



# Evaluating geographical accessibility to healthcare centres in Nagaon Municipal Master Plan area using GIS: obstacles and prospects

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**Abstract** The rapid expansion of urban areas and their populations calls for a judicious allocation of resources across the respective areas. The Sustainable Development Goal 3 (SDG 3) aims to secure the health and well-being of all individuals, disregarding factors such as gender, race, caste, or creed. Inequalities in access to healthcare resources can be eliminated by evenly dispersing healthcare facilities within a given area. Nagaon town, positioned at the heart of the Brahmaputra valley, has recently been undergoing rapid growth in its population, area and urban functions. In the light of this development an attempt is made in this paper to ascertain the coverage area and spatial arrangement of the existing healthcare facilities in the Nagaon town master plan area. Besides, the study endeavours to find out suitable locations for establishing new healthcare centres in the master plan area. The findings demonstrate that the town lacks an adequate distribution of healthcare centres in relation to its population distribution. Only 6% area of the region falls under the zone of high accessibility. 22% area of the region falls under moderate category and 71% of area belongs to the low accessibility zone. The suitability analysis for new healthcare facilities reveals that 22% of the area is highly suitable, 67%

moderately suitable, 9% less suitable and 2% area of the region is not suitable for construction of new hospitals. The study offers valuable insights to urban planners for the establishment of new healthcare centres, thereby promoting the health and well-being of the residents within the ambit of the Nagaon Municipal Master Plan area.

**Keywords** Spatial Accessibility · GIS · Nagaon Town · Access to healthcare · SDGs · Site suitability

## Introduction

Urbanisation has become an integral part of human society and the cities around the world have been undergoing various phases of evolution. Rapid expansion of urban areas contributes to a variety of opportunities like employment, health and education, and problems like environmental degradation, congestion and diseases. Big cities around the world are facing acute shortage of basic amenities and this situation is predicted to get worsened in near future. A variety of underlying factors affect the normal process of urbanisation (Clark et al., 2002, Saikia & Kar, 2023), out of which the impact of urban amenities has been very high. A few very serious problems associated with urbanization are water security, unemployment, pollution, lack of open space, health, etc. The urban dwellers are now concerned with accessibility to basic services like healthcare. It describes how

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simple it is for people or groups to access physically different opportunities, services, and items in an area. It considers certain parameters such as the cost, time, distance and convenience for travelling to a specific place. Due to its impact on people's access to essential services like work, healthcare, education and other necessities, spatial accessibility is critical to public health, transportation, and urban planning. The importance of accessibility to healthcare facilities is growing significantly in recent times, because SDG 3 calls for universal access to healthcare by 2030 (UNDESA, 2015). Potential accessibility is concerned with ensuring the basic health amenities to each and every individual of a community with the limited healthcare service providers (Penchansky & Thomas, 1981; Joseph & Bantock, 1982).

A number of research works have been carried out across the world which deal with the geographical accessibility of healthcare facilities and identification of the problem areas (Luo & Wang, 2003; Jamtsho et al., 2015; Gu et al., 2019; Parvin et al., 2021). Majority of the research works involve application of geospatial techniques for evaluating the accessibility (Higgs, 2004). Various accessibility indices can be derived to compute the level of accessibility in a particular area using integrated approach of vehicular travel time/distance and euclidean distances (Khan & Bhardwaj, 1994; Luo & Wang, 2003; Wang & Luo, 2005). Other methods of analyzing spatial accessibility to healthcare facilities include application of various models, such as cumulative opportunity or isochronic approach (Parvin et al., 2021; Sherman et al., 2005), gravity model (Khan & Bhardwaj, 1994; Guagliardo, 2004; Wang, 2006), floating catchment area method (Luo, 2004; Rekha et al., 2017) etc.

In India, there exists significant variation in the spatial accessibility of healthcare facilities (Parvin et al., 2021; Katta & Srinagesh, 2022; Chatterjee & Sarkar, 2022). The rural communities have to face a variety of challenges due to prevailing diverse geographical conditions, even though urban areas have better access to healthcare facilities. The remote villages often have to struggle hard to access healthcare services. Despite the steps taken by the Indian government, the task for providing fair access to healthcare across the nation still remains a major concern. The north-eastern states of the country still continue to struggle in this respect due to lack of basic infrastructure. One of the problems that the remote rural

settlements in this region face is the lack of desirable access to medical facilities. However, the study concerning availability of healthcare services in the region has been the subject of very few research works (Biswas et al., 2022; Bhattacharyya et al., 2023; Biswas & Rai, 2023). Hence, this study seeks to fill this research gap in this region by undertaking analysis of geographical healthcare facilities in Nagaon Master Plan Area (MPA).

Nagaon town, which is situated in the middle of the Brahmaputra valley, acts as one of the gateway to different states of the north-eastern region. The town occupies an important place in terms of its large population with varied religious and ethnic backgrounds. With a population of 117,722 as per 2011 Census the town currently covers an area of 12.33 sq. km. However, the town is expected to expand further horizontally under the AMRUT (Atal Mission for Rejuvenation and Urban Transformation is an initiative undertaken to facilitate basic civic amenities urban dwellers to improve their quality of life.) program of the Indian government to 149 sq. km by 2045. The proposed GIS-based master plan aims to bring about balanced development of the existing area as well as the peripheral areas in the master plan. The Master Plan Area (MPA) consisting of the existing municipality area, 2 outgrowths, 3 census towns and 76 fringe villages has a total population of 298,680 as per 2011 Census.

As it is proposed to increase the urban area of Nagaon town in near future, there would be substantial increase in the need for healthcare facilities due to increased population, environmental challenges and lifestyle change. This expansion of urban area will lead to greater health risk, emphasizing the importance of accessible and equitable healthcare services to address the health issues of even a larger population. The study therefore aims at evaluating the pattern of spatial accessibility to existing health care services and finding out suitable sites for new healthcare facilities across the town area.

