest city in the Karnataka Coast.

The following three small towns of Vth class such as Bajpe (8032 population), Mullur (5057 population) and Adyar (6501 population) are under the influence of Manglore city as they are located at a closer distance from Manglore city (refer map). The following small towns such as Mulki (IVth Class) with 16398 population, Mallar (Vth Class) with 6052 population and Yenagudde (VIth Class) are under the urban influence of Udupi city as they are very closer to the city of Udupi (See map). The Saligram being class IVth town (14959 population) is also located to the north of Udupi city at a distance of 18 Kms. However it is not shown under the influence of Udupi, as per Gravity Model Break point. This
Saligram town covers an area of 385 Sq. Kms and covers areas of Udupi taluk and Kundapur taluk under its influence. This area covers 28 settlements with 40489 population.

ii) Prakash Rao calculates the degree of influence of urban centres by considering the total number of urban population of the area and the population of individual town.

The original formula of V.L.S. Prakash Rao is:

\[ D = \frac{T \times A}{U} \]

\[ R = \sqrt{\frac{T \times A}{\pi U}} \]

Where: 
- \( D \) is the degree of influence.
- \( A \) is the total area of the region.
- \( U \) is the total urban population of region.
- \( T \) is the total population of a town
- \( R \) is the radius of a circle indicating the degree of influence.
- \( \pi \) 3.14

Looking at the map of sphere of urban influence of 16 towns by using V.L.S. Prakas Rao method, one can understand the hierarchy of urban spheres. In this method also Manglore encompasses a vast region around it, where small towns like Mulki, Mudbidri, Bajpe, Mullur and Adyar are under the influence of Manglore city (Fig. No.5.5). Similarly the city of Udupi also covers small towns like Yenagudde, Mallar and Saligram under its urban influence. However, the rest of the seven towns have independent sphere of urban influence as depicted in the map (vide map).
Table 5.5 Urban Sphere of Influence as per V.L.S. Prakash Rao Method
(as per 2001 Census data)

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Name of the urban centre</th>
<th>Urban Population</th>
<th>Urban Sphere of influence in Km.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mangalore Urban Agglomeration</td>
<td>5,38,560</td>
<td>33.47</td>
</tr>
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<td>2</td>
<td>Udupi Urban Agglomeration</td>
<td>1,27,060</td>
<td>16.26</td>
</tr>
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<td>3</td>
<td>Karwar Urban Agglomeration</td>
<td>75,020</td>
<td>12.49</td>
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<td>4</td>
<td>Bhatkal Urban Agglomeration</td>
<td>42,171</td>
<td>9.36</td>
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<td>5</td>
<td>Kumta Urban Agglomeration</td>
<td>34,498</td>
<td>8.47</td>
</tr>
<tr>
<td>6</td>
<td>Kundapura</td>
<td>28,595</td>
<td>7.71</td>
</tr>
<tr>
<td>7</td>
<td>Ankola Urban Agglomeration</td>
<td>26,135</td>
<td>7.37</td>
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<td>Mudbidri</td>
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<td>17,833</td>
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<td>Mulki</td>
<td>16,398</td>
<td>5.84</td>
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<td>Saligram</td>
<td>14,959</td>
<td>5.58</td>
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<td>Bajpe</td>
<td>8,032</td>
<td>4.08</td>
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<td>Adyar</td>
<td>6,501</td>
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<td>6,052</td>
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<td>Mullur</td>
<td>5,057</td>
<td>3.24</td>
</tr>
<tr>
<td>16</td>
<td>Yenagudde</td>
<td>4,537</td>
<td>3.07</td>
</tr>
</tbody>
</table>
COASTAL KARNATAKA
DELIMITATION OF SERVICE AREA OF
URBAN CENTRES
(As per V.L.S.P. Rao’s Method) 2001

Fig No. 5.5