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SPATIAL ANALYSIS OF CENTRALITY BASED HIERARCHY OF URBAN CENTRES IN BELAGAVI DISTRICT OF KARNATAKA

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Abstract

The study attempted to develop a hierarchical structure of the 31 urban centres in Belagavi district by using their essential characteristics and functional attributes for classifying the urban centres. Based on the centrality scores of all the towns by using the Godlund's retail trade and service method and V.N.P. Sinha's modified method of Davies (by using the tertiary services) the urban centres are graded. The study emphasized the importance of the different functional centre's as service centres in Belagavi district, whose economy is essentially based on retail market services. These centres were considered as 'naturally' occurring service centre's capable of stimulating growth impulses in their catchment areas. The study recommended the adoption of the hierarchical order of the urban centre's as a workable framework for planning the development of the Belagavi district.

Key Words: *Hierarchy, Centrality, Functional index, Urban Centres and Growth Foci.*

Introduction

Settlements are differing in size and functions based upon physio-historic and socio-economic conditions, but they can be graded and grouped in the hierarchical order in any regional set up. The spatial organization of growth centres and their orders distributed in geographic space is the main consideration in the present study. Hence, the gradation and re-grouping of the growth centres into of size classes is termed as hierarchy. Within the field of regional planning, an important aspect of the study comprises the identification of settlements as the "Service Centres" for their respective environs. This theme has been investigated within the conceptual framework of the central place theory. It might be asserted that Geographic study of this aspect is well accommodated within this framework which, in turn, emphasises the need for hierarchical classification of service centres. Needless to point out, such studies abound in the literature of urban Geography and apparently are accepted as a legitimate part of the field of regional planning.

The term 'Central Place', is a synonym of 'service centre'. The term 'Central Place' (Christaller's Zentralort) has been first used to connote a centre of manifold activities for the surrounding countryside. 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 quantitatively 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. 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 wherein these functions are performed, known as central places. A central place can be only that where an exchange of central goods and services for population other than the local one exists or in other words, where a certain central institution through which such an exchange exists 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 market centres, regional market centres and large regional market 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.

Walter Christaller 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. 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 not exactly alike. Nodality stands for absolute importance, whereas 'centrality' stands for relative importance. Nodality usually means the point of most convenient access, and with functional availability, it is a necessary concomitant of interaction. Nodality stands for the degree to which individual interact at a particular place and the significance of nodality is usually expressed by the number of possible services rendered, goods produced, etc.

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 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 an adequate indicator of centrality and this method has been used by **Dickinson** for East Anglia. Similarly **Smailes** 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**, in one of his papers, has made use of per capita wholesale sellers for cities, in the United States. **Carter** has used almost the same method for his tripartite gradation of service centres in Wales. **Carol** has also similarly taken the frequency of central services and institutions for Switzerland and South Africa and has recognized seven categories of centres. **Trewartha** considered empirically the functional attributes and agglomerational size for the American hamlets.

Brush 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** 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. **Green** has measured the centrality of places in England and Wales and also in other parts of Europe by analysing the bus services. Similarly **Carruthers** also followed the same method and classified the centres into hierarchical orders of England and Wales. **Godlund** 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 population in a settlement and number of persons employed in retail trade and services. **Davies** used a

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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 member 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.

Study area

Belagavi is a district and also the headquarters of the Belgaum Revenue Division in the state of Karnataka and the city of Belgaum is located in North Karnataka. It is also called as the second capital of Karnataka state, as it houses the second legislative building "Suvarn Souda", where the Karnataka Legislature will meet once a year. According to the 2011 Census of India, it has 47,78,439 population of which 24.03% living in urban areas, making it the second most populous district in Karnataka (out of 30), after Bengaluru and roughly its population is equal to the nation of Singapur or the US state of Alabama. This gives it a ranking of 25th in India (out of a total of 640).

