GEOGRAPHICAL ANALYSIS

ORIGINAL ARTICLE

Application of Geographic Information System (GIS) in Analyzing the Spatial Distribution of Socio-economic Amenities in Pulwama District, UT of Jammu and Kashmir

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Abstract

Physical access to basic services and facilities inspires the quality of life and living environ of the community, as they are essential to interpret the standard of living individuals enjoy in a peculiar location. This study intends to investigate the spatial disparity and concentration of basic amenities in the Pulwama district of Jammu and Kashmir using GIS. Inequality in the study region is demonstrated in the form of uneven provision of social and economic amenities. Three basic facilities consisting of educational facilities, health care institutions (social amenities) and financial institutions (economic amenities) were analyzed and visualized, using Geographic information system (GIS) Technology. The study mainly relied on secondary sources of data. Two techniques namely the Z-score variate and Location Quotient have been employed to investigate the level of spatial clustering pattern in allocating selected amenities. However, the GINI coefficient along with the Lorenz curve technique has been utilized for accessing and computing the spatial disparity among the selected amenities. The results convey that imbalances exist in the provision of availability of selected amenities among different blocks in the district, as certain blocks are more advanced in terms of the accessibility of particular facilities while others fall well short of the average degree of development.

Keywords: Geographic Information System (GIS); Socio-economic amenities; Z-score variate; Location Quotient; GINI coefficient; Jammu and Kashmir

1 Introduction

Social amenities include the goods, infrastructure, facilities, and services that play an indispensable role in developing and offering a quality life for society. These play a progressive role in the evolution and expansion of society; without these facilities, society cannot arise and sustain itself [(1)]. An essential role is performed by these amenities and services to improve the community's quality of life. Access to elementary services like educational institutions, healthcare centers, electricity, sanitation, drinking water,

adequate transportation, and solid waste management is crucial in offering a quality life and well-being[2,3]. In addition to improving a community's quality of life, improved facilities and equitable access to these amenities also support greater social interaction and community building, environmental sustainability, economic growth, and health and well-being.

The phenomenon of urbanization is spreading rapidly across the globe. Urbanization is occurring in all countries—developed, developing, and even underdeveloped—at an extremely rapid pace. Nevertheless, India has a fairly low level of urbanization. Countries' population has increased by 2.5 times during the past 50 years, but the proportion of individuals living in cities has increased by about 5 times[4]. This slight increase in urban population leads to inequity in the distributional pattern of social amenities.

Due to swift population growth and low investment in urban development, towns and cities suffer from a severe lack of essential amenities and infrastructure[5]. The investment for the infrastructural development and provisions of essential services from the past few decades have not been spatially balanced. Studies have manifested that due to a lack of urban policy, disparities are found in the accessibility of basic amenities in the city, as some regions of the city are better planned while others are devoid of these facilities[6,7]. Over the past thirty years, the dissemination of social amenities in rural and backward areas of India has undergone significant changes. Traditionally these facilities were mostly found in metropolitan regions; however, as industrialization and globalization have progressed, these facilities have spread along the rural areas. Studies have expressed that rural areas were lagging much far behind than urban areas in attainment of the access to essential basic amenities[8]. In the Himalayan areas, Urban development is an astonishing phenomenon that has been attributed to the expansion and advancements in transportation and tourism facilities[9]. The socioeconomic growth of a community is significantly influenced by the availability of basic facilities in that particular region. Amenities are essential in comprehending the quality of life that a community experiences in a particular area since they make some areas desirable for living and working[10].

At the international level, programs like Sustainable Development Goals (2015-2030) emphasize the need and importance of basic amenities with the primary goal of ensuring that every individual should have access to these facilities. Despite being an essential component of any community's existence, whether rural or urban, these infrastructures are dispersed unevenly over space. Empirical studies have manifested that social infrastructure is unevenly distributed within communities[11,12], this unevenness may be a result of inadequacy in the allocation and distribution of facilities between the regions or as a result of community barriers like geographical inaccessibility, ethnicity, religion, or social status which may leave the great majority of people perpetually struggling to gain access to the infrastructure they need to enhance their standard of living[1].

In India, the historical origin of Inequality in accessibility to social infrastructures within the population of a society is not a new concept, it has existed since Prehistoric times. The caste system for instance developed in India was one of the main causes of inequity in the availability of specific facilities which resulted in a spatial imbalance of certain facilities among the population. In India, disparity in the allocation of public amenities is an integral part of society and is present at every level of national development be it the state, district, or block level. The small towns and cities were worst affected by this disparity[13] and thus to combat this situation PURA (Providing Urban Amenities to Rural Areas) programme was implemented to overcome these inequalities[14]. The degree of urbanization is one of the primary factors contributing to regional differences in allocating social amenities. According to Bhagat[3], there is a positive interrelationship between the states with low levels of urbanization and those with low availability of essential services in urban areas.

