ANALYSIS OF SERVICE CENTRES IN MUNGER DISTRICT, BIHAR (INDIA): EXPLORING CENTRALITY, HIERARCHY, AND SPATIAL DISTRIBUTION PATTERNS

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Abstract. Service centres are crucial to regional development, driving socio-economic progress by offering essential services. The study analyses the spatial distribution of 57 rural service centres in Munger district using the Composite Centrality Index (CCI) based on secondary data. Munger ranks highest with a CCI of 26.64, while Bangawan ranks lowest at 0.10, with a total CCI of 80.51. The centres are categorised into four hierarchical levels based on the CCI, revealing varying clustering patterns: first-level centres are moderately clustered, second-level less so, and third- and fourth-level centres are randomly distributed. These findings provide important insights for regional planning and for addressing disparities.

1. INTRODUCTION

Service centres, defined as permanent settlements that cater to the socio-economic needs of their surrounding areas, play a crucial role in regional development. The identification of a service centre and its complementary area is determined by several factors, including population size, infrastructure availability, proximity to other settlements, and the movement of people. The concept of central places, introduced by Mark Jefferson in 1931, laid the foundation for understanding these socio-economic hubs. This idea was further refined in 1933 by German scholar Walter Christaller through his 'Central Place Theory', which provided a structured framework for analysing the distribution and hierarchy of settlements. In 1950, François Perroux introduced the 'Growth Pole Theory', emphasizing the uneven nature of regional development, where growth is concentrated in certain areas and diffuses outward. Boudeville (1961) expanded this theory by incorporating spatial dimensions, providing a geographical lens to the concept of growth poles. The reach and influence of a service centre are largely determined by its size and the range of services it offers. These centres act as conduits, transferring innovations and new ideas from metropolitan areas to rural regions, thus fostering development in remote villages and hamlets (Tiwari, 2020). According to the growth pole theory, development does not occur uniformly across all regions; rather, it begins in areas of concentrated growth and expands outward through various channels. Indian scholars have applied this theory to regional planning, categorizing growth centres into a five-tier hierarchy: growth poles, growth centres, growth points, service centres, and central villages. The latter two, in particular, play a pivotal role in rural development. Significant contributions to the study of growth poles and service centres in the Indian context have been made by scholars such as Mishra, Sundaram & Rao (1974), Kayastha and Mishra (1981), whose work has enriched the understanding of regional development dynamics in India.

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2. LITERATURE REVIEW

The relationship between service centres and regional growth has been the subject of extensive research, with scholars contributing significantly to our understanding of their role in settlement hierarchies and regional development. Early studies by Singh (1975), Tiwari & Khan (1984) laid the groundwork by exploring the functions of service centres within regional growth frameworks. Wanmali and Islam's (1995) work on rural services, infrastructure, and regional development in India is a notable contribution in this area. Their analysis focused on the demographic, functional, and spatial distribution of rural services across three Indian states, offering insights into the regional implications of service accessibility. Mallick and Routray (2001) took a more granular approach in their study of Kendrapara District, Andhra Pradesh, analysing settlement distribution having central functions and services. They assessed the hierarchy of settlements and identified service centres, along with unserved areas, based on people's interactions and accessibility. Mishra and Sharma (2003) have applied a Final Centrality Score by adding the Functional Index value of Web and the Social Amenity Index value by L.S. Bhatt for the identification of the hierarchical arrangement of the settlements.