The district has 13,415 sq. kms. of geographical area, lies between 15° 23' and 16° 58' northern latitude and 74° 05' and 75° 28' eastern longitude and administratively Belagavi district has been divided into 10 tahsils. Athani taluk is the largest with an area of 1,998 sq. kms and Raibag taluk is the smallest with an area of 958.8 sq. kms. The district comprises three revenue sub-divisions and six police sub-divisions. Apart from the Belagavi City Corporation, there are 17 municipalities, 13 census towns, 485 gram Panchayats, 1,138 inhabited villages and 26 uninhabited villages. The district has a population density of 356 inhabitants per sq. Kms. Its population growth rate over the decade 2001–2011 was 13.38%. Belagavi has a sex ratio of 969 females for every 1000 males and a literacy rate of 73.94%. In Belagavi district out of 31 urban centers one urban centre (Belagavi) fall under class-I town, two towns (Gokak and Nippani) are noticed under class-II town category, ten towns under class-III towns, twelve towns fall under class-IV and six towns recognized under class-V town category.

Objectives

The main objectives are to analyze the centrality based hierarchy of urban centres in Belagavi district and to delineate the position of urban centres as per growth foci theory.

Data base

The necessary data are collected from district statistical report and 2011 Census of India reports for determining the position of urban centres in Belagavi district on the basis of population strength.

Metodology

The centrality of all the towns of Belagavi district is worked out by using the Godlund's retail trade and service method and V.N.P. Sinha's modified method of Davies (by using the tertiary services).

Godlund Method

In the absence of any functional data, Godlund has attempted a classification of Swedish settlement 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 service. The regional mean index of centrality was given by the formula:

$$C = \frac{T_c}{P_t} \times 100$$

Where: C - is the regional mean index of centrality
 Tc - is the number of persons employed in retails trade and services.
 Pt - is the total population of the study region.

In this way, the centrality of every urban centre in the study area is determined. All urban centres whose index exceeds the regional mean are supposed to have a service area, higher indices being naturally associated with important urban centres.

Davies method (modified by V.N.P. Sinha's method):

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.

$$C = \frac{T \times 100}{P}$$

Where: T - is the number of persons dependent upon tertiary services of a centre.
 P - is the total regional tertiary population.
 C - is the desired centrality of the place.

Comparison of population size with the centrality scores

To make a comparison between population size of 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 correlation matrix between two methods a population size of urban centres, as given in Table 1.

Table No. 1: Correlation Matrix of Two Methods.

	X_1	X_2
Y_1	0.5741	0.9879

Note: Y_1 - is the population size of the urban centre
 X_1 - is the centrality score obtained by Godlund's method
 X_2 - is the centrality score obtained by Sinha's modified method of Davies.

This matrix reveals that between the two methods, the Sinha's method (modified method of Davies) of centrality score shows high correlation with population size of urban centres ($r = 0.9879$) with 0.01 level significance. While the centrality scores of Godlund method show positive (+0.5741) relation with population size. It is summarised that among these two centrality methods V.N.P. Sinha's method gives more appropriate result than the Godlund's method.

The industrial towns namely, Belagavi (MC), Gokak, Athani, Chikkodi, Belagavi (CB) and Gokak falls have 1st, 2nd 4th, 7th, 5th and 26th ranks in their hierarchical ladder by Sinha's method but according to Godlund's method these towns have 6th, 12th 8th, 11th, 1st and 13th ranks in their hierarchy (Table No. 2) and these towns invariably qualify for the lower rungs of the ladder.

The administrative centres (tahsil headquarters) are pushed up to the higher order and these centres performing socialised functions are greatly exaggerated. The higher centrality scores

indicate the greater position in the area. In all instances whatever the method employed, true central places always show dependable centrality.

Relationship between ranks of centrality scores and population size of urban centres

The relationship between centrality ranks and population ranks of urban centres are shown on the graph (Fig. 1), which reveal that all the urban centres are very close to the ideal line of Sinha's method than the Godlund's method. The higher order urban centres indicate the perfect relationship between the centrality and their population size.

Hierarchy of urban centres

The urban centres are functionally organized in a nesting pattern and 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. 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 setting. 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 a 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-organised 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 activities, secondary activities and tertiary activities. The tertiary functions are performed in varying amounts by all urban centres. Hence hierarchical concept is based on the idea of central place which is centrally located in a homogenous 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 functions. 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. Several places are strung at short intervals along an important transport route and their tributary areas are not of hexagonal or circular shape but are elongated along the main transport lines.