GIS (Geographic Information Systems) is a prevailing tool for visualizing and analysing the geographical distributional pattern of civic amenities. GIS is a contemporary invention that plays a pivotal role in understanding regional variations in the accessibility of amenities and making future decisions regarding the planning and distribution of these amenities[15]. It is an applied science, that allows users to visualize, analyse, measure, interpret, and display spatial data to understand relationships, patterns, and trends in geographic space. It has increasingly become an important component in the planning process in both developing and developed parts of the world. Recent advances in the integration of GIS with planning models have made GIS more useful for urban planning[16].

Accelerated growth and development in the city pose several challenges in terms of the spatial distributional pattern of amenities. GIS is an immaculate scientific technology that can visualize the spatial disparity of selected amenities. The use of Geographical Information System (GIS) technology for the quantification of physical accessibility is well established and has been employed in many areas of interest including spatial analysis, network analysis, statistical analysis, and healthcare planning[17]. GIS plays an influential role in quantifying the level of the dispersion of current facilities in a particular region and their forward-looking plan. Besides, it has the proficiency to highlight the areas that are both sufficient or deficient in terms of the distribution of these facilities particularly in remote rural areas[18]. Map-based visualization is one of the prominent tactics of Geographic information system (GIS) technology which is used to depict the spatial distribution of urban facilities [39]. The purpose of using GIS in the present study is that maps generated through the Geographical Information System (GIS) provide an added

dimension to data analysis, which helps in visualizing the complex patterns and relationships among different variables.

A review of the literature on the disparities in essential services conveys that most of the studies are limited to large geographic areas while smaller units like at the tehsil and block level are not examined. Henceforth, the paper is an attempt to investigate disparities in levels of public facilities among different blocks of the Pulwama district of Jammu and Kashmir. Analysis of data exhibits that there is distinctness in the distribution of financial, health care, and educational institutions among the distinct blocks of the district. Therefore, to confiscate this disparity that is significant in the various blocks of the district, it becomes essential to find a sustainable solution related to appropriate and equitable distribution in the allocation of the selected amenities.

2 Database and Methodology

This study is attributed to the spatial distribution of basic amenities in different blocks of district Pulwama. The present study is mainly based on secondary sources of data and partly on primary sources of data. The Secondary sources include the collection of data from the District Statistics and Evaluation Officer Pulwama, Directorate of Census, Financial Commissioner's Office Pulwama, different books and journals and internet sources as well. The study area comprises 11 blocks of Pulwama districts. Data relating to the population of each district, number of schools, number of health centres and number of financial institutions, were acquired from the district headquarter Office. The pdf image of study area was acquired from the district planning office and was georeferenced with toposheet maps of the survey of India using QGIS 3.2 software. After data analysis, Software like QGIS 3.2 and SPSS (Statistical Package for Social Science) were used to generate different maps about these facilities. The technique of analysis used was the Location quotient and Z-score variate for concentration analysis, while the Gini coefficient and Lorenz curve enabled the spatial disparity in the distribution of social facilities to be determined.

Methodology adopted

z- score

The Z-score variate is used to determine the spatial distributional variation of selected amenities. The key characteristic of the Z-score is that it provides us with standardized scores that are more relevant, eminently fair, and bias-free.

Z - score variate is given by

$$Z_i = \frac{X_i - \bar{X}}{Sx}$$

Where Z_i is the Z-score for observation 'i'

X_i is the value of X for the Ith observation
X is the mean of all the values of X
Sx is the standard deviation of the X values
Sx is derived from the formula

$$S_x = \sqrt{^N\sum_{i=1} (Xi - \bar{X})\frac{2}{N}}$$

Where N is the total number of observations

Lorenz Curve

The extent of regional disparity concerning the distributional pattern of distinct public amenities has been estimated using a unique kind of cumulative graph called the Lorenz Curve, which is frequently used to measure income inequality. The Lorenz curve is a graphical representation used to illustrate the population. The distributional degree of variation in the allocation of various facilities has been measured in the current study by using the number of amenities concentrated in a particular block rather than the income and the proportion of the population belonging to that concerning block.

GINI coefficient

The Gini coefficient is a statistical measure of the level of inequality pertaining to selected amenities. its value ranges from o to 1, where a low value indicates equal distribution, and a higher value specifies unequal distribution. In the present study, block-wise Gini coefficient is calculated by measuring the area between the line of perfect equality and the Lorenz curve.

Location quotient

The technique of Location quotient computes the relative proportion of a particular feature in a region compared to a large, referenced area.

$$LQ = \frac{Xi/Ni}{x/P}$$

Were, Xi = number of facilities i in a selected block
Ni = population of the concerned
x = Number of facilities i in the Pulwama district
P = Total population of the Pulwama district