In recent years, scholars have increasingly turned to geospatial technologies to enhance regional planning and the study of service centres. Gualberto (2008) and Kharate (2009) further advanced this field, helping shape regional development policies through an improved understanding of the interaction between service centres and settlement patterns. Notable contributions include those of Yadav and Singh (2009), Khan & Ahamad (2013), and Chaturvedi (2013), who leveraged geographic analysis to improve our understanding of service centre distribution and functionality. Sharma and Sharma (2016) studied the rural central places as a new perspective for micro-level development planning. Sarkar's (2018) study of rural service centres in Chanduali district, Uttar Pradesh, used a spatial database to analyse spatial distribution and functional inadequacies, highlighting the importance of geospatial analysis in identifying service gaps. Supriya (2018) also used a regional planning framework to address service centre distribution in Muzaffarpur district, focusing on the hierarchical layout and the challenges facing these centres in rural settings. Sharma (2018), focused on this study of rural development scenarios and strategies in the Bundelkhand region of Madhya Pradesh. Khadke and Waghmare's (2019) research on the centrality and hierarchy of urban centres in Maharashtra provided further insights into urban service centre distribution and its regional impact. Sharma (2019) analyses the spatial pattern of rural growth centres in Sagar district with the help of the nearest neighbour analysis. Kumar's (2022) study in Jaunpur district, Uttar Pradesh, examined the spatial organization of service centres using secondary data at the block level, contributing to our understanding of service centres and their complementary areas. Most recently, Kumar (2023) has shifted the focus to rural service centres in Bodhgaya, examining their role in socio-economic development and resource distribution, particularly for marginalized communities such as the scheduled castes. Their work underscores the socio-economic dimension of service centres in rural India, complementing earlier spatial analyses. These studies highlight the evolving nature of research on service centres, from early theoretical frameworks to contemporary applications of geospatial technologies, offering a comprehensive understanding of their role in regional growth and development. In Munger district, major problems have been noted regarding healthcare facilities, educational facilities, transportation and communication services, administrative services, and finance and trade. Therefore, there is an urgent need to explore the centrality, hierarchy, and distribution pattern of the service centres.

3. SIGNIFICANCE OF THE STUDY

The present study of service centres in Munger district helps in understanding the role of service centres in the development of the socio-economic structure of the district. In the study area, the decentralization of socio-economic activities and other services facilitates the distribution of resources within their vicinity to the resident population. For an area like Munger, which has much potential, it is

essential to develop the service centres in a manner that can reduce regional imbalance and promote the socio-cultural and economic development of the district.

4. STUDY AREA

Historically, Munger is known as 'Maudgalyagiri', which is believed to derive from the renowned Buddhist monk Maudgalya. Another tradition attributes the name 'Modagiri' to Sage Mudgala Muni, the grandfather of Ahilya. During the British period, the district was referred to as 'Monghyr', but this name was changed to 'Munger' in the 1971 census. The district was officially established on July 15, 1812. Geographically, Munger is notable for the Ganga River, which flows from West to East along its northern boundary. The district spans latitudes from 24° 56' 46" N to 25° 29' 55" N and longitudes from 86° 18' E to 86° 44' 24" E, covering a total geographical area of 1,419.70 square kilometres, accounting for 3.30% of Bihar's total area. According to the 2011 Census, Munger has a population of 1,367,765, that is, 1.31% of the state's population, with a population density of 964 persons per square kilometre. Topographically, the southern part of Munger is characterised by the Jamalpur-Kharagpur hills, while the rest of the district consists of flat plains. Administratively, Munger is divided into three subdivisions and nine development blocks: Munger, Bariarpur, Jamalpur, Kharagpur, Dharhara, Tarapur, Tethia Bambor, Asarganj, and Sangrampur, as shown in Figure 1.

