

SPATIAL ANALYSIS OF SERVICE CENTRES IN AL BAHÁ REGION, SAUDI ARABIA

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Saudi Arabia has adopted a strong national development planning system as a major instrument for promoting social and economic development. Since the beginning of the 1970s, four five-year development plans were implemented, and the Fifth Plan is presently in effect for the period of 1990-1995. One of the basic objectives of the national plans has been to achieve the equitable distribution of socio-economic opportunities and wider access to public services in all regions, and especially in rural areas (Ministry of Planning, 1980, : 108).

In line with this objective the Ministry of Municipal and Rural Affairs conducted a regional plan for Al Baha region in 1985 which proposed a hierarchy of service centres as a basis for service provision in the region. The purpose of this paper is to examine and identify the spatial patterns of service centre distribution in Al Baha region. By using nearest neighbour analysis, it was possible to identify the distribution patterns of these centres at each level of the hierarchy and also the average nearest neighbour distances at each level of the hierarchy.

Nearest neighbour technique has been used to analyse spatial distribution by many researchers, especially in the Western world, including Dacey (1962), King (1962), Getis (1964), Birch (1967), Kariel (1970), Sherwood (1970), Jensen-Butler (1972), and Kivell and Shaw (1980). A few research workers in Saudi Arabia (Al-Said, 1989 and 1991; Al-Harrah, 1990, and Al-Jarallah and Al-Hamud, 1992) have used the technique to examine the spatial patterns of certain services in urban centres. The first section of this paper examines the distribution of service centres in Al Baha region. The second section examines the theory behind nearest neighbour analysis, and the third section lists the results of applying this

theoretical analysis to the distribution of service centres in Al Baha region.

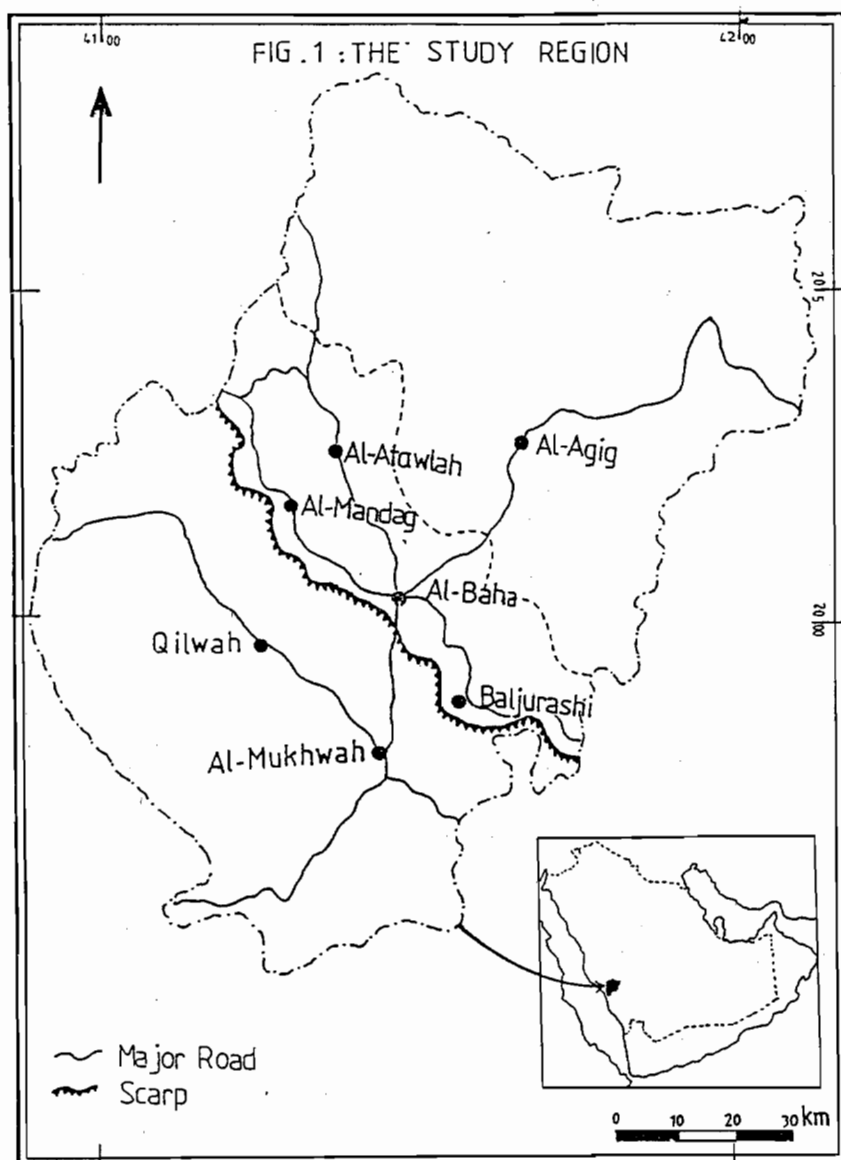
1. Service Centres in Al Baha Region:

Al Baha region, situated in the southwest of the kingdom, is one of the smallest of the fourteen administrative regions in the Kingdom of Saudi Arabia (Fig. 1). The region covers about 10,690 square km, which represent about 0.5% of the area of the whole Kingdom. An estimation of the region's population in 1990 was around 350,000 inhabitants, or 2.6% of the Kingdom's population (Ministry of Municipal and Rural Affairs, 1985). Al Baha is one of the most densely settled regions of the Kingdom, although it has a predominantly rural character. Excluding its urban areas, the region's 1,236 villages and hamlets had a total population of about 238,000 in 1984, or about 80% of the region's population (Ministry of Municipal and Rural Affairs, 1984).

The study region has been divided into three areas as shown in Figs. 1 and 2. These areas were chosen on the basis of their physical status and settlement pattern which are suitable for the purposes of this analysis: area one being the northern Sarat which is a dry highland area in the northern part of the main mountain area; area two is the Proper Sarat which is the main densely settled mountain ranges around Al Baha, Baljurashi and Al Mandag towns; area three is the Tihama area below the escarpment in the south and southwest of the region which is part of the Red Sea coastal plain (Ministry of Municipal and Rural Affairs, 1985).

The classification system of service centres used here was that developed by the Ministry of Municipal and Rural Affairs which devised a regional development plan for Al Baha region in 1985. This spatial structure of service centres has two basic objectives: (1) to stimulate the development of the whole region; (2) to encourage the region-wide spread of public services to reduce the existing disparities both between the region and the rest of the Kingdom, and within the region (Ministry of Municipal and Rural Affairs, 1985, Report No. 6: 33).

The plan designated 283 centres for the region grouped as regional (A), sub-regional (B), district (C), and local centres (D). These were mainly selected for their range and capacity of the services provided, the catchment areas, and the future development of services in the region. The only "regional centre" is in Al Baha town, in view of its importance as the regional capital. The six sub-regional centres are located in the smaller towns of Baljurashi, Al Mandag, Al Arawlah, Al Aqig, Al Makhwah and Qilwah. The thirty-seven district centres are situated in the larger villages in the region. A further 239 local centres were designated to form the lowest order centres.



Source : Compiled by the author.

The location of these centres is shown in Fig. 2, while Table 1 shows their distribution among the three areas. The Proper Sarat area has the largest number of centres, with 163 (57.2%) to attempt to meet the demands of its large population, followed by the Tihama area with 91 centres (32.2%), while the Northern Sarat area has the fewest number of centres (10.6%):

Table 1
The Distribution of Service Centres by Areas

Area	A	B	C	D	Total	%
Northern Sarat	-	1	5	24	30	10.6
Proper Sarat	1	3	20	138	162	57.2
Tihama	-	2	12	77	91	32.2
Total	1	6	37	239	283	100.0
%	0.4	2.1	13.1	84.4	100.0	

Source: Ministry of Municipal and Rural Affairs, 1985,
Report No. 6, p. 44.

