Analyzing Settlement Pattern in Aurangabad Region

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Abstract : In the process of regional planning, it is important to understand the primacy within the region, the interdependency of various settlements and their hierarchy of importance. This helps in identifying the underserved areas of the region which need to be uplifted to achieve balanced development. This study aims at determining the existing settlement pattern of Aurangabad District. This has been determined based on population size, Centrality Functional Index (CFI), Guttman Scalogram and radius of influence. It is observed that Aurangabad District has an imbalance in terms of number of facilities and travelling distance to reach them. This issue can be countered by proposing counter magnet nodes which reduce the importance of primate settlements.

I. INTRODUCTION TO SETTLEMENT PATTERN

The primary role of a regional plan is to identify under-developed areas within a region, uplift these areas and promote equitable development throughout the region. This process is known as balanced regional development.

To carry out this process, it is a requisite to understand the potential of each settlement and interdependency of various settlements. This helps in identifying the most important settlements, the underserved settlements and their influence zones. This study of settlement pattern is vital to study settlement hierarchy of a region.

Settlement hierarchy is decided based on the population, amenities and facilities available in that particular region. Therefore, while studying the existing settlement pattern all central villages and the rural, urban growth centres are taken into considerations which at least have basic level amenities and facilities. These rural, urban growth centres provide more complex set of services than those of central villages. Position in a settlement hierarchy can also depend on the sphere of influence; this is how far people will travel to use particular service in the settlement.

II. METHODOLOGY FOR DETERMINING EXISTING SETTLEMENT HIERARCHY

For this study, Settlement hierarchy has been determined using a combination of CFI and Guttman Scalogram. The steps are shown in figure 1.
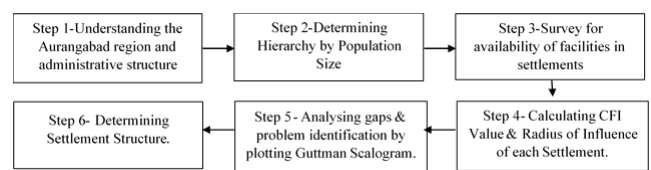

Figure 1. Methodology for the Study

III. UNDERSTANDING THE AURANGABAD REGION AND ADMINISTRATIVE STRUCTURE

In the context of regional planning in Maharashtra, the district boundary is considered as a region. Aurangabad District as a whole has been considered as the study area for this research. It consists of 9 Tehsils and 1344 Villages are present. The urban setting in Aurangabad District consists of Aurangabad Municipal Corporation and 9 Municipal
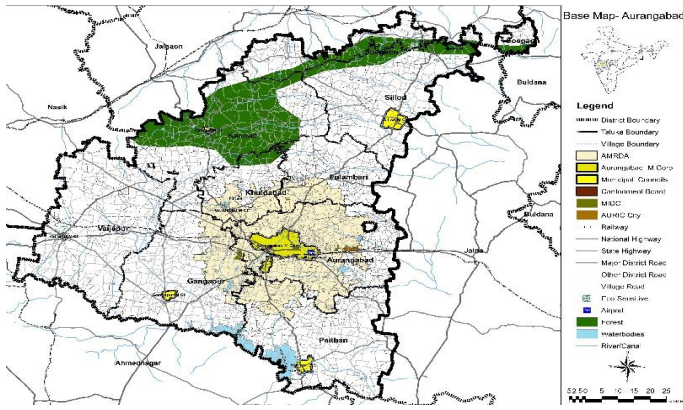
Council.

Figure 2. Base Map of Aurangabad District
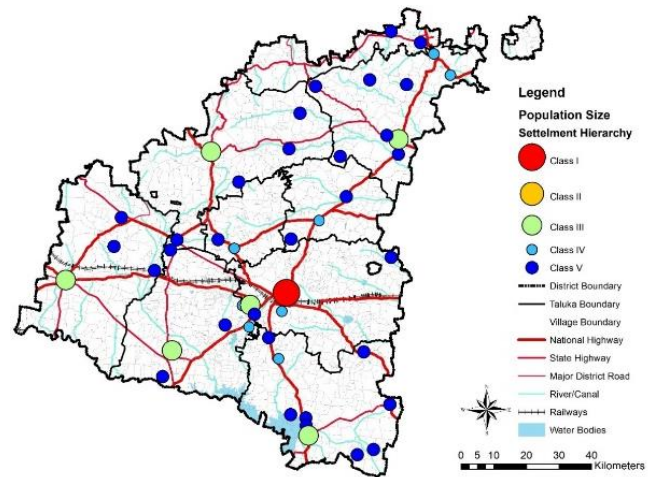
IV. DETERMINING HIERARCHY BY POPULATION SIZE

Settlement Hierarchy by population distribution helps in analyzing the pressure on existing infrastructure and other services. This study determines the threshold population and order of services to be provided in each settlement.