In order to find out the suitable areas of establishment of new healthcare facilities in the town area, several methods and techniques have been used in previous works. The Analytical Hierarchy Process (AHP) (Saaty, 1982) is one of the most popular multi-criteria decision making process (Malczewski, 2004; Kar & Hodgson, 2008; Akıncı et al., 2013; Zabihi et al., 2015; Zolekar & Bhagat, 2015; Halder et al., 2020; Bhuyan et al., 2024). This process has been used

to solve various site selection related problems that involve pair-wise comparison and weighted multi-criteria analysis of several physical and socio-economic criteria (Saaty, 1982; Miller et al., 1998; Halder et al., 2020). This work has been organised into different sections for further analysis. Section two deals with materials and methods used in the study followed by results in the third section; the fourth and fifth section deals with discussion and concluding remarks respectively.

## Materials and methods

### Study area

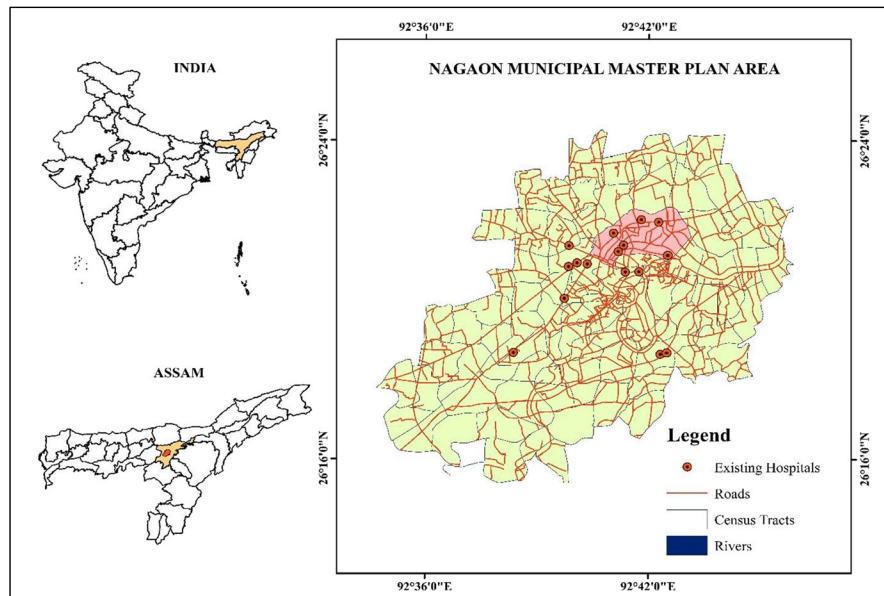
The present study has been carried out in the proposed master plan area of Nagaon Municipal Board, located in Nagaon district of Assam (Fig. 1). Situated in a low lying portion of the Brahmaputra valley, the area enjoys a sub-tropical humid climate. With a population of 298,680, the area showcases an assimilation of varied cultures and ethnic traits (2011 census). The present municipal board constitutes 39.41% of the total population of the area. The rural area contain a population of 150,184 which is about 50.28% of the total planning area. Decadal population growth rate (2001–2011) of the planning area is 17.34%, while the literacy rate is 82.79%. 62.85% of the people in the area are non-working.

Currently there 2 general government hospitals, 1 community health centre and 13 private nursing home, child welfare and maternity centres and 48 diagnostic centres are operational in the area (The Assam Gazette, June, 2022). The area still doesn't have the provision of polyclinic, intermediate, specialty and multi-specialty hospitals. For the current study, a total of 16 (government and private) hospitals i.e., the hospitals with out-patient and in-patient departments are considered.

### Data collection

In the present study, data from a variety of sources have been used for preparation of healthcare accessibility map and the site suitability map of the Nagaon MPA (Table 1). The hospital location data has been obtained using handheld GPS. Seven site suitability criteria such as population density, levels of accessibility, distance from major roads, distance from existing hospitals, distance from residential areas, distance from wetlands and distance from clustered vegetation have been considered for selection of suitable areas for establishing new healthcare facilities. Multi-temporal satellite imageries and topographical maps have been used for deriving various criteria maps for site suitability. These data have been further processed in ArcGIS for relevant thematic map preparation.

**Fig. 1** Study area. Source: Created by the authors



**Table 1** Data products used in the study

Data description	Purpose	Year	Source	Resolution/ scale
LANDSAT 8	Settlement area, clustered vegetation, wetlands,	2022	USGS (Earth explorer)	30 m
Primary Census Abstract	Population Density	2011	Census of India	Village level
Topographical map	Road network digitization	2009	Survey of India	1: 50,000

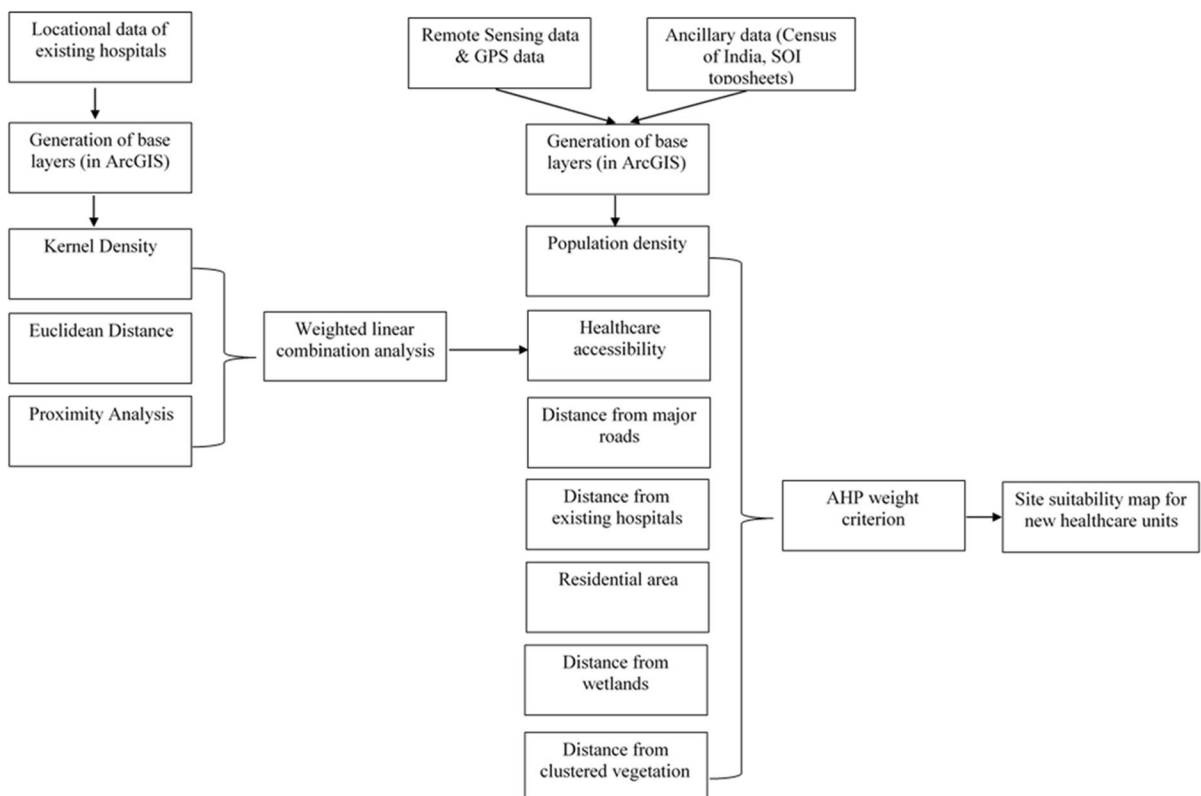
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## Methodology