3 Study area

The study area is the Pulwama district of the UT of Jammu and Kashmir, and the administrative center of the district is located 31 km away from Srinagar. Pulwama is situated between 33.50' to 33.54' North latitudes and 74.52' to 74.58' East longitudes with 0 0 0 0 a geographical area of about 1090 sq. Km. District Pulwama was formed in the year 1979 when it was carved out of Anantnag district. The Physiographic of the

district is highly uneven. It is mountainous and hilly towards the northeast and southwest with a broad intermountain valley with an average altitude above mean sea level of about 3700 meters. While as the Valley area is found in the central part of the district having flat undulating topography possessing an elevation above the mean sea level of about 1650 meters. The district also has some elevated plateaus of alluvial and lacustrine deposits. These elevated plateaus of alluvial and lacustrine deposits are locally known as "Wudars" (Karewas) and cannot generally be brought under irrigation. The karewas of the district are famous for the quality saffron production all over the world. Besides, prominent crops grown in the district are Rice, Wheat, Maize, Vegetables and Fruits and oil seeds. The district is called Rice Bowl of Kashmir for its maximum production of rice grains in the Jammu and Kashmir and is also called the Anand of Kashmir or Dudha Kul of Kashmir on account of its high milk production. Three major tributaries of River Jhelum viz a viz Sazara, Rambiara and Romushi river drains the sloping land in the south-west and have wide channels.

It possesses Sub humid temperate type of climate with an average temperature of 19 °C. Overall the weather condition of the district in summer is slightly muggy while the winters are extremely cold. For administrative purposes, the district has been dissected into eight Tehsils and eleven blocks viz Achgoze, Aripal, Awantipora, Dadsara, kakapora, Lassipora, Newa, pampora, Pulwama, shadimarg and Tral. As per 2011 census, the population of the district is 5.60 lac. Population is mostly rural and only 14.35% of it resides in urban areas (District Statistics and Evaluation Officer Pulwama) (Figure 1).

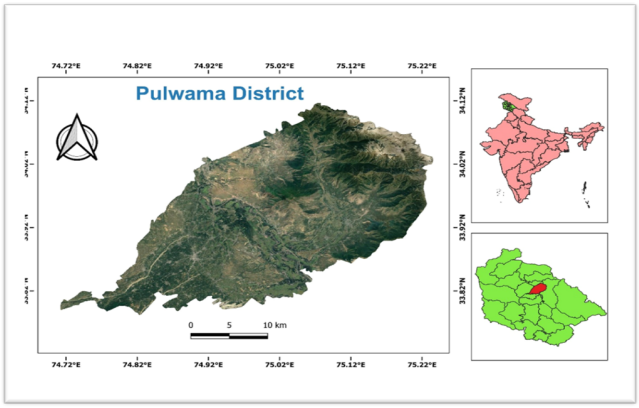

Fig. 1. Study area (Source: Generated by author)

4 Results and Discussion

Table 1 shows information on the population of each block of the district, the number of schools, the number of healthcentres and the number of financial institutions.

4.1 Spatial Distribution Analysis of socio-economic Amenities

Over the past three decades, district Pulwama has experienced steady growth in its population. In 1981, the population of the district was 4.04lakh and it increased to 5.6 lakh in 2011 [4]. Compared with the growth of population, social amenities have not been developed and as a consequence demand for services and facilities increases, which may result into the greater majority of people perpetually struggling to get access to the public infrastructure. Before planning and futuristic development of public amenities, knowledge should be gained about the distributional pattern of existing social facilities in the study region. Henceforth present study seeks to analyze the spatial distribution of selected amenities i.e. two social amenities (educational and healthcare facilities) and one economic amenity (financial institutions) in different blocks of the Pulwama district. The outcome of the study manifested that there is an uneven distribution of educational, healthcare, and financial institutions in the district Pulwama.

Based on standard and quality, educational institutions have been grouped into various categories. The block-wise distributional pattern of educational facilities is presented in Table 1. From Figure 2, it is evident that in the context of educational institution services, block Pulwama has a higher concentration of primary and middle schools (110) followed by Tral (104), and Lassipora (83), while as minimum number are found in Achigoza (54). Similarly, for high and higher secondary schools, Awantipora has maximum number of (27) higher secondary schools, followed by Pulwama and Kakapora. On the other hand, least number is found in block Achigoza possessing 6 such institution. There are 19 higher education institutions in the district amongst which six are located in block Pulwama and four in Awantipora, while as block Dadasora, Achigoza, Aripal, and Lassipora are void of such amenities.

Likewise, the distributional pattern of financial institutions has also been taken into consideration in the present study and data exhibits that financial institutions are more concentrated in block Pulwama (23) followed by Awantipora (15) and Pampore (13). While two blocks (Aripal and Achigoza) have only one such facility. Similarly, in the case of health institutions, a large number of such facilities are concentrated in block Tral (23) followed by Pampore (18) and Pulwama (18) compared to Aripal (8) and Achigoza (5) which has the least number of such amenities.

It is evident from the above table that disparity exists in terms of the availability of basic services and amenities among different blocks of the district. The blocks located along the south of the Pulwama block are lagging in the availability of selected amenities, compared to those blocks located along the north of the Pulwama block.