As shown in table 1, it can be observed that in the year 2001, 48 settlements are above the population of 5000. While in the year 2011, 66 are above the population of 5000. The settlement is classified based on class sizes defined in Census of India. These are spatially located as shown in Figure 3 & 4.
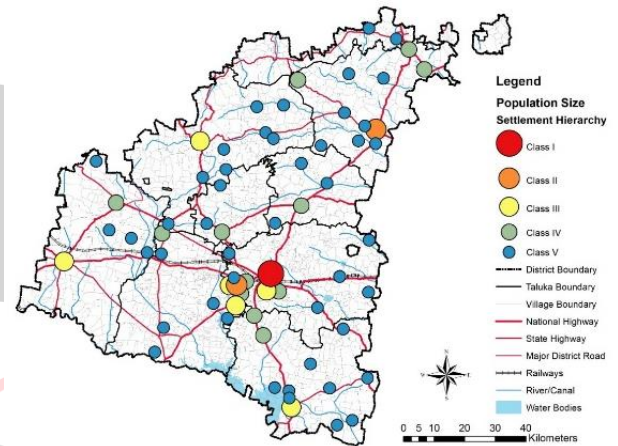
Class	Population	2001	2011
Class I	Greater than 1,00,000	1 (Aurangabad M Corp.)	1 (Aurangabad M Corp.)
Class II	50,000-1,00,000	0	2 (Wadgaon Kholati, Silod)
Class III	20,000-50,000	6 (Wadgaon Kholati, Gangapur, Kannad, Paithan, Silod, Vaijapur)	7 (Satara (CT), Gangapur, Ranjangaon (CT), Waluj Bk., Kannad, Paithan, Vaijapur)
Class IV	10,000-20,000	9	18
Class V	5,000-10,000	32	39
Total		48	67

Table 1. Change in Class of Settlements

ure 3. Hierarchy based on population hierarchy (2001)

Figure 4. Hierarchy based on population hierarchy (2011)

V. SURVEY FOR AVAILABILITY OF FACILITIES IN SETTLEMENTS

A detailed secondary survey has been done to examine availability of facilities in the settlements. Table 2 shows the facilities considered for identifying the settlement hierarchy in further steps using CFI and Guttman Scalogram.

Level	Facilities Considered
Regional Growth Centre	Veterinary hospital, MIDC, Post office, Zilla Parishad, Airport, University, National Highway, State Highway
Urban Growth Centre	Senior Colleges, Medical Colleges, Bus stand, Rural hospital, Tehsil headquarter, municipal council
Rural growth Centre	Primary health centres, Nationalised banks, Hospital, Fire station, Colleges, Dispensary
Central Villages	Village roads, Electricity, telecomm, weekly markets, secondary school, community centre, bus stop

Table 2. Facilities to be considered for identifying the settlement hierarchy

VI. CFI VALUE AND RADIUS OF INFLUENCE

The CFI of a settlement is assessed based on the number and order of facilities in the settlement. CFI is calculated in
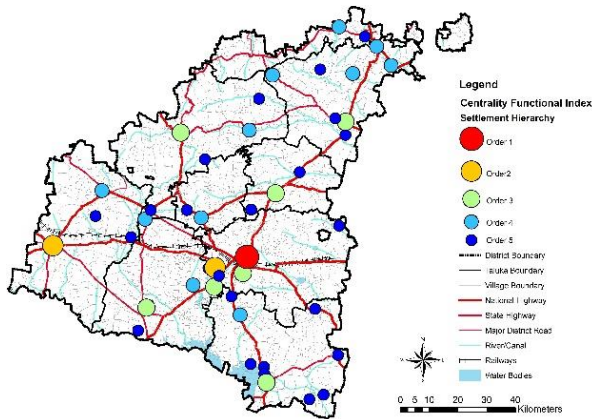
two steps as follows,

Step 1: The weightage of each of these facilities in the District is calculated as

Weightage= (Total No. of Settlement)/ (No. of Settlement having that facility)

Step 2: Centrality Functional Index value is calculated for each of the settlements as

CFI= Sum {(No. of Particular facilities in a settlement) X (Weightage of that facility)}