Geospatial tools and techniques have been used in this study for deriving the accessibility map and the site suitability map for new healthcare facilities. The study adopts hybrid decision making approach to derive the accessibility map and MCDA and AHP to derive the suitability map. The methodology of the study is illustrated in Fig. 2.

## Derivation of accessibility map

For deriving the healthcare accessibility map of the study area, Euclidean distance, kernel density, and proximity have been used (Fig. 3). Further, the raster has been combined to obtain the accessibility map using weighted linear combination analysis in ArcGIS. The study adopts equal weight method to classify the region into accessible and inaccessible areas for healthcare. The selected raster layers were



**Fig. 2** Methodology applied for deriving healthcare accessibility and site suitability map for new healthcare units. Source: Created by the authors

reclassified with equal cell size (30 m) to combine them into a single raster layer (Parvin et al. 2021). Weighted linear combination is defined as follows:

$$A = \sum_{i=1}^n W_i * P_i \tag{1}$$

where,  $W_i$  is the weightage of the deciding factor  $I$ ,  $P_i$  is the selected raster input, and  $n$  is the number of selected criteria. The map, so obtained from the combination of selected raster layers represent the levels of accessibility in the region.

Euclidean distance is a measure of the straight-line distance between two points in Euclidean space. It is the most common method for calculating distances between points in Cartesian coordinate systems. Euclidean distance between the existing healthcare facilities has been measured using the Spatial Analyst tool in ArcGIS. The formula for Euclidean distance

between two points in a two-dimensional space is given by:

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \tag{2}$$

Kernel Density is one of the most popular Spatial Analyst tools in ArcGIS used for measuring the density of features in a neighborhood around these features. It is a non-parametric way to estimate the probability density function of a random variable. It is often used for visualizing the distribution of data points in a continuous space. Density of the healthcare facilities was measured to show their spatial availability.

The kernel function is typically centred at each data point, and its shape determines the contribution of that point to the overall density. Commonly used kernel functions include the Gaussian (normal) kernel, Epanechnikov kernel, and others. The kernel density estimate at a point is given by:

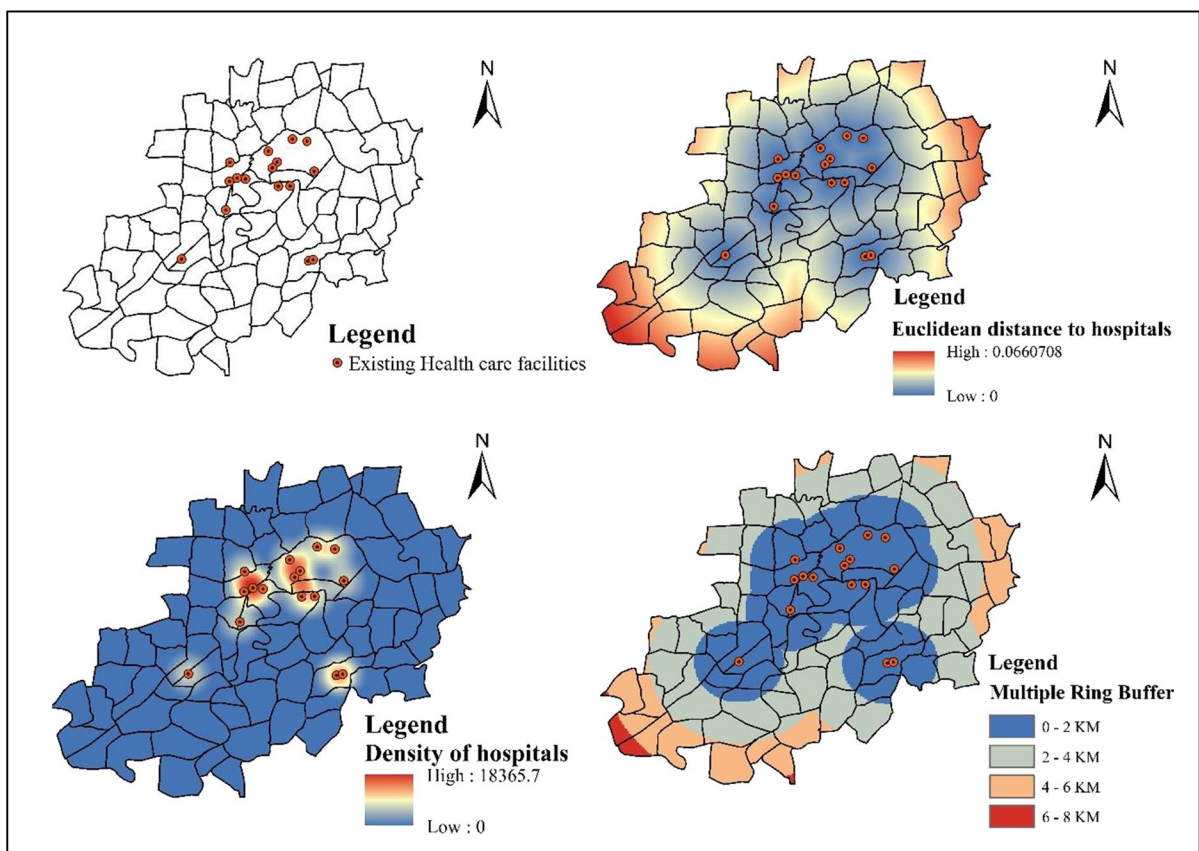


Fig. 3 Factors for assessing healthcare accessibility. Source:Created by the authors

$$f(y) = \frac{1}{nh} \sum_{i=1}^n k\left(\frac{x - X_i}{s}\right) \quad (3)$$

where 'k' is the kernel function with density  $f(y)$ , 'y' is the sampled data, 'n' is the number of sample and 's' is the smoothing parameter or say bandwidth.