Table 1. Distributional Pattern of Social Amenities in the Blocks of Pulwama Districts

Sl. no	Block	Population	No. of educational facilities			No. of healthcare facilities	No. of financial institutions
			PS+MS	HS+HSS	HE		
1	Pulwama	87227	110	23	6	18	23
2	Lassipora	40774	83	10	0	10	8
3	Achigoze	20206	54	6	0	5	1
4	Shadimarg	45455	71	17	1	14	7
5	Pampore	75433	68	13	2	18	13
6	Tral	60679	104	14	3	23	6
7	Aripal	30379	70	9	0	8	1
8	Dadsara	34971	60	11	0	14	4
9	Awantipora	68008	75	27	4	15	15
10	Kakapora	56196	79	21	2	14	9
11	Nawa	41070	56	14	1	9	5
Total		560398	830	165	19	148	92

Source: District Statistics and Evaluation Officer Pulwama.

4.1.1 Spatial Distribution Analysis of Educational Institutions

Fabricating a conducive learning environment and supporting the overall development of society, educational facilities play a key role in this direction. Education is often regarded as an essential instrument for enacting social and economic change in any society. Educational institutions are vital for enhancing and upgrading the quality of education and has a direct effect on people's welfare and degree of societal progress. In India particularly in north Kashmir, the spatial disparity in educational institutions at the block level is a significant issue manifested in various regions [19]. Due to socioeconomic, political, and geographical factors inequality exists in the accessibility of educational amenities as some areas have a greater concentration of this facility others lag behind from the national average.

Educational facilities are distributed unevenly in the district of Pulwama. In the current study educational institutions have been divided into three divisions consisting of schools (primary schools and middle schools), (high schools and higher secondary schools) and higher educational institutions (colleges and universities). GIS-based spatial distribution analysis of education facilities has been executed using the QGIS domain. The geodatabase of education facilities was fed into QGIS software, and the displayed result distribution has been presented below.

Figure 2 highlights the unevenness in the distributional pattern of primary and middle schools as some areas are well served in terms of the particular facility while others lag behind from the mean development. The three blocks in the district namely Pulwama, Tral and Lassipora have a high proportion of schools, while as remaining blocks possess a medium concentration of this amenity.

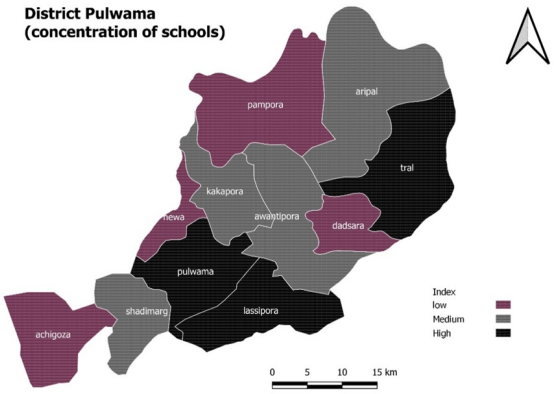

Fig. 2. Concentration of primary and middle schools

Figure 3 reveals that the two blocks with the highest concentration of high and higher secondary schools are Awantipora and Pulwama, followed by the next two blocks, Kakapora and Shadimarg, have a medium proportion of these facilities. While other blocks have a low concentration of such kind of amenity.

Figure 4 reveals the highest concentration of higher education institutions in the district is found in Block Pulwama (6), followed by block Awantipora (4) and block Tral (3). Four blocks in the district lack access to this type of facility, while blocks Pampore and Kakapora have a medium proportion of the chosen amenity.