Except in a few cases, each higher level central place usually performs all functions available in small central places and some additional centralized 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 requirement 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 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.

Table 2: Population Size & Centrality Scores of Urban Centres of Belagavi District, 2011

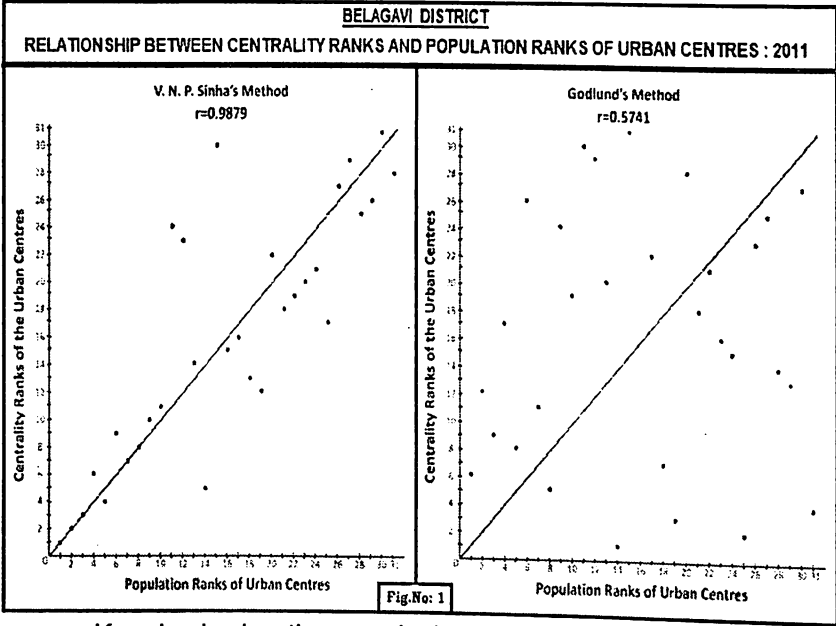
Sr. No	Name of the Town	Population Size of the Town	Centrality Scores by Godlund Method	Ranks	Centrality Scores by modified Davies Method	Ranks
1	Belagavi (MC)	490,045	21.16	6	45.89	1
2	Gokak	79,121	18.32	12	6.41	2
3	Nippani	62,865	19.03	9	5.3	3
4	Bailhongal	49,182	16.43	17	3.58	6
5	Athani	47,842	19.54	8	4.14	4
6	Savadatti	41,215	12.51	26	2.28	9
7	Chikkodi	38,307	18.70	11	3.17	7
8	Ramadurg	34,800	21.32	5	2.33	8
9	Sankeshwar	34,637	14.24	24	2.18	10
10	Mudalgi	29,128	16.13	19	2.08	11
11	Sadalgi	23,790	6.63	30	0.72	4
12	Kudchi	23,154	10.82	29	0.71	23
13	Hukkeri	22,988	15.96	20	1.62	14
14	Belagavi (CB)	19411	44.45	1	3.82	5
15	Konnur	19386	5.78	31	0.53	0
16	Khanapur	19309	18.78	10	1.6	15
17	Raibag	18736	15.59	22	1.3	16
18	Mache	18073	20.92	7	1.67	13
19	Peeranwadi	17874	21.94	3	1.73	12
20	Kakati	13946	11.66	28	0.72	22
21	Hindalga	13741	16.18	18	0.98	18
22	Sambra	13159	15.95	21	0.93	19
23	Yellur	11850	17.46	16	0.92	20
24	Benaknalli	10999	17.81	15	0.87	21
25	Kangrali-BK	10496	22.72	2	1.06	17
26	Mouje-Nandagad	8837	15.00	23	0.59	27
27	Sulebavi	8503	13.89	25	0.52	29
28	Kangrali-KH	8204	17.84	14	0.65	25
29	Gokak falls	8080	18.00	13	0.64	26
30	Mutga	7561	11.68	27	0.39	31
31	Londa	5956	22.38	4	0.59	28

Source: Computed by Researcher.