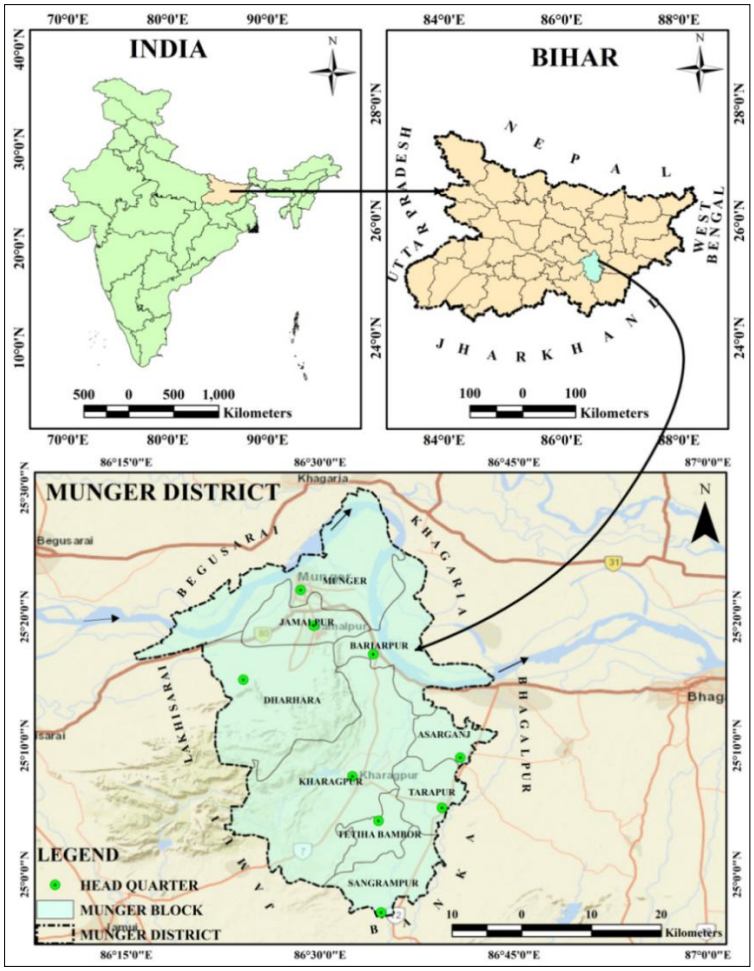

Fig. 1 – Location Map of the Study Area.

5. OBJECTIVES

The main objectives of this research are as follows:

- Evaluating the availability of institutional and infrastructural services in development-focused service centres.
- Analysing the significance of service centres in different development areas.
- Identifying and assessing the central location of service centres.
- Establishing a hierarchy based on the centrality of service centres.
- Attaining a level of dispersion and randomness among different service centres.
- Investigating the spatial arrangement of service centres in various development areas.

6. HYPOTHESIS

The present study is based on the hypothesis given below:

1. The dispersion of low-level service centres is more than that of high-level service centres.

7. DATA SOURCE & SOFTWARE

In this study, secondary data sources were used to derive results, while an empirical analysis was employed to identify service centres across various regions. Reliable sources, including Statistics Magazine, the Census of India, and several government agencies, provided the necessary secondary data. Specifically, data from the Primary Census Abstract (PCA) and Village Details (VD) were used to examine service centres' determination and spatial distribution. For the data analysis, Microsoft Excel and SPSS were employed, generating village-level tables and facilitating in-depth analyses. Additionally, spatial distribution maps of service centres were created using ERDAS Imagine Software and ArcGIS, offering a comprehensive visual representation of the findings.

8. METHODOLOGY

The study was conducted in two distinct phases to analyse the centrality, hierarchy, and spatial distribution of service centres in the study area. The selection of variables and indices was guided by their relevance to functional significance and spatial analysis as part of central place theory and settlement geography.

Phase 1: The Determination of Centrality and Hierarchy Using the Composite Centrality Index (CCI). In this phase, the Composite Centrality Index (CCI) was constructed to evaluate the relative importance and hierarchical positioning of each service centre. The choice of variables incorporated into the CCI was based on their capacity to capture both functional significance and population-based influence, essential for identifying central places. Two indices were used:

1. Functional Centrality Index (FCI): This index was developed based on the number and diversity of services available at each centre. The services included were those relevant to daily needs and administrative functions, such as education, healthcare, transport, banking, and markets. The rationale behind choosing these functions lies in their role in attracting population and facilitating inter-settlement interactions.

2. Tertiary Population Index (TI): This index considers the population served by each service centre, including the centre’s population and those of surrounding settlements dependent on it. This variable was selected to reflect the service catchment area and demand-side importance of each centre. The CCI was calculated as a composite score by normalising and aggregating the FCI and TI values for all 57 identified service centres. This provided a hierarchical ranking, allowing the categorisation of service centres into different levels based on their composite centrality.

Phase 2: Spatial Distribution Analysis Using Nearest Neighbour Matrix and Dispersion Metrics. The second phase focused on examining the spatial arrangement of the 57 service centres so as to understand whether their distribution exhibited clustering, randomness, or uniform dispersion.

1. Nearest Neighbour Matrix (NNM): The NNM was used to calculate the average distance between each service centre and its closest neighbour. This metric helps assess the overall spatial pattern.