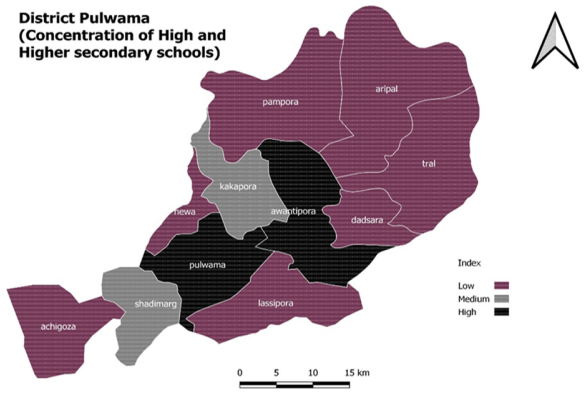

Fig. 3. Concentration of high and higher secondary schools

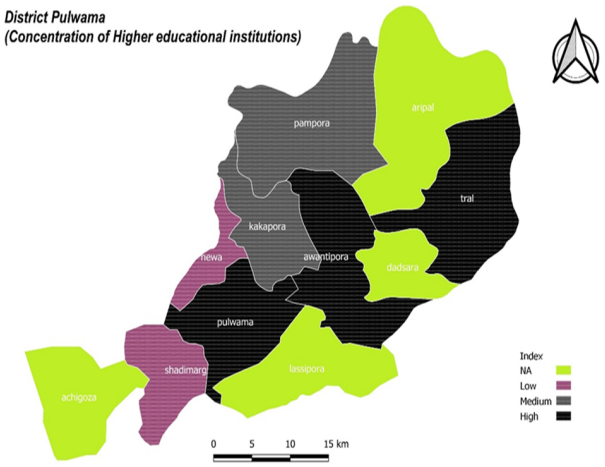

Fig. 4. Concentration of higher educational institutions

4.1.2 Spatial Distribution Analysis of Healthcare Facilities

The general state of physical, social, and mental health of a community is influenced by its access and availability to health care services. International organizations namely the World Health Organization (WHO) advise that everyone should reside five kilometers away from a medical center to have better access [20]. Access to healthcare facilities plays a significant role in shaping the overall health conditions of the population, as access to healthcare facilities is directly linked to the welfare and well-being of better human resources. Empirical Studies have observed that the areas with a higher proportion of the healthcare system have access to high-quality medical care [21]. Geographic accessibility, availability, affordability and acceptability are some of the factors that affect people's ability to access healthcare facilities [22]. Therefore, to understand the geographical distribution of healthcare institutions, equitable access to and enhancement of such establishments may result in improved societal welfare and health.

in the Pulwama district, one can find unevenness in the distributional pattern of healthcare facilities. GIS-based spatial distribution analysis of healthcare facilities has been examined using QGIS software. Figure 5 reveals that there exists a remarkable disparity in the healthcare facilities in different blocks of the district. The maximum number of healthcare institutions are concentrated at block Tral (23) followed by Pampora (18) and Pulwama (18), while five blocks in the district possess a medium concentration of these amenities. The remaining three blocks have a low concentration of this type of amenity.

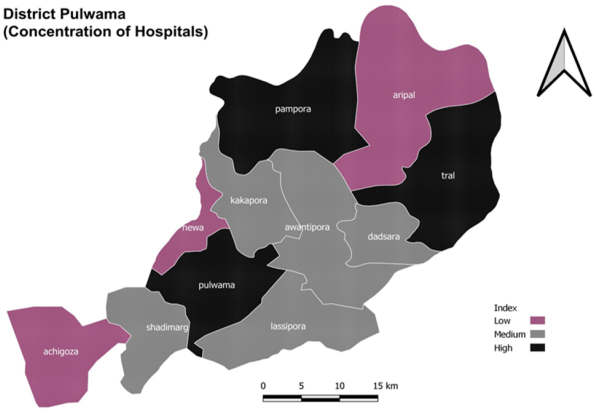

Fig. 5. Concentration of healthcare facilities

4.1.3 Spatial distributional analysis of financial institutions

Financial institutions are active in today's global market which performs the essential functions of channeling the investment in terms of funds from the surplus areas to the deficient (with a shortage of funds). The setting up of financial institutions is necessary for both rural and urban economies in a country because the service sector is relying on these financial institutions. Spatial distributional analysis of financial institutions has been carried out in QGIS and visualization of distribution is presented below.

Disparity in financial institutions is a critical issue as it has conspicuous implications for the economic growth and development of a region. Studies have observed that financial institutions are partially distributed across various regions in India, as their greater concentration is found in high-income and more developed regions and vice versa [23].

The Figure 6 shows that the highest number of financial institutions are concentrated at block Pulwama (23) followed by Awantipora (15) and Pampore (13) and four blocks have medium concentration, while a low concentration of these services is found in the remaining block with Aripal and

Achigoze, each having only one such amenity.

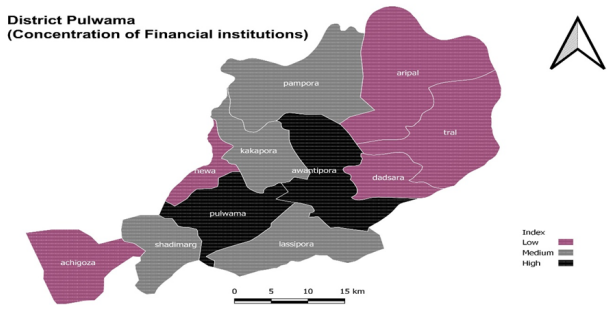

Fig. 6. Concentration of financial institutions

4.2 Spatial Concentration of Amenities

The spatial concentration of amenities takes into consideration the distribution and density of various amenities and services (like schools, hospitals, etc.) within a specific geographic area. The spatial concentration of facilities is determined by employing the location quotient method. This technique is essential in urban and regional planning to ensure equitable access to basic services among the masses. Location quotient has been utilized extensively in several geographic research [24] [25] in order to quantify the geographical distribution of regional facilities.

Using the formula a table of location quotients for the selected public facilities in different blocks of the district has been generated. If the value of the Location quotient for a particular facility in a particular block is greater than (1) it indicates a higher proportion of that facility, while a low value of the Location quotient less than (1) indicates a lower concentration. Table 2 represents the spatial concentration of primary and medium schools, high and higher secondary schools, higher educational institutions, hospitals and financial institutions within the different blocks of district Pulwama.

From the above table, it can be found that in the case of educational facilities, only six blocks have adequate primary and medium schools, while for high and higher secondary schools seven blocks have LQ greater than one indicating higher concentration. But in case of the distribution of higher educational institutions, four blocks have a higher concentration compared to the remaining seven blocks which have a low concentration of selected amenities with respect to its population.