Sr. No.	Facilities	No. of Settlement	Weigh-tage	No. of Facilities in Settlements
1	Primary School	67	1	50
2	Public Bus Service	67	1	15
3	Daily Newspaper Supply	67	1	1
4	Self - Help Group	67	1	1
5	Post Office	66	1.01	1
6	Mandis/Regular Market	65	1.03	1
7	Agricultural Credit Societies	65	1.03	25
8	Nationalised/ Commercial Bank	64	1.04	25
9	Secondary School	63	1.06	16
10	Auditorium/Community Hall	62	1.08	8
11	Public Reading Room	61	1.09	10
12	Primary Health Sub Centre	61	1.09	1
13	Senior Secondary School	59	1.13	35
14	Public Library	56	1.19	22
15	Gram Panchayat	51	1.13	0
16	PHC / Family Welfare Centre	46	1.45	1
17	Major District road	37	1.81	1
18	Hospital Allopathic	35	1.91	4
19	Dispensary	34	1.97	1
20	State Highway	33	2.03	1
21	ATM	30	2.23	1
22	Arts/ Science/Commerce College	20	3.35	20
23	Sports Club/Recreation/Stadium	19	3.52	20
24	National Highway	18	3.72	1
25	Cinema/Video Hall	18	3.72	8
26	Polytechnic	7	9.57	7
27	Municipal Council	6	11.16	0
28	Mobile Health Clinic	3	22.33	1
29	Fire Fighting Service	3	22.33	1

Sr. No.	Facilities	No. of Settlement	Weigh-tage	No. of Facilities in Settlements
30	Vocational Training School/ITI	3	22.33	6
31	Engineering College	1	67	2
32	Medicine College	1	67	3
33	Management Institute	1	67	3
34	Railway Station	1	67	1
35	Airport	1	67	1
36	Municipal Corporation	1	67	1
37	ZP Office	1	67	1
				Total CFI Value=1516

Table 3. *Weightage of the Facilities & Sample CFI Calculation for Aurangabad*

Total no. of settlements in Aurangabad district is 67 settlements and No. of Settlements having a particular facility is as per secondary survey carried out in March 2021.
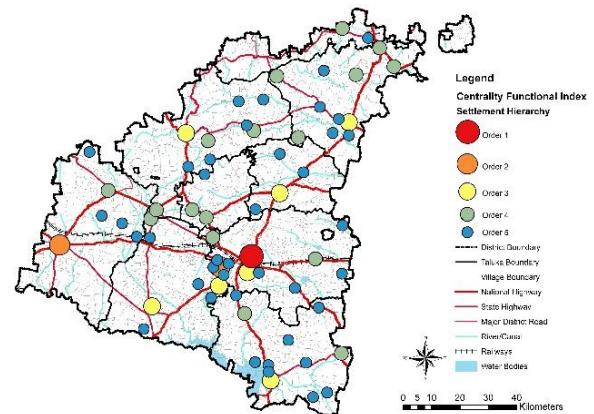

Figure 5. Map showing hierarchy by CFI (2001)

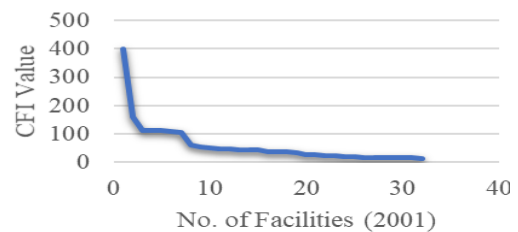**Figure 6. Map showing hierarchy by CFI (2011)**

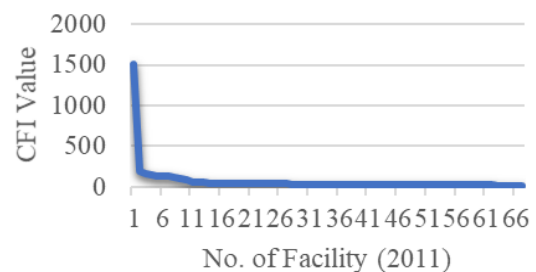**Figure 7. CFI Values for Settlements (2001)**

Figure 8. CFI Values for Settlements (2001 & 2011)

Aurangabad (M.Corp.) has the highest CFI of 400 in 2001. It is increased to 1516 in 2011, as it is primate city within the Aurangabad district. Available facilities not only support its own population but also the surrounding population of lower order settlements. Two Sub-regional settlements are identified i.e. Vaijapur and Wadgaon Kholati. As no. of facilities present in Vaijapur and

Wadgaon Kholati are more due to its connectivity and locational aspect. 7 Class III urban growth centres are identified namely Satara (CT), Silod, Kannad, Paithan, Gangapur, Fulambri and Waluj Bk. (CT) due to industrial activity. To support such population and non-availability of any other higher order settlement in the range, facilities has been upgraded here. 17 Rural Growth Centres and 39 Central Villages are identified.