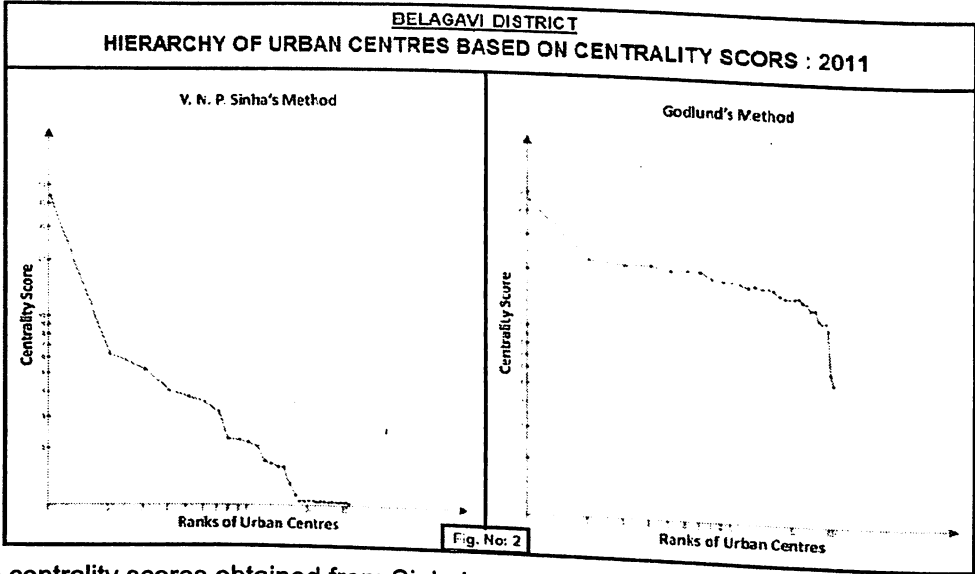
More recently some Indian Geographers have dealt this problem. **Dutt** and **Bannarjee** have classified central places of West Bengal into six classes. **O. P. Singh** has classified the towns of Uttar Pradesh into different orders of hierarchy. **Diddee** has classified the central places of upper Bhima basin into six classes. **Deshmukh** 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.

Hierarchy of urban centres in Belagavi district

The hierarchy of urban centres of Belagavi district is brought out in this section on the basis of



functional scores. Keeping in view the complexity of the physical (soils), agricultural and cultural landscape of Belagavi district, it will not be correct to take centrality of single function as hierarchy index. 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 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 ($r = 0.9879$).



The centrality scores obtained from Sinha's method (Modified Davies Method) for each urban centre has been ranked in order of their centrality scores and ranks are plotted on a log-log scale. To compare the centrality scores of Sinha's method with Godlund's method another log-

log graph is prepared (Fig. No.2). The demarcated urban centres on the graphs clearly indicate different slop grouping of urban centres of different order having different levels of functional specialization. Thus, all 31 urban centres in Belagavi district have been categorised into five different orders (see Table No.2 and Fig. No.2), as Regional centres, Sub-regional centres, Intermediary centres, Small centres and Local centre. The place assigned to each of the service centres is depending entirely upon the hierarchy of the services they perform to serve the surrounding region.

The number of service centres falling in Regional centre, Sub-regional centre, Intermediary centre, small centres and local centre appear to follow the norm of 1, 2, 4, 10 and 14. It is evident that these numbers do not strictly confirm to any of the three principles advocated by Christaller. Christaller principles were as follows:

$$K = \frac{K_1 + K_2 + K_3 + \dots + K_n}{n}$$

K_3 (marketing) – 1, 2, 6, 18, 54, 162, 486; K_4 (transport) – 1, 3, 12, 48, 192, 768, 3072; and K_5 (administrative) – 1, 6, 42, 294, 2058, 14406, 100842. In Belagavi district the successive numbers fall much short of expectation, on the basis of the administrative principle as there is no sound correlationship ($r = 0.1169$) between the functional status below the sub-regional centres. The distribution of different order urban centres particularly that of big centres display the effect of axial routes. However, far flung small centres in the region are deprived of transport facilities. Thus, the number of urban centres at the lower successive levels shows 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:

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

$$K = \frac{1+2+4+10=14}{5} \quad K = 6.20.$$

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 6.20. This value indicate that it does not fit for any theoretical model of Christaller, because his transport principle hierarchical class value is K- 4, market principle pattern value is K-3 and administrative principle is K₅. Hence it shows noticeable difference from the theoretical number.