Similarly, in the case of healthcare institutions, only three blocks (Dadsara, Tral and Shadimarg) have LQ greater than 1, while the other eight blocks possess LQ less than 1 indicating a lower concentration of selected amenities among the population of different blocks of the district. The distribution of financial institutions indicates that only four blocks (Pulwama, Awantipora, Lassipora, and Pampore) have LQ greater than 1, compared to seven blocks having a lower value of LQ i.e. less than 1.

4.3 Spatial Inequalities in the Distribution of Amenities

Far carry out the future planning and development of the social-economic amenities in the concerned region, it is paramount to understand the existing level of spatial inequality in the number of social amenities distributed across various blocks of the district. In this study, utilization of the Z-score variate has been carried out to analyze the degree of regional disparity in the distribution of socio-economic amenities in the district pulwama. Z-score variate has been utilized in several geographic research [12]. The standardized scores collected from the regional distributional pattern of amenities in distinct blocks of the district Pulwama using educational institutions, healthcare facilities, and financial institutions as criteria have been given in Table 2. To ascertain the relative concentration of particular amenities throughout the various blocks, the standardized scores of the amenities have been categorized into many groups. The composite indicator of the amenities, which represents the overall degree of disparity in the supply of the chosen amenities, is obtained by adding the standard scores of each amenity (Figure 7).

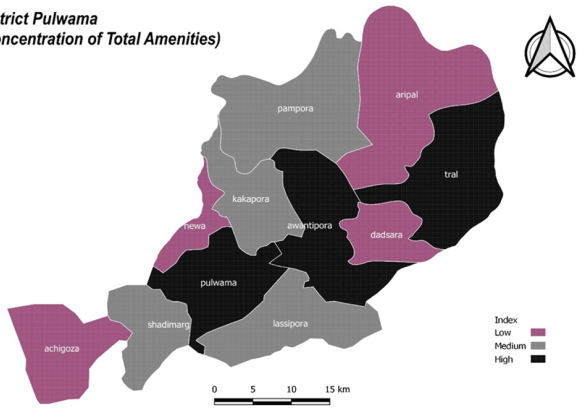

Fig. 7. Concentration of total selected amenities

Using the formula a table of Z-score variate for the selected public facilities in distinct blocks of the district has been generated. Table 3 represents the regional variation of primary and medium schools, high and higher secondary schools, higher educational institutions, hospitals, and financial institutions within the number of blocks of the Pulwama district. Table 3 shows that block Pulwama has a very high composite indicator (8.87) followed by Awantipora and Tral. While other blocks of the district have low composite indicators derived from their standardized score.

Table 2. Location quotient of different socio-economic facilities

Block name	LQ Values of Different Socio-economic Facilities				
	Primary school	Secondary schools	Higher educational institutions	Hospitals	Financial institutions
Pulwama	0.85	0.89	2.02	0.78	1.61
Lassipora	1.37	0.83	0	0.92	1.20
Achigoza	1.80	1.00	0	0.93	0.30
Shadimarg	1.05	1.27	0.64	1.16	0.93
Pampore	0.60	0.58	0.78	0.90	1.05
Tral	1.15	0.78	1.45	1.43	0.60
Aripal	1.55	1.00	0	0.99	0.20
Dadsara	1.15	1.06	0	1.51	0.69
Awantipora	0.74	1.34	1.73	0.83	1.34
Kakapora	0.94	1.26	1.04	0.94	0.97
Newa	0.92	1.15	0.71	0.82	0.74

Source: compiled by authors.

Table 3. Standardized Scores of five socio-economic Amenities and composite indicators for different blocks of the Pulwama district

Block	Financial institutions	Healthcare facilities	Educational institutions			Composite indicator
			schools	Higher Secondary schools	Higher educational institutions	
Pulwama	2.35	0.91	2.00	1.30	2.29	8.87
Lassipora	-0.05	-0.69	0.43	-0.81	-0.92	-2.06
Achigoze	-1.18	-1.71	-1.24	-1.47	-0.92	-6.53
Shadimarg	-0.21	0.11	-0.25	0.32	-0.39	-0.43
Pampore	0.74	0.91	-0.43	-0.32	0.14	1.05
Tral	-0.37	1.93	1.65	-0.16	0.68	3.72
Aripal	-1.18	-1.10	-0.31	-0.98	-0.92	-4.51
Dadsara	-0.70	0.11	-0.89	-0.65	-0.92	-3.06
Awantipora	1.06	0.31	-0.02	1.96	1.21	4.53
Kakapora	0.10	0.11	0.20	0.98	0.14	1.54
Newa	-0.54	-0.90	-1.12	-0.16	-0.39	-3.12

Source: compiled by authors.

Figure 7 reveals that three blocks i.e. Pulwama, Awantipora, and Tral have a high concentration of selected amenities, followed by four blocks (Kakapora, Pampore, lassipora and shadimarg) which possess a medium concentration. While the remaining four blocks have a low concentration in connection with the selected amenities.