VII. OBTAINING RADIUS OF INFLUENCE OF EACH SETTLEMENTS

Sphere of Influence of all considered settlements in study area is obtained for examining their functional relationship with the region. The Sphere of Influence constitutes economic and social zone of control. A mathematical model is used to find out zone of influence of considered settlements in study region as shown below:

$$Degree\ of\ Influence\ (D)= T\ x\ A/C$$

Where,

D= Degree of Influence
A= Total area of the Region
T= Total Centrality value of a particular settlement
C= Total Centrality of all settlements in a study region
R= Radius of circle indicating degree of influence

Aurangabad (M.Corp.) has a radius of influence of 31.83 km and 27.3 km in 2001 & 2011 respectively to nearby growth centres, as it is primate city of Aurangabad district. Two Sub-region are identified i.e., Silod and Fulambri having a greater influence of facilities on nearby growth centres. As no. of facilities in Silod and Fulambri are more due to its connectivity and locational proximity. 13 Class III Urban Growth Centres are identified due to greater degree of influence activity. 30 Rural Growth Centres and 21 Central Villages are identified on basis of Radius of Influence. Connectivity and concentration of facilities are the main reasons for rural growth centers.
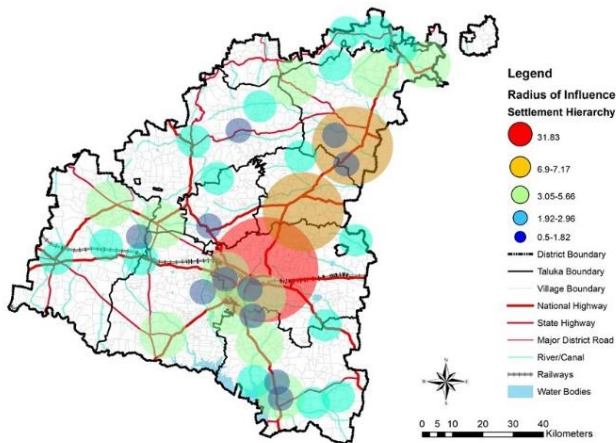

Figure 8. Map showing hierarchy by Radius of Influence (2001)
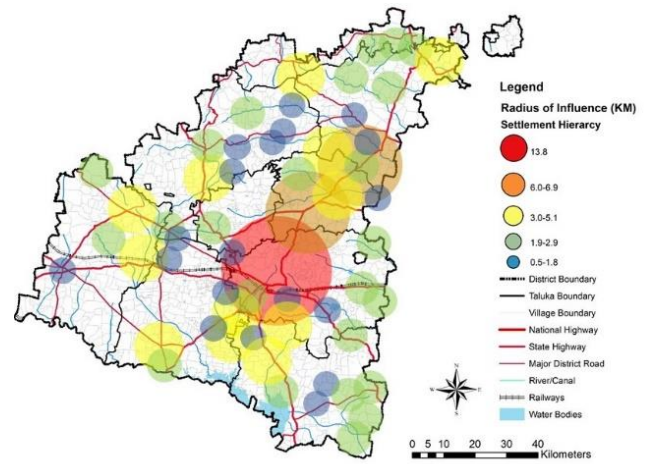

Figure 9. Map showing hierarchy by Radius of Influence (2011)

VIII. ANALYZING GAPS & PROBLEM IDENTIFICATION BY PLOTTING GUTTMAN SCALOGRAM

Guttman Scalogram is used to plot the availability of facilities in the settlements. Then they are rearranged in ascending order from bottom to top and right to left. The curve formed by rearranging should ideally replicate an inverse exponential curve. Scalogram is useful to find regional disparity among the settlements if any.
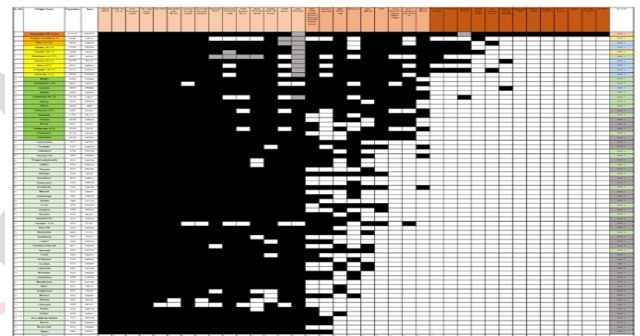

Figure 10. Guttman Scale for Aurangabad District (2011)