Proximity is a spatial analyst tool in GIS to understand the spatial relationship between features in a dataset based on proximity or their distances to one another. By establishing zones around a particular feature, the buffer and multiple ring buffer tool within proximity aids in gaining information about the spatial features. In this study, the buffer tool has helped in creating multiple ring buffer zones surrounding the healthcare units that are currently in operation. This allowed researchers to find out the nearness and remoteness of any point of the region from the existing healthcare units.

#### *Site suitability analysis for new healthcare facilities*

The problem of finding suitable sites for specific geographic problems can be solved using MCDA and geospatial techniques. In this study, AHP has been used for finding best sites for establishing new hospital sites in Nagaon MPA. Previous studies of Murad (2007), Vahidnia et al. (2009), Soltani and Marandi (2011), Busief and Shouman (2012), Chatterjee and Mukherjee (2013), Chiu and Tsai (2013), Sharmin and Neema (2013), Rahimi et al. (2017); Dell'Ovo et al. (2018), Soltani et al. (2019), Nsaif et al. (2020), Kaveh et al. (2020), Rezayee (2020), Halder et al. (2020), Almansi et al. (2021), Tripathi et al. (2022), Almansi et al. (2022) has helped in selecting the influencing factors of hospital site selection. The influencing factors considered in this study are population density, healthcare accessibility, distance from major roads, and distance from existing hospitals, distance from residential areas, distance from clustered vegetation and distance from wetlands (Figs. 4 & 5).

**Generation of criteria maps** Choropleth maps of population density for villages and wards have been generated using the population data collected from Primary Census Abstract published by Census of India (2011). Population density is calculated by using the following equation:

$$D = \frac{N}{A} \quad (4)$$

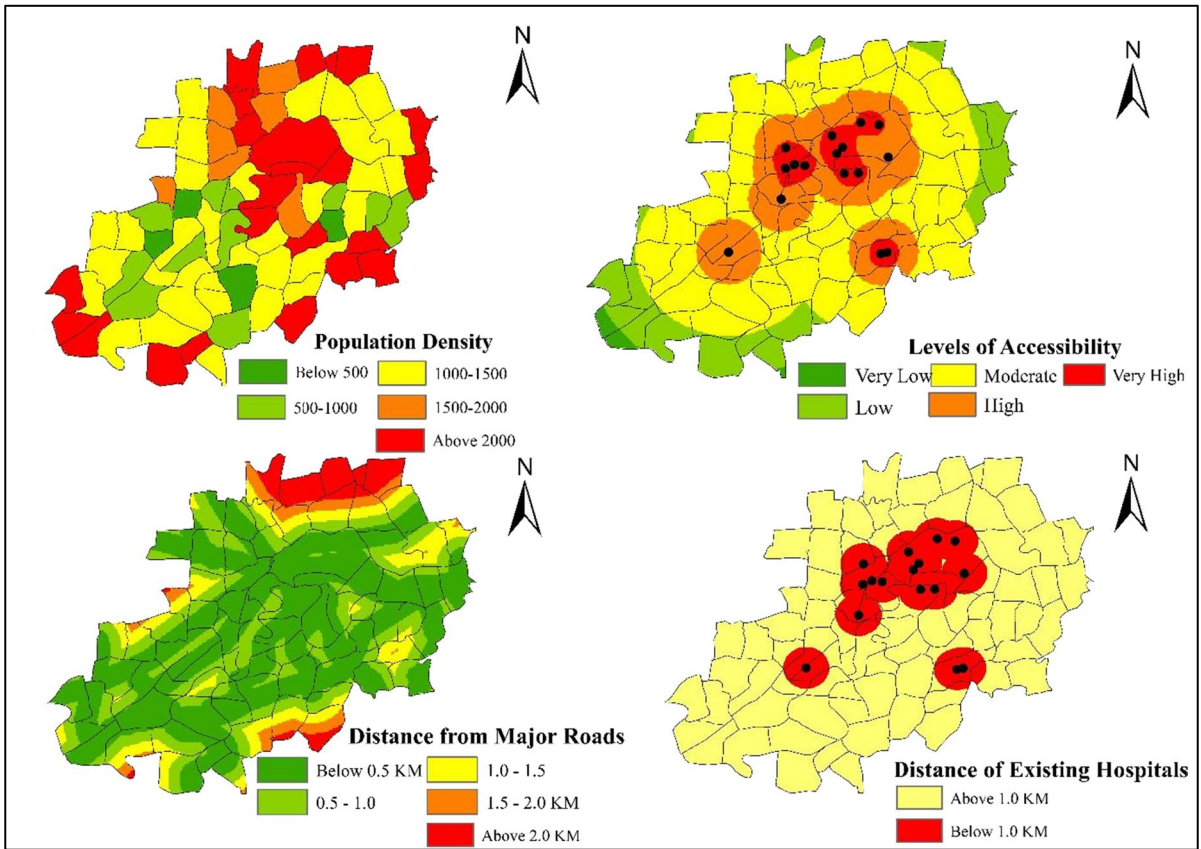
where, D is the density, N is the population of the area and A is the geographical area. The villages with high population density possess high demand for new healthcare facilities to fulfill its growing demand.

The methodology for generation of healthcare accessibility map has been discussed in the previous section. The areas with low healthcare accessibility needs new hospitals to be established than the areas with high levels of healthcare accessibility.