4.4 Spatial disparity

The spatial imbalance approach performed in the section above has exhibited 18 that there are considerable differences in the degree of concentration of different facilities among the blocks in the district Pulwama. This imbalance in the geographical distribution of provisions has resulted in the unequal distribution of selected facilities.

The extent of the difference among different blocks has been visually represented using the Lorenz Curve and is frequently used to measure income inequality, to provide information about the degree of spatial disparity concerning various public facilities. The Lorenz curve was first practised in 1905, to quantify income or wealth distribution inequalities [26].

The equitable distribution of the facilities is depicted by the line of equality. The proportion of deviation of the Lorenz curve from the line of equality gives the degree of spatial disparity in terms of a particular facility. The least amount of disparity is shown by a curve near the line of equality, the greater the deviation from the line of equality, the greater the disparity. In the current study, the proportion of a public amenity has been utilized in place of income, and

the proportion of the block population has been employed in place of income receivers. The magnitude and extent of the difference are shown by the Lorenz curve for different public facilities located in the distinct blocks of Pulwama and are presented below.

4.4.1 Analysis of Spatial Disparity in Educational Amenities

The district Pulwama exhibits a disparity in the allocation of several educational institutions. As seen in Figure 8, 42 per cent of the district's population shares only 66 per cent of the facility, while the remaining 48 per cent has access to 34 per cent of the facility. This suggests that spatial inequality is evident in the distributional pattern of educational amenities.

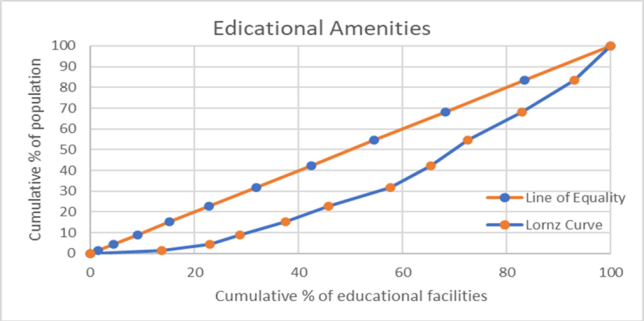

Fig. 8. Educational amenities

4.4.2 Analysis of Spatial Disparity in Hospitals

In the district Pulwama, while analyzing the allocation of healthcare institutions, Spatial imbalances exist. From Figure 9, it is apparent that fifty-two per cent population of the district has only fifty per cent portion of the facility, while the remaining fifty-six per cent of population shares the fifty per cent of the facilities indicating that inequality exists in connection to this facility.

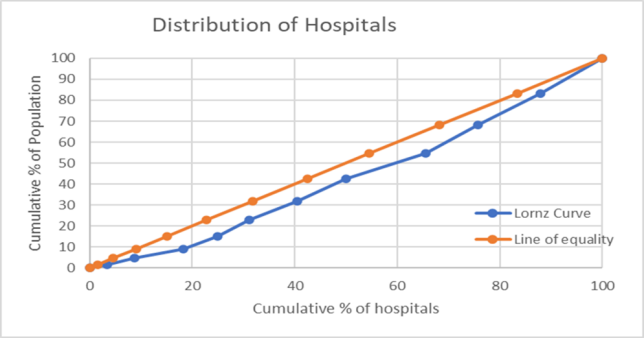

Fig. 9. Healthcare facilities

4.4.3 Analysis of Spatial Disparity in financial institutions

The review of Figure 10 reveals that fifty-five per cent population of the district has access to 45 per cent of the facilities, while the remaining forty-five per cent population shares fifty-five per cent of the facilities, which reflects the proportion of spatial imbalances in the distributional pattern of financial institutions between different blocks of the district.

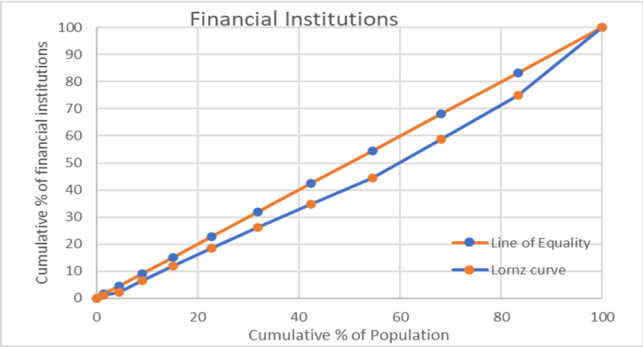

Fig. 10. Financial institutions

4.5 Spatial Inequality Index

Selected amenities under investigation were examined through a technique called the Gini coefficient— which is an indicator of inequality, and it can be computed using the Lorenz Curve. The Gini coefficient, a measure of aggregate inequality, ranges from perfect equality (0) to perfect inequality (1). The calculated Gini coefficients for the public facilities under evaluation are presented below.