2. Randomness Index (Rn): Derived from the NNM, the Rn was applied to quantify the degree of randomness in the spatial distribution. An Rn value close to 1 indicates randomness, below 1 indicates clustering, and above 1 suggests uniformity.

3. Dispersion Index: This index was employed to measure the variability in inter-centre distances, further supporting the assessment of spatial organisation. High values signify irregular distribution, while low values indicate systematic spacing.

9. CRITERIA FOR IDENTIFYING AND SELECTING SERVICE CENTRES

Discrepancies in institutional infrastructure across regions can significantly impact the social and economic landscape, posing common challenges in locating service centres in a particular country or region for geographical research purposes. In 2011, out of the 858 villages in the district, 534 were populated. Additionally, seven urban areas were designated as service centres alongside these 534 villages. Consequently, out of the 541 settlements, 57 (comprising seven urban and fifty rural areas) were selected to function as service centres. The reason behind this decision was the pivotal role of administrative and institutional services in functioning as service centres. Given the impracticality of studying every village in the Munger district, only villages meeting the following criteria are included:

- It must be recognized as an inhabited village or centre.
- A settlement with a population exceeding 4,000 individuals.
- It should have road connectivity with other settlements.
- It should have establishments, businesses, and facilities representing at least three different functional categories (medical, commercial, transportation, and administrative).

Table 1

Weighted Score for the Selected Functions in Munger District (2011)

Functional Group/Selected Service	Number of Services	Weighted Score
1.0 Educational Facilities		
1.1Middle school (M)	450	1.20
1.2 Secondary School (S)	137	3.95
1.3Senior Secondary School (SS)	66	8.20
1.3 Vocational training school /ITI	15	36.07
1.4 Degree College of Arts, Science & Commerce (ASC)	12	45.08
1.5 Polytechnic College	2	270.50
2.0 Medical Amenities		
2.1 Anganwadi Centre (Nutritional Centres)	398	1.36
2.2 ASHA (Accredited Social Health Activist)	386	1.40
2.3 Medicine Shop	323	1.67
2.4 Primary health sub-centre (PHS)	129	4.19
2.5 Maternity and Child Welfare Centre (MCW)	66	8.20
2.6 T.B. clinic (TBC)	53	10.21
2.7 Family Welfare Centre (FWC)	33	16.39
2.8 Primary Health Centre (PHC)	26	20.81

Table 1 (continued)

Functional Group/Selected Service	Number of Services	Weighted Score
2.9 Dispensary (D)	24	22.54
2.10 Veterinary Hospital (VH)	19	28.47
2.11 Community Health Centre (CHC)	2	270.50
3.0 Communication Features		
3.1 Telephone	186	2.91
3.2 Post Office	182	2.97
3.3 Telephone Exchange	2	270.50
4.0 Transportation Services		
4.1 Bus Service	174	3.11
4.2 Taxis and Vans	145	3.73
4.3 Auto Rikshaw	134	4.04
4.4 Railway Station	42	12.88
4.5 Paved Road	436	1.24
4.6 Other districts connected by road	283	1.91
4.7 Main districts connected by road	214	2.53
4.8 Connected to State Highway	128	4.23
4.9 Connected to National Highway	33	16.39
5.0 Finance and Trade		
5.1 Mandi/ Regular Market	332	1.63
5.2 Weekly Market	220	2.46
5.3 Agricultural Credit Societies	76	7.12
5.4 Commercial and Co-operative Banks	63	8.59
5.5 Agricultural Marketing Centre	57	9.49
6.0 Administrative Services		
6.1 Block Headquarters	9	60.11
6.2 Census Town	4	135.25
6.3 Nagar Parishad	2	270.50
6.4 Municipal Corporation	1	541.00
6.5 District Headquarters	1	541.00
7.0 Other Features		
7.1 Public Library	39	13.87
7.2 Newspaper Supply	429	1.26
7.3 Power supplies for all uses	372	1.45
7.4 Auditorium/Community Hall	13	41.62
7.5 Cinema	7	77.29
7.6 Stadium	4	135.25

Source: Computation based on the Census of India (2011) and the Statistical Department, Munger (2011).