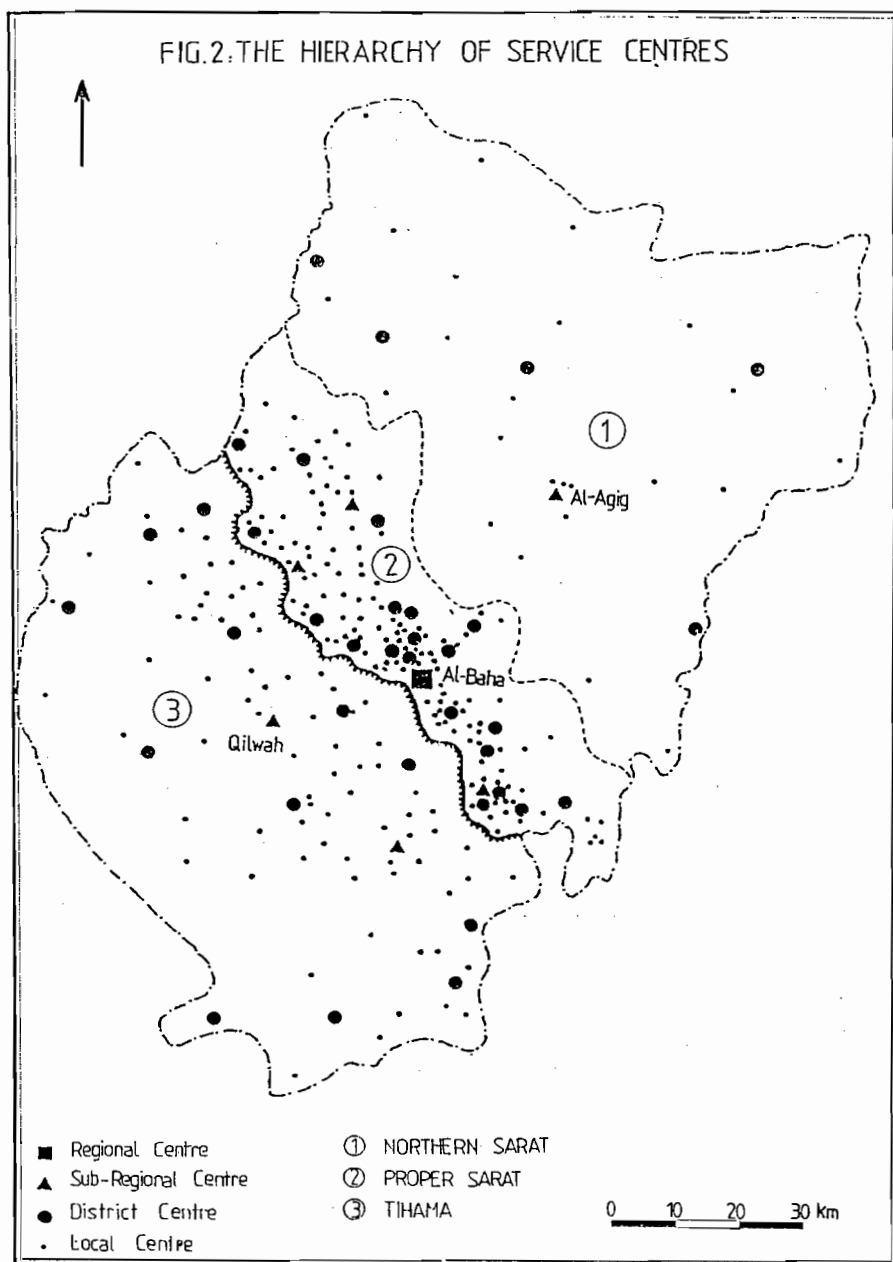
It is important to note that population densities are high in the study area compared with the rest of the country, but are not spread evenly throughout the region. The Proper Sarat area is the most densely populated part, with an average density of about 106 persons per square km. Tihama area has a density of about 30 persons per square km. The average density in the Northern Sarat area is very low, with only 5.4 persons per square km (Ministry of Municipal and Rural Affairs, 1985).