Smooth connectivity is positively associated with hospital suitability in terms of providing better access (Tripathi et al., 2022; Almansi et al., 2022). Generally, hospitals are established near the main roads so that it can provide quick access to the people who are in need of medical services. Hence, priority has been given to the areas nearby the main roads (Vahidnia et al., 2009, Dehe & Bamford, 2015, Senvar et al., 2016, Rahimi et al., 2017, Ramani et al., 2007). In this study, the region is categorized into five zones based on their distance from the major roads. Below 0.5 km is considered as most suitable and above 2 km is considered as not suitable for new hospital construction.

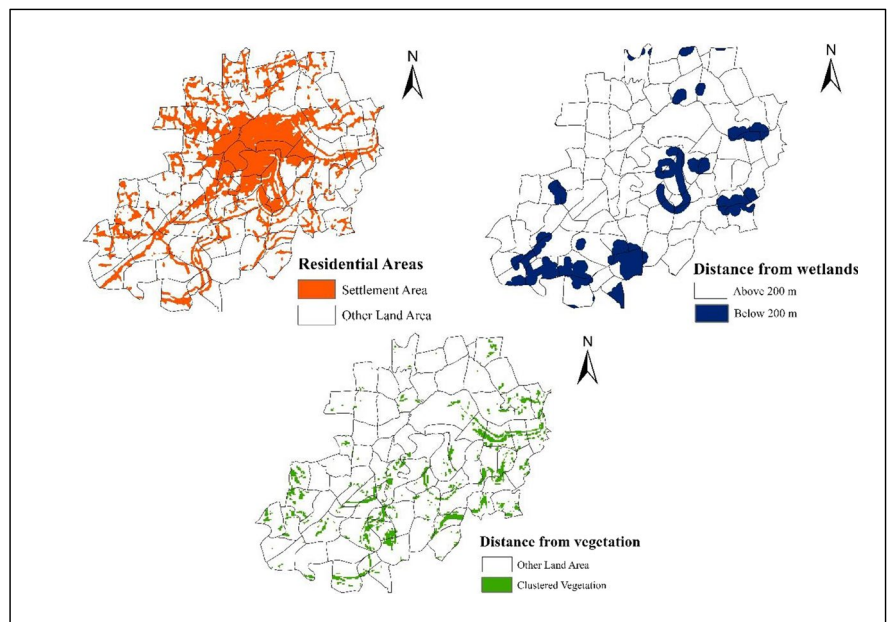
The areas which has provisions of hospitals already don't require new hospitals to be established. Assuming a 1.0 km service area, other regions lacking healthcare facilities are deemed appropriate for the construction of new hospitals.

Land use and land cover data of the region have been used for identification of residential areas, wetland areas and vegetation. Identification of residential areas serves as one of the criteria for hospital site suitability analysis. The whole region has been classified into two categories viz. residential areas and other than residential areas. Hospitals are meant to serve the residential areas. Nearness to the residential areas provides more convenience for the people (Almansi et al., 2022). Thus, any barren or open land near the residential area are preferable for establishing new hospitals (Ramani et al., 2007; Tripathi et al., 2022). Therefore priority has been given to the areas situated nearby the residential areas for establishing new hospitals. The region also possesses a number of wetlands. These wetlands serves as the natural filters. Establishing hospitals near wetlands may result



**Fig. 4** Criteria for hospital site suitability. Source:Created by the authors

**Fig. 5** Criteria for hospital site suitability. Source:Created by the authors



**Table 2** Saaty scale (1982)

Scale	Numerical rating	Reciprocal rating
Extremely important	9	1/9
Very to extremely strongly important	8	1/8
Very strongly important	7	1/7
Strongly to very strongly important	6	1/6
Strongly important	5	1/5
Moderately to strongly important	4	1/4
Moderately important	3	1/3
Equally to moderately important	2	1/2
Equally important	1	1

Source: (Hammami et al., 2019)

in disposing hazardous materials to them. Thus areas near to wetlands are not considered suitable for new hospitals. A buffer of 200 m has been created to differentiate the wetlands from other areas. Areas with clustered vegetation are not suitable for new hospitals because doing so would result in the removal of significant tree species.

Euclidean distance tool has been used for finding out the distances of major roads, distance from existing hospitals, residential areas, wetlands and clustered vegetation. The factors of each criterion are used to categorize the distance ranges.

**Weight determination using AHP** AHP has proved to be one of the most popular methods of solving complex problems by rearranging those into a hierarchy (Qazi & Abushammala, 2020; Harsha et al., 2022) and assigning weights according to ranks. Major stages in the process includes preparation of comparison matrix using the comparison scale of Saaty (Table 2), calculation of eigen vector, weighting parameters (Table 3) and calculation of consistency ratio (Table 4).

The Consistency Ratio (CR) is calculated using Eq. (5). The value of CR is determined by dividing Consistency Index (CI) by Random Index (RI). RI is based on the number of selected criteria.

$$CR = CI/RI \tag{5}$$

where, CI is the Consistency Index and RI is the random inconsistency index.

$$CI = (\lambda - n)/(n - 1) \tag{6}$$

where,  $\lambda$  is the average value of the consistency vector and n is the number of criteria selected. If the CR is greater than 0.1, then the judgement is said to be too inconsistent. However, when the CR is near to 0, the judgement seems to be consistent (Elkhrachy, 2015). The CR (0.021157) obtained in this study seems acceptable. Thus the results can be utilized for hospital site selection.