10. RESULT AND DISCUSSION

10.1. Determination of Centrality of Service Centres

The centrality of a service centre refers to the type and quantity of central functions it performs, which can vary across different ecosystems. For this study, 57 service centres were selected based on 45 services (7 service groups). The "Composite Centrality Index," CCI, was used to establish the service centre hierarchy. It was computed using two indices: (1) Functional Centrality Index (FCI) and (2) Tertiary Population Index (TI).

Following is the analysis of these indices:

- **Functional Centrality Index (FCI)**

The Functional Centrality Index (FCI) measures the availability of various functions or services at a given centre. It is calculated by adding up the weightage of all functions available at the centre and then dividing that sum by the total combined weightage of the selected centres. In this study, 45 functions or services, including education, healthcare, communication, transport, finance, trade, and administrative services, have been considered when computing the FCI.

The Functional Centrality Index is measured using the following formula:

$$\mathbf{FCI} = (\boldsymbol{FWi} / \sum \boldsymbol{W}) \boldsymbol{X}\ \mathbf{100}$$

Where,
FCI = Functional Centrality Index
$\boldsymbol{FWi}$ = Weightage for i^{th}centre
$\sum \boldsymbol{W}$ = Total Weightage of all the centres

- **Determination of Weightage for Specific Services**

The weightage of service functions at 57 service centres has been calculated using the formula developed by L.S. Bhatt (1976 & Mishra (1985). The details of this calculation are provided in Table 1.

$$\mathbf{W}\boldsymbol{i} = \boldsymbol{N}/\boldsymbol{Fi}$$

Where,
$\mathbf{W}\boldsymbol{i}$ = Weightage of i^{th} function
N = Total number of settlements
$\mathbf{F}\boldsymbol{i}$ = Number of settlements having that function

When comparing the weightage of service centres, the Municipal Corporation, as the sole institution in the district, has a weightage of 541. In contrast, the Nagar Parishad, which operates in two locations within the district, has a combined weightage of 270.50. This indicates that, from a workload perspective, the Municipal Corporation is twice as significant as the Nagar Parishad.

- **Tertiary Population Index (TI)**

The centrality of service centres from the point of view of the tertiary population has been ascertained in the current study using Gudlund's modified formula:

$$\mathbf{TI} = (\boldsymbol{TcPi} / \boldsymbol{TcP})\ \boldsymbol{X}\ \mathbf{100}$$

Where,
TI = Tertiary population index of P^{th}service centre
$\mathbf{Tc}\boldsymbol{Pi}$ = Tertiary population of P^{th} service centres
TcP = Total Tertiary population in the district

- **Composite Centrality Index (CCI)**

The measurement of the Composite Centrality Index (CCI) is based on the mean value of the Functional Centrality Index (FCI) and the Tertiary Population Index (TI) mentioned above. The database of the hierarchy of service centres in the Munger district is shown in Table 2.

This index has been calculated using the following formula:

$$\mathbf{CCI = (}\boldsymbol{FCI}\mathbf{+}\boldsymbol{TI}\mathbf{)/2}$$

Table 2

Database of Hierarchy of Service Centres in Munger District, 2011

Sl.No.	Service Centre	Population	FCI	TI	CCI	Hierarchy
1.	Munger (M Corp.)	213,303	30.49	22.80	26.64	**I**
2.	Jamalpur (NP)	105,434	14.79	10.98	12.88	**I**
3.	Kharagpur (NP)	31,385	6.13	2.39	4.26	**II**
4.	Gazipur (CT)	11,299	4.41	0.93	2.67	**II**
5.	Tarapur (CT)	7,450	4.39	0.75	2.57	**II**
6.	Bariarpur	16,614	3.57	1.46	2.51	**II**
7.	Asarganj (CT)	6,327	4.08	0.56	2.32	**II**
8.	Karharia	17,788	2.97	0.91	1.94	**III**
9.	Paria (CT)	4,922	2.96	0.40	1.68	**III**
10.	Nauagarhi	34,356	0.74	2.35	1.55	**III**
11.	Itahri	15,716	1.47	0.82	1.14	**III**
12.	DharharaKasba	11,845	1.11	0.81	0.96	**III**
13.	Itwa	6,367	1.09	0.53	0.81	**III**
14.	Mangarh	6,534	1.17	0.46	0.81	**III**
15.	Manikpur	13,870	0.46	1.10	0.78	**III**
16.	Raunakabad	17,108	0.95	0.56	0.76	**III**
17.	BindaDiara	32,488	0.83	0.68	0.75	**III**
18.	Indrukh	9,317	0.57	0.90	0.74	**IV**
19.	Singhia	6,845	0.69	0.77	0.73	**IV**
20.	Halimpur	4,144	1.02	0.44	0.73	**IV**
21.	Rampur Kalan	7,463	0.93	0.50	0.72	**IV**
22.	Patam	9,029	0.45	0.90	0.67	**IV**
23.	Parham	5,059	0.59	0.61	0.60	**IV**
24.	Parsando	4,649	0.98	0.19	0.59	**IV**
25.	Bagalwa	5,989	0.85	0.28	0.57	**IV**
26.	MirzapurBardah	7,025	0.57	0.54	0.56	**IV**
27.	Tetiha	4,309	0.91	0.16	0.53	**IV**
28.	Sibkund	8,139	0.59	0.44	0.51	**IV**
29.	Rampur Bisai	5,627	0.65	0.38	0.51	**IV**
30.	Amari	4,601	0.62	0.40	0.51	**IV**
31.	Sikandrapur	8,979	0.38	0.55	0.47	**IV**
32.	Hemzapur	5,549	0.61	0.32	0.46	**IV**

Table 2 (continued)

Sl.No.	Service Centre	Population	FCI	TI	CCI	Hierarchy
33.	OraBagicha	4,690	0.52	0.38	0.45	**IV**
34.	Tikarampur	9,382	0.38	0.50	0.44	**IV**
35.	BahaChauki	4,271	0.54	0.28	0.41	**IV**
36.	TolaBanhara	8,489	0.46	0.30	0.38	**IV**
37.	Dariapur	4,955	0.43	0.27	0.35	**IV**
38.	KutlupurDiara	12,104	0.53	0.16	0.34	**IV**
39.	Mozaffarganj	4,277	0.43	0.26	0.34	**IV**
40.	HarnathpurBarni	5,319	0.29	0.37	0.33	**IV**
41.	Nurpur	7,147	0.32	0.31	0.31	**IV**
42.	Gobadda	5,248	0.41	0.19	0.30	**IV**
43.	Gangta	4,366	0.49	0.07	0.28	**IV**
44.	Dhobai	4,491	0.22	0.29	0.25	**IV**
45.	Murheri	4,831	0.36	0.15	0.25	**IV**
46.	Rahmatpur	4,503	0.22	0.29	0.25	**IV**
47.	Agarhan	4,551	0.39	0.08	0.24	**IV**
48.	Rataitha	5,359	0.29	0.16	0.22	**IV**
49.	Ratanpur	4,055	0.29	0.15	0.22	**IV**
50.	Jorari	4,740	0.08	0.36	0.22	**IV**
51.	Chorgaon	4,630	0.31	0.10	0.21	**IV**
52.	Jhikuli	4,411	0.22	0.08	0.15	**IV**
53.	Majhgain	4,208	0.23	0.07	0.15	**IV**
54.	Murade	4,836	0.20	0.04	0.12	**IV**
55.	Bahira	4,928	0.13	0.12	0.12	**IV**
56.	Dhauri	4,981	0.12	0.11	0.11	**IV**
57.	Bangawan	4,219	0.16	0.04	0.10	**IV**

Source: Computation based on the Census of India (Village Directory and Primary Census Abstract), 2011.