Vaijapur and Wadgaon Kholati act as Sub-Regional Growth Centre because of its connectivity, availability of level I facilities and its spatial location. Northern part of Aurangabad District is deprived of any regional or sub-regional growth centres. This shows inequality in development.
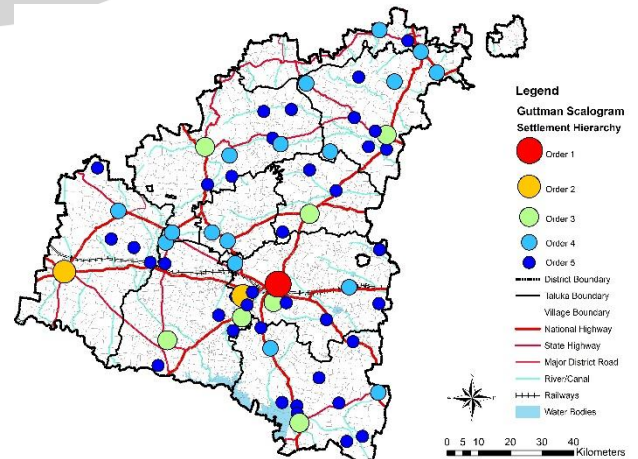

Figure 10. Map showing hierarchy by Guttman scale

Level	Order of Settlement	No. of Settlement	Facilities Considered
Regional Growth Centre	First Order	1	Airport, Municipal Corporation, Railway station, APMC, University, Connectivity by railway, Civil Hospital, District cooperative, Engineering College, Vocational Training
Sub-regional Centres	Second Order	2	Police Station, Bus Depo/Sub-Bus depo, Market yard/ Sub APMC, Post office, Eng./Medical College, Municipal Council, Community Health Centre, Fire Station, National Highway,
Urban Growth Centre	Third Order	7	PHC/Maternity/Child Welfare/Family Welfare Centre, Nationalised Bank, SH, Sub post office, Senior Colleges(BSc, B.com), Daily Market, Veterinary Hospital, Medium & Large Scale Industry, Fire post, Police chowki/post, Nagar Panchayat/Panchayat samiti, Bus stand
Rural growth Centre	Fourth Order	17	Junior College, Bus stop, Weekly Market, Post Branch office, Ware House/ Godown, Commercial bank, Cooperative Bank, Dispensary, Major District Roads,
Central Villages	Fifth Order	39	Pre-Primary & Primary School, Secondary School, Gram panchayat, Post Office , Village Roads+ODR, Primary Health Sub-centre, SHG, Shops/Mandai, Dairy

Table 4. Type of facilities w.r.t class of settlement by Guttman Scalogram

IX. EXISTING SETTLEMENT HIERARCHY

With settlement orders obtained from CFI Index analysis and population size, existing Settlement Hierarchy in a Aurangabad District is determined as shown in figure 11.
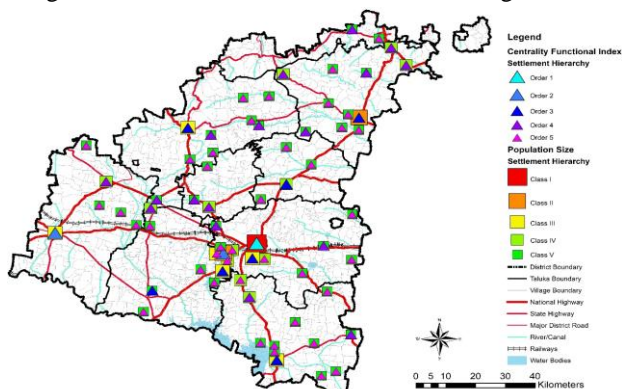

Figure 11. Existing Settlement Pattern of Aurangabad District

X. CONCLUSION

Through this study, it is realized that Aurangabad Municipal Corporation is the first order settlement which makes it the primate city in the district. The district is highly dependent on this urban local body for facilities. This district has two sub-regional centres namely Silod Municipal Council and Wadgaon Kholati. They have the potential to become urban growth centres with deliberate development efforts. There are seven urban growth centres namely Paithan Municipal Council, Vaijapur Municipal Council, Ranjangaon, Kannad Municipal Council, Satara Census Town, Gangapur Municipal Council and Waluj Bk. Along with this, seventeen rural growth centres have been identified.

Regional settlement hierarchy analysis is an inevitable part of regional planning. It helps in identifying underserved and neglected areas for proposing balanced development. This study is the starting point for equitable provision of amenities and facilities for the upliftment of the region. It also is the starting point for conducting various research on regional planning.

ACKNOWLEDGMENT

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