**Table 3** Pairwise comparison matrix of physical indicators using AHP

	PD	HA	MR	EH	RA	CV	WL
PD	1	2	3	3	6	7	9
HA	0.5	1	3	3	4	6	7
MR	0.33	0.33	1	2	3	4	6
EH	0.33	0.33	0.5	1	2	3	5
RA	0.16	0.25	0.33	0.5	1	2	4
CV	0.14	0.16	0.25	0.33	0.5	1	2
WL	0.11	0.14	0.16	0.25	0.5	0.5	1

PD Population density, HA healthcare accessibility, MR distance from major roads, EH distance from existing hospitals, RA distance from residential areas, CV distance from clustered vegetation and WL distance from wetlands

Source: Calculated by authors

**Table 4** Random inconsistency index

n	3	4	5	6	7	8	9	10
RI	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

Source: Saaty (1982)



Each parameter has been divided into several sub categories and weight is assigned to each class ranging between 1 and 9 (Table 5). The weights assigned to each class have been normalized and the resultant weights are assigned according to their relative importance in hospital site selection. The processed data is further used to derive the hospital site suitability map using weighted overlay method in ArcGIS to find out the hospital site suitability index (HSSI). The index is calculated by using Eq. 7.

$$HSSI = W_{PD}R_{PD} + W_{HA}R_{HA} + W_{MR}R_{MR} + W_{EH}R_{EH} + W_{RA}R_{RA} + W_{CV}R_{CV} + W_{WL}R_{WL} \tag{7}$$

where,  $W_n$  = Weight of the  $n^{th}$  Factor  
 $R_n$  = Rate assigned to  $n^{th}$  class

### Results

In this section, the results of comprehensive spatial accessibility analysis to healthcare services are presented. The present study aimed to assess the geographic distribution of healthcare facilities and their accessibility to the population within Nagaon MPA. Utilizing the advanced spatial analysis techniques, the availability and proximity of healthcare resources to different communities have been analysed. The following findings highlight the key insights into the spatial patterns of healthcare accessibility, shedding light on potential disparities and areas for improvement in healthcare service distribution.

The results of accessibility analysis indicate significant issues in terms of geographical access to healthcare facilities. The present municipality area and the area near Borghat witness a high degree of accessibility due to concentration of a large number of hospitals with well-connected transport network. But major

**Table 5** Classes of flood hazard factors and weights assigned

Factors	Class	Factor weight	Rate	Class weight	Weight (%)
Population Density (PD)	2000 & above	0.30	9	2.7	33
	1500–2000		8	2.4	30
	1000–1500		6	1.8	22
	500–1000		3	0.9	11
	Below 500		1	0.3	3
Healthcare accessibility (HA)	Very Low	0.26	9	2.34	38
	Low		5	1.3	31
	Moderate		3	0.78	19
	High		2	0.52	8
	Very High		1	0.26	4
Distance from Major Roads (MR)	Below 0.5 km	0.168	9	1.512	38
	0.5 km – 1.0 km		8	1.344	31
	1.0 km – 1.5 km		6	1.008	19
	1.5 km – 2.0 km		3	0.504	8
	2.0 km & above		1	0.168	4
Distance from existing hospitals (EH)	Above 1 km	0.111	9	0.99	90
	Below 1 km		1	0.11	10
Distance from Residential area (RA)	Settlement area	0.087	9	0.783	90
	Other land area		1	0.087	10
Distance from clustered vegetation (CV)	Clustered vegetation	0.045	9	0.405	90
	Other land area		1	0.045	10
Distance from wetlands (WL)	Active Flood Plain	0.023	9	0.207	90
	Older Flood Plain		1	0.023	10

Source: Calculated by authors

portion of the region falls under very low category in terms of geographical access to healthcare facilities. The region is categorized into four zones, i.e. high, moderate, low and very low based on the levels of accessibility (Fig. 6). The backwardness of the region is evident from the fact that only 6 percent area of the region falls under the zone of high accessibility. 22 percent area of the region falls under moderate category and 71 percent of area belongs to the low accessibility zone (Fig. 7). This problem has arisen in the region due to the concentration of hospitals in a small portion of the region.

The site suitability analysis for new healthcare facilities incorporates a multi-dimensional approach, considering factors such as accessibility, demographic distribution, and infrastructural compatibility. The findings outlined below offer valuable insights into the most suitable sites, aligning with our objective of enhancing healthcare accessibility and addressing community needs. The data-driven outcomes presented herein serve as a foundation for informed decision-making and strategic planning in the development of healthcare infrastructure.

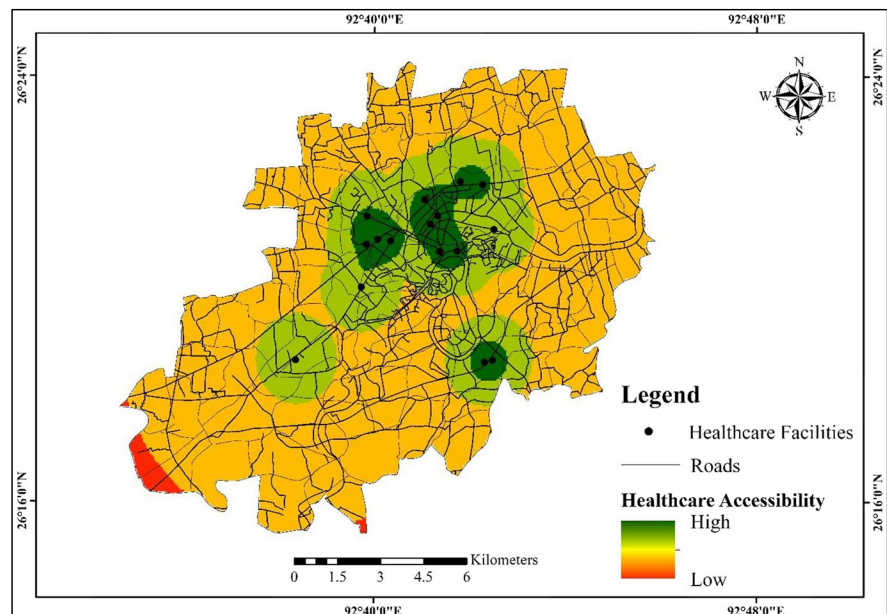
A final site suitability map for new healthcare facilities is obtained after the criteria maps are assigned weights using AHP technique. The weights calculated using AHP has been processed in ArcGIS using weighted overlay tool. The final site suitability map so found is classified into four categories, i.e. not