Table 3: Growth Foci of Urban Centres in Belagavi District – 2011

Hierarchical Order	Category	Hierarchical Number of Urban Service Centres (By Sinha's Method)	Name of the Urban Service Centres
I	Regional Centre (Growth Pole)	1	Belagavi (MC)
II	Sub-regional Centres (Growth Centre)	2	Gokak and Nippani
III	Intermediary Centre (Growth Point)	4	Athani, Belagavi (CB), Bailhongal and Chikkodi
IV	Small Centres (Market Towns)	10	Ramdurg, Savadatti, Sankeshwar, Mudgi, Peeranwadi, Mache, Hukeri, Khanapur, Raibag and Kangrali-BK
V	Local Centres (Service Town)	14	Hindlaga, Sambra, Yellur, Benakanalli, Kakati, Kudchi, Sadalgi, Kangrali-KH, Gokak falls, Mouje-Nandagad, Londa, Sulebhavi, Konnur and Mutga
	Total	31	

Source: Computed by Researcher.

Analysis of the hierarchy of urban centres as per growth foci

The transmission of developmental activity in space may be conceived as taking place through a select number of growth foci (Table 3 & Fig: 3). 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 Belagavi city. This city has a south-western location in the study area and having a population nearly five lakh (4,90,045). It is marked by highly specialised secondary and tertiary activity, which, normally cannot be performed by other centres. It has concentration of wholesale and retail traders, branches of the important banks of India, universities, post-graduate campus, medical colleges, technical colleges, large civil hospital, regional bus junction, railway station, 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, etc. It occupies the highest rank in hierarchy of urban centres.

2. Sub-Regional Centre (Growth Centre)

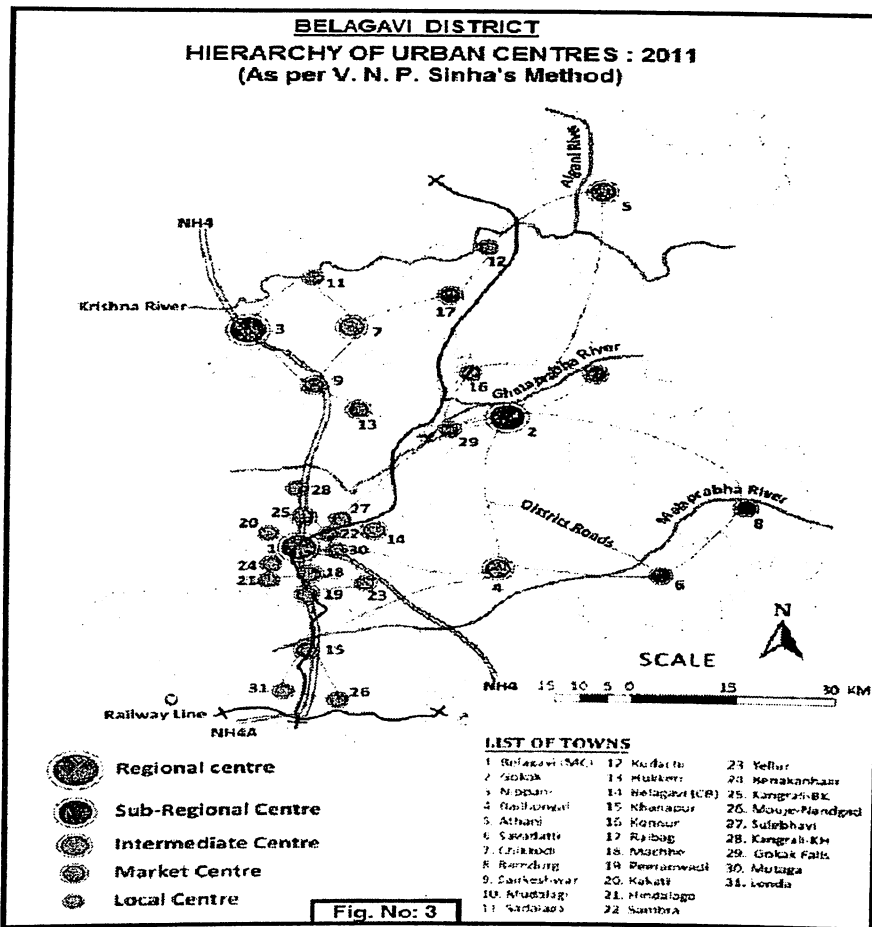
There are two centres qualified to this category i.e., Gokak and Nippani, which are sub-divisional headquarters in the study area. These are less developed than the first order centre. The sub-regional centres stand as sub-servient to growth pole. The population of sub regional centre (Gokak) is 79,121 and Nippani centre is 62,865 and these centres act as 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 of types. These centres also have large collecting storages and processing facilities for agricultural products, television station, 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, traffic police station, lower court, chief engineer office and other servicing facilities.