Four analysis were made to examine the distribution patterns of service centres. These analyses were for different areal units:

1. the entire study area
2. the Northern Sarat area
3. the Proper Sarat area
4. the Tihama area

II. Theoretical Nearest Neighbour Analysis:

The nearest neighbour statistics (R) is a ratio of the observed mean distance to the expected mean distance for any given number of points in a defined area (Kariel, 1970). The R statistics can be calculated for first nearest neighbour as follows (Jensen-Butler, 1972,: 357, and Taylor, 1977,: 157):



Source : Ministry of Municipal and Rural Affairs, 1985,
Report No. 6, P. 47.

$$R = \frac{RA}{RE}$$

where RA: the observed average distance between every point in a defined area and its first nearest neighbour

$$\frac{\sum r}{N}$$

RE: the expected average distance between each point and its first nearest neighbour for the same density of randomly distributed points.

The RE can be derived by using the following formula:

$$RE = \frac{1}{2\sqrt{N/A}}$$

where N: the number of points

A: the area of the study area

The R values range from 0 to 2.149. An R value of 0 represents a completely clustered pattern, in which all points are on the same location. An R value of 1 would indicate a random distribution. When the R value reaches 2.149, the distribution indicates a completely uniform pattern. In general, the R values of less than 1 indicate patterns tending toward a clustered distribution, and the R values greater than 1 indicate patterns tending toward dispersal distribution (Taylor, 1977), Fig. 4.11, : 157).

The number of service centres (N) can be regarded as a sample of size; thus the departure of R from random can be tested for the 5% level. All measurements for the nearest neighbour analysis in this study are in millimeters.

III. Results:

The results of nearest neighbour analysis for the whole study area are given in Table 2. The value of nearest neighbour statistic shows a marked tendency to rise above 1 at all hierarchical levels and at each hierarchical level, indicating a tendency for the service centres to be more dispersed towards uniform distribution and confirming to what is visually apparent in Fig. 2. These results are statistically significant departures from random at the 5% level. It is clear that the observed average nearest neighbour distances increase with hierarchical level. The D centres were 4.5 km from one another; C centres were 12 km apart, and B centres occurred at intervals of 31.3 km. It is also clear that the values of R rise with hierarchical le-

vel. The D centres have results for R statistic close to 1.3; C centres have 1.4, and B centres have 1.5.

The tendency for service centres in the study area to be more uniformly distributed can be explained by the fact that these centres were designated to help developing the provision of social and economic services, so they are expected to be evenly distributed to ensure the services meet the needs of all sectors of the population.

Table 2
Results of Nearest Neighbour Analysis
(R) for the whole study area.

Hierarchical level	N	Σr	RA	RE	R	SE	Z	Signif.
ABCD	283	1224.7	4.328	3.112	1.391	0.097	-12.536	Yes
B	6	187.5	31.250	21.370	1.462	4.560	-2.167	Yes
C	37	445	12.027	8.605	1.398	0.740	-4.624	Yes
D	239	1040.7	4.355	3.386	1.286	0.114	-8.500	Yes

With the rapid social and economic development in Saudi Arabia in the last twenty years, the demands for basic public services like education, health and other similar facilities have vastly grown; therefore the Saudi government has launched very ambitious plans for promoting the network of public services through a pattern of service centres. One of the basic features of the National Development Plans for public services is that the services should be provided by the government to all sectors of the population free of charge; these services are seen as a means of achieving national development; because they are basic to the well-being of the population (Ministry of Planning, 1990).

Al Baha is a well settled region of predominantly rural population compared with other regions in the Kingdom. Although it is a mountainous region, which makes it unique for Saudi Arabia, it is divided by a series of green fertile valleys and basins which allows for a large number of village and hamlet settlements between the mountains and hills. It contains 1,236 villages and hamlets which represent about 12% of the total number of villages in Saudi Arabia. The main feature of these mountain villages is the

variety of their sizes. About 78% of the region's villages have a population of under 250; villages with between 250-700 inhabitants make up 16% of the total, while villages with more than 700 inhabitants represent only about 6% of the total number of villages in the region (Ministry of Municipal and Rural Affairs, 1984).

With so many small villages, the provision of basic services presents major problems: It is clear that each village would not normally support a school, a health centre or other facilities. Therefore, there are very many lower order service centres (D), which appear to be more regularly dispersed to serve as many small villages as possible. The large well-located villages and the traditional market villages began to grow rapidly as service centres (C) because the demand for central services grew. Thus there is a tendency towards a uniform pattern in their distribution.