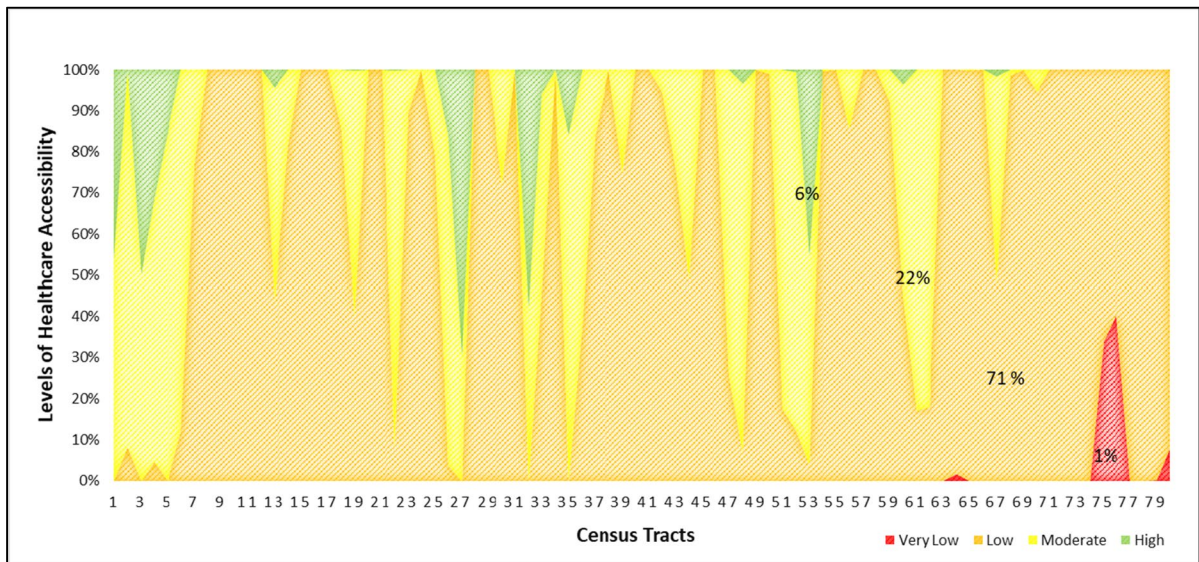
suitable, less suitable, moderately suitable and highly suitable areas (Fig. 8). From the site suitability analysis, it is evident that 22 percent of the area is highly suitable, 67 percent moderately suitable, 9 percent less suitable and 2 percent area of the region is not suitable for construction of new hospitals.

## Discussions

The present study was undertaken to assess the level of accessibility to healthcare services in Nagaon MPA, where weighted linear combination analysis (Gulliford et al., 2002; Higgs, 2004; Murad, 2007) has been used in a geospatial environment. The results of accessibility analysis discloses that the region is still lagging behind in terms of providing better access to healthcare facilities. Clustering of the healthcare facilities in a small portion of the region has created disparity among the people especially the sub-urban and rural areas. The master plan area encompasses several villages where there is no provision of healthcare facilities. People have to travel to the municipality area where majority of the hospitals (govt. and private) are concentrated. The expansion of the present jurisdiction of the municipality area will surely increase the urban functions in the near future. Thus, concentration of the hospitals in the present municipality area will create more problems for the people living in the sub-urban and rural areas due

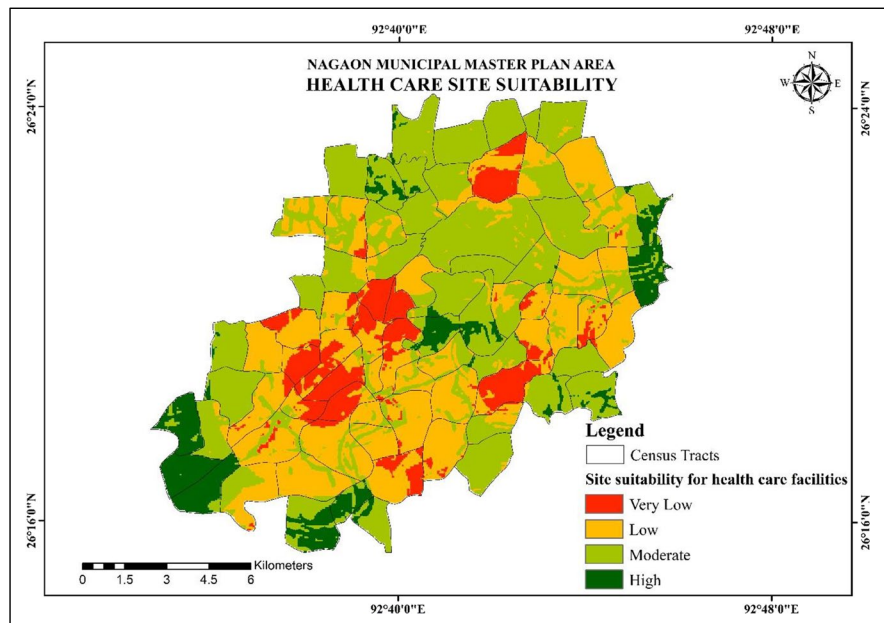
**Fig. 6** Spatial accessibility to healthcare facilities in Nagaon MPA. Source: Created by the authors





**Fig. 7** Spatial accessibility of healthcare facilities in Nagaon MPA. Source: Created by the authors

**Fig. 8** Site suitability map for new healthcare facilities in Nagaon MPA. Source: Created by the authors



to increase in traffic congestion and other urban functions (Zhao, 2010; Lu et al. 2021). Peripheral regions like Dimou, Juria, Gumuthagaon, Dakhinpat, Borjoha, Pathari, and Nonoi suffer from inadequate access to hospitals, highlighting the disparities in healthcare accessibility. The study has also dealt with finding the best possible sites for establishing new healthcare facilities, i.e.

hospitals in the region using multi-criteria decision making and AHP. For this, several criteria, viz. population density, healthcare accessibility, distance from major roads, and distance from existing hospitals, distance from residential areas, distance from clustered vegetation and distance from wetlands has been integrated to produce site suitability for new hospitals (Soltani &

Marandi, 2011; Vahidnia et al., 2009; Almansi et al., 2021; Tripathi et al., 2022; Almansi et al., 2022). 22 per cent of the total area is found to be highly suitable for establishing new hospitals.