3. Intermediatory Centre (Growth Points)

In the study region four towns have been identified as Intermediatory (Growth point centre). These are relatively small in comparison to the growth centres and growth pole and occupy small service area. The important economic activities of the growth points (Athani, Belagavi (CB), Bailhongal and Chikkodi) are weaving activities and processing of agricultural products. Along with this the normal service functions like degree colleges, junior colleges and secondary schools, government hospital, departmental telephone exchange office, bus depot, tahasildar office, block development office, tahsil court, head post office, daily market, public library, etc, are existing.

4. Small Centres (Market Towns)

There are ten urban centres which come in this category. These urban centres include five tahsil head-quarters (Ramdurg, Savadatti, Hukkeri, Khanapur and Raibag) and another five non-tahsil headquarters (Sankeshwar, Mudalgi, Peeranwadi, Machche and Kangrali-BK). In these 10 centres, weaving, spinning, ginning, agricultural marketing activities (with necessary ware housing and storage facilities) are existing. Every urban centre of this category has colleges, high schools, primary health centres, post and telegraphic offices, cinema theatres, veterinary hospital, bus stand, banks, co-operative banks and police stations. The tahsil headquarters contain all the usual facilities of tahsil place.



5. Local Centres (Service Towns)

Service towns or local centres are the lowest level centres serving all types of activities. In the study area there are 14 towns i.e., Hindlga, Sambre, Yellur, Benkanalli, Kakati, Kudchi, Sadalgi, Kangrali-KH, Gokak falls, Mouje-Nandagad, Londa, Sulebavi, Konnur and Mutga were classified 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.

Conclusion

This study has sought to examine the spatial characteristics, service functions and population dynamics of urban centres in Belagavi district. The study has emphasized the importance of the urban centres as local nodal service centres. Each urban centre

links many villages and therefore integrate them into the national economic system through commodity exchange, information flow and innovation spread. The urban centres facilitate trading activities in the study region whose economy is essentially based on agriculture and other related activities. Apart from their economic functions, the higher order other multi-faceted central functions offer additional services of centrality that make them attractive. They are the "drivers of the urbanization process" in the region. Indeed, the urban geography and economic history of the Belagavi district cannot be understood without reference to the population dynamics and their functional diversity.

Within this context it is emphasized that the continuous functioning of many of the lower order urban centres in the region will grow to a large extent and it depend on sustainable supply of farm produce from their local catchment areas. Improvement in the functional varieties may improve the quality of life in urban centres of Belagavi district and priority should be given to the existing urban functional structure. Therefore, the towns of Belagavi district especially those which have below 50,000 populations should exhibit basic functions rather than primary and service / non-basic functions. This expected scenario may be changed if special programmes lay in our newly introduced "Smart City" programmes in five year plans to develop small and medium towns in terms of functional dynamism. Once the district continues its trend towards development facing all the odds which are prevalent in the study region and it leads to change the hierarchy of urban centres based on their centrality of functions boost to flourish and grow towards to promote the small urban centres as growth points and growth centers.

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Declaration

We, declare that the above article is original and has not been published by us or by any one in any Journal or book.

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