10.2. Determining the hierarchy of service centres

The hierarchy of service centres refers to the classification of settlements based on the service and functional levels they provide. Higher-level service centres offer more advanced services and are positioned higher in the hierarchy, while lower-level service centres provide fewer services and occupy lower levels (Tiwari, 2020). In the Munger district, service centres are classified into four levels based on continuous data indices. The distribution of service centres is as follows: two at the first level, five at the second level, ten at the third level, and forty at the fourth level (Table 2, Fig. 2). The district comprises hilly, mountainous, and plain areas near the Ganga River, affecting the service centre development sequence. The first-level service centres are Munger Municipal Corporation & Jamalpur Nagar Parishad urban area with the high Composite Centrality Index (CCI) of 26.64 and 12.88, respectively. This centre houses administrative headquarters, development block headquarters, and numerous socio-economic facilities. It also has a high Functional Centrality Index (FCI) and Tertiary Working Population Index (TI). The average population of these centres is 159,369. Second-level service centres include Kharagpur Nagar Parishad, Gazipur Census Town, Tarapur Census Town, Asarganj Census Town and Bariarpur. These four areas serve as administrative headquarters of

development blocks, with the exception of Gazipur, and offer various socio-economic facilities, supporting the surrounding areas. The average population of these centres is 14,615. Third-level service centres consist of ten settlements: Karharia, Paria (CT), Nauagarhi, Itahri, Dharhara Kasba, Itwa, Mangarh, Manikpur, Raunakabad, and Binda Diara. Some are very near to development block headquarters, while others have significant socio-economic facilities. The average population of these centres is 16,099. Fourth-level service centres include forty settlements that lack high-level institutions and services. These centres have smaller populations, averaging 5,793 individuals, and fewer administrative, health, business, and economic institutions.

Fig. 2 – Spatial Distribution of Service Centres in Munger District.

10.3. Spatial distribution of service centres

The distribution pattern of service centres significantly reflects and influences regional economic development, making it a vital aspect of state economic studies. The placement of service centres is shaped by physical, economic, social, and cultural factors and directly impacts economic growth. Areas with sufficient service centres experience accelerated development, whereas those lacking such centres

face developmental hindrances. In the Munger district, the distribution of service centres across development blocks reveals a marked influence of topography, relief, soil, water availability, and socio-economic and cultural elements. There are significant disparities in service centre distribution between the district's hilly and plain regions.

In the present work, an attempt has been made to analyse the block-wise distribution of all levels of service centres after taking into account the functional weightage of service centres and their total CCI values. The number of service centres varies in different development blocks, such as Kharagpur (13), Dharhara (9), Jamalpur (8), Munger (7), Bariarpur (6), Tarapur (5), Tethia Bambor (4), Asarganj (4), and Sangrampur (1). Weightage is assigned according to the rule of thumb in order to highlight quality variation. The weightage is determined based on the numbers of first, second, third, and fourth-level service centres, which are 2, 5, 10, and 40, respectively. The weightage for first, second, third, and fourth-level service centres is, therefore, decided by reversing the numbers with values of 40, 10, 5, and 2, respectively. In the Munger block, there is one first-level centre, one third-level centre, and five fourth-level centres, resulting in a total CCI weightage of 55, calculated as (1*40) + (1*5) + (5*2). The Jamalpur block has the highest total weightage (57), while Sangrampur has the lowest (2). Kharagpur, Tarapur, Bariarpur, Dharhara, and Asarganj have moderate scores, with Kharagpur scoring 37, Tarapur and Bariarpur both scoring 29, Dharhara scoring 27, and Asarganj scoring 16. The spatial distribution of service centres was further analysed using the data Composite Centrality Index (CCI), which aggregates the indices of all service centres in a block. The Munger block has the highest one at 30.33, attributed to its first-level service. The Jamalpur block's eight service centres have a composite centrality index of 18.22, while Sangrampur has the lowest at 0.15, Kharagpur (7.98), Bariarpur (7.42), and Tarapur (6.79) have medium composite centrality index totals, reflecting the varying levels of social, economic, and administrative services (Table 3).