Being a rural region, Al Baha has few urban centres which could naturally act as sites for first order centre. According to the 1974 census Al Baha region had only one urban place with a population of less than 6,000. However, when development got underway in the region in the late 1970's, a few well-located local administrative centres like Baljurashi, Al-Mandag, Al-Atawlah, Al-Aqig, Al-Mukhwah and Qilwah began to expand rapidly and form second order centres (B) below the main town of Al Baha, which had a population of less than 45,000 in 1990. Those centres serve a much greater population than their own, and their distribution appears to be relatively uniform.

The results of R statistic for the patterns of service centres in the three areas are given in Table 3. For each of the three areas it can be seen that the distribution pattern appeared to be relatively uniform, the same pattern as for the region as a whole. This tendency is, however, much more marked in the Northern part than in the Proper Sarat and Tihama areas. This may result from the fact that since there are so few service centres they are well distributed across the area in order to serve as many villages as possible.

The low R value for all hierarchical levels in the Proper Sarat area is due to the concentration of settlements in this area. This area contains more than 60% of the total villages in the region, and therefore has more than 57% of the total service centres in the region. The high-density of service centres in this part lowers the overall average nearest neighbour distance (RA) and thus causes R values to fall.

Table 3
Results of Nearest Neighbour Analysis for the Three Areas of Al Baha Region

[illegible]

In the Tihama area, the pattern of service centres is much more scattered than in the proper Sarat area. Most service centres are located beneath the main escarpment where more water and better land are found. The distribution pattern of all hierarchical levels of centres appeared to be relatively uniform.

Considering the observed average nearest neighbour distances at each level of the hierarchy in the three areas, it is clear that there are marked variations between the three parts of the region. The average nearest neighbour distance of all levels of the hierarchy in the Proper Sarat area is only 2.6 km from one another. In the Tihama area they are at an average distance of 5.3 km. In the Northern Sarat area they are at an average distance of 10.6 km apart. It is also obvious that these distances increase with hierarchical level in the three areas, but they are much more marked in the Northern Sarat area than in the other areas. This can be seen in Fig. 2 and Table 3 and thus causes R values to increase.

IV. Conclusion:

In this paper the spatial pattern of service centres in Al Baha region was analyzed using the whole area of the region and the three topographical areas. Nearest neighbour analysis has been used as an exploratory technique to examine and describe the spatial pattern. The spatial pattern of the distribution of the service centres at each level of the hierarchy in the region as a whole and in the three different areas showed a tendency towards uniform spacing. The tendency is much more noticeable in the upper hierarchical levels. The observed average nearest neighbour distances (RA) increased with the hierarchical level of centres, but they are greater in the Northern Sarat area than in the Proper Sarat and Tihama areas.

From the above results, it is possible to say that an hierarchy of service centres emerges in Al Baha region. However, this system cannot be explained by the postulate of central place theory because the topography of the study area is not uniform, population is not distributed evenly throughout the area, and transport network is not well developed.

The study area is expected to see major social and economic development during the 1990's (Ministry of Municipal and Rural Affairs, 1985). Therefore, it is important for the regional authorities to pay more attention to the development of the lowest level of the hierarchy, because with so many lower order centres the region will not be attractive to private enterprises and will not raise the well-being of the remote rural inhabitants.

As long as the rural development is still a priority in the National Devel-

opment Plans, as it is now in the Fifth Plan (1990-1995), it is expected that the spatial pattern of service centres will be changing in the near future. It is hoped that this approach of analysis will receive more attention by other researchers in Saudi Arabia to examine the spatial distribution of neglected settlements in many parts of the country.

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Developing public services through a hierarchy of service centres is an important feature of the National Development Plans of Saudi Arabia. This paper is an attempt to examine and describe the spatial patterns of service centres in Al Baha region in the southwestern part of Saudi Arabia. Nearest neighbour analysis has been employed to describe more precisely the distribution patterns. The results of this analysis showed that the distribution patterns are relatively uniform at each level of the hierarchy across the whole region and its three different areas.