Table 4. Gini coefficient index

		Gini's Coefficient
1	Schools	0.13
2	Higher Secondary Schools	0.24
3	HEI	0.58
4	Hospitals	0.18
5	Financial institutions	0.53

From the Table 4, it can be observed that the extent of spatial inequality is maximum for higher educational institutions followed by financial institutions, while the Lowest level of imbalance is found in the provisions of schools and hospitals. Thus, it can be concluded from the present study that a high level of inter-block disparity is evident in terms of most of the selected public facilities.

Table 5. Weightage of the particular facility

Number of Amenities					Total number of selected facilities in the study area	Weighted Score				
Primary and middle schools	High and Higher Secondary schools	Higher educational institutions	Healthcare facilities	Financial institutions		Primary and middle schools	High and Higher Secondary schools	Higher educational institutions	Healthcare facilities	Financial institutions
830	165	19	148	92	1254	1.51	7.6	66	8.47	13.6

Source: "Constructing a weighted Matrix", modified by Dr. Apichat Sopadang and Craig Borysowich- 1988.

Table 6. Aggregate weightage score of selected amenities

Block	Financial institutions	Healthcare facilities	Primary and middle schools	High and Higher Secondary schools	Higher educational institutions	Aggregate Weighted Score
Pulwama	23	18	110	23	6	1203
Lassipora	8	10	83	10	0	395.14
Achigoze	1	5	54	6	0	183.12
Shadimarg	7	14	71	17	1	516.4
Pampore	13	18	68	13	2	663.13
Tral	6	23	104	14	3	738.03
Aripal	1	8	70	9	0	255.49
Dadsara	4	14	60	11	0	347.3
Awantipora	15	15	75	27	4	913.95
Kakapora	9	14	79	21	2	573.14
Newa	5	9	56	14	1	401.34
Total	92	148	830	165	19	

Source: compiled by authors.

4.6 Gaps Identifying in the provision of public amenities

Identifying the gaps in the existing distributional pattern of public amenities requires knowledge of the population and relative concentration of amenities in the concerned block. These knowledgeable Gaps play a key role in identifying and analyzing the adequacy or inadequacy of the services within each block of the complementary region.

To quantify the Weightage of each item of different Amenities, a "weighted matrix was constructed" to reflect the weight of individual facilities in the study region.

To quantify the disparity in the allocation of social amenities in the Pulwama district, weightage has been assigned to different facilities as per their standard and existing number of facilities. Firstly, the total number of facilities in each block was calculated. Then it was multiplied by the value obtained from dividing the aggregate number of all types of facilities by the total unit of each facility. Each block's total weighted score was quantified by adding the separate weighted scores of its various facilities.

After calculating the Aggregate Weighted Score of each block of the district, underserved blocks of the district Pulwama were identified. These underserved blocks have been highlighted on a map (Figure 11).

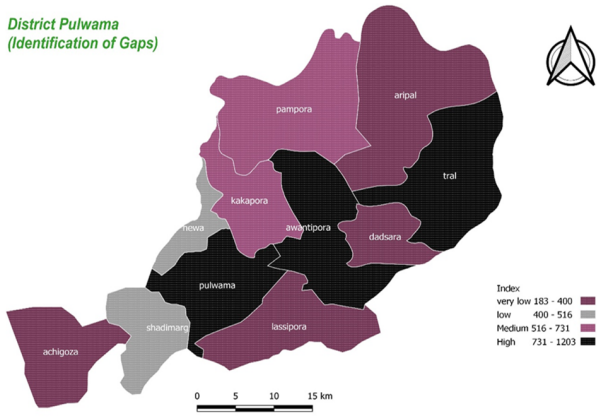

Fig. 11. Identification of Gaps

From Figure 11, it is evident that block Pulwama, Awantipora and Tral enjoy the highest share of selected amenities, followed by Pampore and Kakapora. While as minimum concentration of these facilities is found in Achigoze, Aripal, Dadsara and Lassipora.

5 Conclusion

The present research study mainly examines the provision of public facilities in the Pulwama district using GIS [Geographic information system] technology. Three indicators—financial institutions, healthcare facilities, and educational amenities—have been chosen for the assessment of District Pulwama's basic amenities. The results indicate that public amenities are not evenly distributed among different blocks of the district which leads to several issues deterioration within the living environment and disparity in the standard of living among city dwellers.

Remote sensing and Geographic information system an influential tool for understanding regional variations in the availability of basic amenities and have proficiency in making future decisions regarding the planning and distribution of these amenities. In terms of the availability of public facilities, the analysis and visualization of the processed data show that there is a geographical discrepancy in the distribution of certain amenities among various blocks. Certain blocks are more developed in particular facilities, while others lag far behind in relation to the degree of development. A greater concentration of disparity has been found in the distributional pattern of Higher Educational institutions and is followed by financial institutions throughout distinct blocks of the district. Several research studies have shown that amenities normally decrease from the city's center to its fringes [27,28]. An almost identical trend has been found in the study area where a greater concentration of selected amenities is found along block Pulwama, and the relative concentration of amenities normally decreases towards its periphery. This paper suggests that the future development of these uneven distributions of amenities should be carried out keeping in mind the priority areas that lag from the normal developmental level in terms of selected facilities.

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