### Policy implications

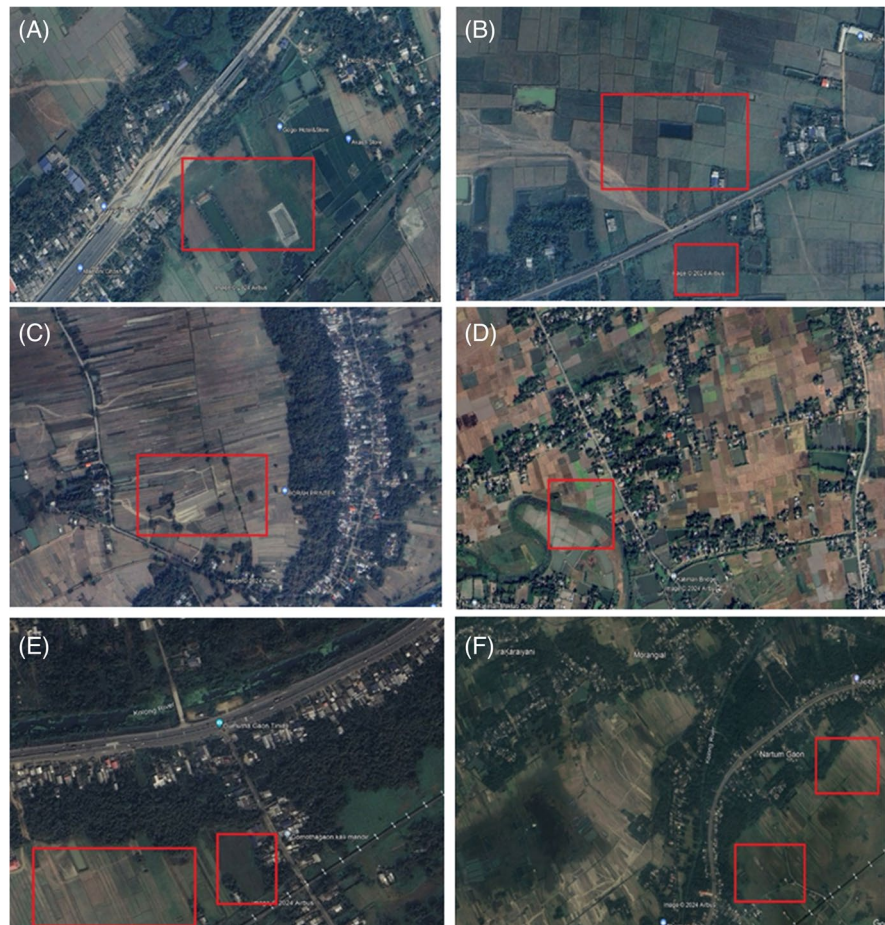
One of the prominent findings underscores the necessity for individuals to travel to Guwahati for healthcare services. This not only signifies a potential lack of local healthcare infrastructure but also emphasizes the significant burden on residents who must undertake these journeys. In light of this, the establishment of new hospitals in strategically identified areas could alleviate the need for extensive travel, ultimately enhancing healthcare accessibility for the community. The frequent referrals to Guwahati in the context of healthcare highlight its current status as a primary hub for medical services. It raises

questions about the distribution of resources and the need for decentralization to ensure equal access to healthcare facilities. By reaching out to the areas with a higher demand, we can address the existing imbalance and cater to the healthcare needs of a larger population.

Important peripheral areas like Dimow, Bebejia, Juria, Dakhinpat, Uriagaon, Bherbheri, etc. (Fig. 9) possess a high density of population. These places are also well connected by transport network. They also fulfil other criteria of hospital site suitability. Thus new hospitals can be established in order to serve the people living in and around these areas. This will help in fulfilling the healthcare demand of the people and reduce the load of the existing hospitals that are operational in the urban areas.

The absence of super specialty hospitals in the study area points towards a potential gap in healthcare services. Incorporating super specialty facilities in the proposed sites for new hospitals would not only

**Fig. 9** Ground truth areas of proposed healthcare sites after suitability analysis (A-Dimow, B-Bebejia, C-Juria, D-Dakhinpat, E-Uriagaon and F-Bherbheri) Source: Google Earth Pro



enhance the comprehensiveness of healthcare but also attract patients who might otherwise need to travel considerable distances for specialized treatments.

### Limitations and scope

Although this study provides insights into the specific healthcare needs of the community and inform the design and services offered by the new hospitals, they address the shortcomings of existing options, the study also has scope for further studies. The study has considered limited number of criteria that can be considered for finding the best possible sites. The study does not cover factors such as land cost, nearness to education institutes, etc. However, in this study, we have used the criteria which are given the top most priority by previous researches. Furthermore, the task of weighting the criteria has been done under the supervision of academicians only, although the advice of experts is also required. The identified urgency for a study on the service quality of existing hospitals is a critical aspect to consider. Understanding the strengths and weaknesses of current healthcare providers is essential towards guiding the development of new facilities.

### Conclusion

Nagaon town is expected to broaden its jurisdiction by 2045. With the increase in its area, population and urban functions of the region are also expected to increase in near future. With the increase in population the increase in demand for healthcare facilities is obligatory. Thus, addressing accessibility concerns, decentralizing healthcare services, incorporating specialized care and prioritizing service quality are pivotal considerations for ensuring the healthcare needs of the community. The present study tried to examine the prevailing accessibility issue in Nagaon MPA. The results showcased that more than 72 percent area of the region falls in a low accessibility zone and there is an urgent need to decentralize the healthcare services to these areas, so that the people living there are not compelled to travel a long distance to the municipality region. The study also aimed to find the best suitable sites for new hospitals to be established in the region. It suggested that around 22 percent area

of the region was highly suitable for new hospitals. A field survey was also conducted for this site selection process, and the ground truth data was further verified using google earth pro. Policymakers can make further arrangements for proper evaluation in order to establish new healthcare infrastructure in these sites.

The findings of this study can be considered a significant input to the district administration and National Health Mission (NHM) in designing the most strategic planning for decentralizing the healthcare facilities. It can help in identifying the gap areas of healthcare services and establishment of new facilities in the low accessibility regions. Hence, this discussion would serve as a foundation for informed decision-making and lay the groundwork for future developments in the healthcare infrastructure of the area.

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