Table 3

Block-wise distribution of Service Centres and Weighted Scores in Munger District, 2011

Sl. No.	Developmental Block	Population	No. of various Service Centres levels					% of the total inhabited settlement	Weightage of the Service Centre of different level	Total CCI of Service Centres
			I	II	III	IV	Total			
1.	Munger	134,089	1	0	1	5	7	11.05	55	30.33
2.	Bariarpur	109,359	0	1	3	2	6	5.06	29	7.42
3.	Jamalpur	102,896	1	0	1	6	8	8.43	57	18.22
4.	Dharahara	131,753	0	0	3	6	9	18.16	27	5.49
5.	Kharagpur	180,920	0	1	1	11	13	17.23	37	7.98
6.	Asarganj	74,380	0	1	0	3	4	8.24	16	3.01
7.	Tarapur	110,214	0	2	1	2	5	9.93	29	6.79
8.	TethiaBambor	76,303	0	0	0	4	4	9.74	8	1.13
9.	Sangrampur	97,729	0	0	0	1	1	12.17	2	0.15
Munger District		**1,367,765**	**2**	**5**	**10**	**40**	**57**	**100.00**	**260**	**80.51**

Source: Computation based on the Census of India (Village Directory and Primary Census Abstract), 2011.

Worth noting is that the maximum number of service centres is in Kharagpur block, while the highest number is located in Munger and Jamalpur blocks. Table 4 and Figure 2 illustrate the spatial distribution of service centres, which was analysed using statistical methods, such as mean actual distance, expected mean distance, hypothetical spacing, randomness value, and the dispersion index. These methods were applied to determine whether the distribution of service centres is clustered, random, or uniform. In this context, the 'Nearest Neighbour Analysis' (NNA) used by Clark and Evans

has been adopted. Similarly to the settlements, the distribution pattern of service centres is also influenced by various physical, cultural, social, and economic factors. In this approach, service centres act as a catalyst in the socio-economic development of an area. Their absence in an area obstructs the process of development. This can be fulfilled by establishing new centres (Tiwari, 2020).

Table 4

Spatial Distributional Pattern of Service Centres of Munger District, 2011

Hierarchy Category	No. of existing service centre	Mean actual distance (rO) in km	Expected mean distance (rE) in km	Hypothetical spacing (Hs) in km	Dispersion Index (Di) in %	Randomness Index (Rn)	Nature of distribution
I	2	5.36	13.33	28.63	19	0.40	**Moderately Clustered**
II	5	7.52	8.43	18.11	42	0.89	**Least Clustered**
III	10	5.38	5.96	12.80	42	0.90	**Random**
IV	40	3.13	2.98	6.40	49	1.05	**Random**

Source: Computation based on the Census of India (Village Directory and Primary Census Abstract), 2011.

Table 4 shows that the first hypothesis is accepted because the dispersion in high-level (first-order) service centres is 19% (low), whereas the dispersion in low-level (fourth-order) service centres is 49% (high). There are only two first-order service centres in the study area – Munger Municipal Corporation and Jamalpur Nagar Parishad – whose mean actual distance is 5.36 km, expected mean distance is 13.33 km, randomness value is 0.40, and dispersion is 19%, indicating a moderately clustered distribution. Second-order service centres have a mean actual distance of 7.52 km, an expected mean distance of 8.43 km, a randomness value of 0.89, and a dispersion of 42%, showing a less clustered distribution. For third-order service centres, the mean actual distance is 5.38 km, the expected mean distance is 5.96 km, the randomness value is 0.90, and the dispersion is 42%, with a random distribution pattern. Fourth-order service centres have a mean actual distance of 3.13 km, an expected mean distance of 2.98 km, a randomness value of 1.05, and a dispersion of 49%, reflecting a random distribution.

11. CONCLUSION

This study highlights that regions with a well-established and cohesive system of service centres experience lower regional disparities and greater support for the development process. The analysis reveals a significant functional gap in the service capacity of these centres in terms of population size and geographic area. The comparative study shows that first-order service centres exhibit a moderately clustered distribution, second-order centres are less clustered, and third- and fourth-order centres display completely random distribution patterns. The findings align with the theory that development does not occur uniformly across all regions. Service centres tend to emerge from growth poles, acting as focal points from which development spreads through various channels. This research underscores the need for the establishment of new rural growth centres, particularly in underdeveloped areas, to address the socio-economic needs of rural populations. In conclusion, effective rural transformation and resourceful management at the village level are essential for promoting balanced development. Strategic planning for service centre development is necessary to foster the district's comprehensive growth and ensure equitable access to essential services across all regions.

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