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Spatial Patterns and Road Network Accessibility of Cultural Heritage for Tourism Potentials in Banswara District, Rajasthan (India)

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Abstract

Integrating cultural heritage with tourism helps reveal the tangible and intangible characteristics of a place that are the outcome of long-term interactions between the local population and their natural environment. The goal of this study is to investigate cultural heritage in relation to the tourism development in Banswara district, Rajasthan, India. The study first identified and classified the cultural heritage sites of Banswara district; thereafter, it used spatial statistical tools from ArcGIS 10.7 to find out distribution patterns as well as clusters and hotspots of cultural heritage. In addition to this, accessibility to cultural heritage sites is examined using buffer analysis. The results derived show the presence of hotspots and coldspots in the central part of Banswara district, which includes the Talwara block. Compared to intangible cultural heritage, which is more sporadic, tangible cultural heritage tends to form hotspots and exhibits a more clustered pattern. Also, tangible cultural heritage sites are frequently found close to major highways when compared to intangible cultural heritage. This research can help planners formulate different strategies for incorporating cultural heritage for tourism development in this area. Policymakers can promote the tangible heritage sites for year-round tourism, whereas the fairs and festivals that constitute an important segment of intangible heritage happening during specific times of the year can be made more accessible through enhancing direct transport connectivity.

Keywords: *cultural heritage, intangible, tangible, tourism, accessibility, spatial autocorrelation*

Introduction

According to the United Nations Educational, Scientific, and Cultural Organization (UNESCO), "Cultural heritage includes artifacts, monuments, and groups of buildings and sites that have a diversity of values, including symbolic, historic, artistic, asthetic, ethnological or anthropological, scientific and social significance (UNESCO, 1972). "Intangible cultural her-

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itage, or ICH," is another aspect of heritage that is regarded as living and immaterial. ICH includes "the practices, representations, expressions, knowledge, skills - as well as the instruments, objects, artifacts, and cultural spaces associated therewith - that the communities, groups, and, in some cases, individuals recognise as part of their cultural heritage that is being constantly recreated by them in response to their environment" (UNESCO, 2003). Simultaneously, the UNESCO convention of 2003 on the "Safeguarding of the intangible cultural heritage" reaffirms the interdependence of tangible and intangible heritage.

Cultural heritage is regarded as an important segment of the modern tourism industry that has grown significantly in recent years (Seraphin et al., 2018), as it allows tourists to integrate themselves with the region's historical fabric, increasing their knowledge and cultivating a sense of appreciation and pride for the region's history and culture (Arumugam et al., 2023). Tourism yields potential benefits such as enhancing business opportunities, improving transport, and so on, thus adding value to the cultural heritage, which can provide reasons to focus more on conservation and sustainable use of these assets (Brooks et al., 2023). The United Nations World Tourism Organization (UNWTO) has argued that a lack of visits to monuments results in significant decay of tangible heritage, whereas intangible heritage may be forgotten if tourists show no interest in them; thus, tourism aids in the revival of intangible aspects of culture while also encouraging the preservation of tangible heritage (World Tourism Organization, 2018).

Rajasthan is well-known for its heritage tourism, as there are several tangible and intangible cultural elements that attract tourists (Chandel, Sharma, 2020). The 2020 Rajasthan Tourism Policy has highlighted cultural heritage tourism by focusing on the lesser-known attractions of rural areas, establishing clusters that can be promoted as 'Special Heritage Village' or 'Special Craft Village', and fostering tribal culture and heritage (Department of Tourism, Government of Rajasthan, 2020). The Banswara district in Rajasthan State of India, has a rich cultural legacy. Research on the material heritage of Arthuna, Talwara, and other areas (Trivedi, 1995), the customs of the indigenous tribes (Rana et al., 2014), and the celebrations of the Bhil tribal community (Sharma, 2019) provide insight into the region's tangible and intangible cultural heritage. Within the planning hierarchy, there are several stages at which tourism planning takes place (Sarıkaya Levent et al., 2024). Promoting cultural heritage tourism at the local level demands a symbiotic strategy that includes not only top-level planning but also a 'bottom-up approach' in which local people make decisions about the use and conservation of their heritage resources (Theerapappisit, 2012). This study attempted to identify cultural heritage clusters at the block level in Banswara district, which can aid in effective policymaking at micro level administrative unit and long-term cultural heritage tourism planning. Block is considered to be an important administrative unit for planning at grassroot level below the district level (Maheshwari, 1984).

Literature review

Culture, heritage and tourism

The tourism industry started developing rapidly in the second half of the twentieth century (Virginija, 2016). In the modern tourism industry, the concepts of 'special interest tourism' and 'niche tourism' have gained prominence. In such a kind of tourism, the specific needs of the tourists are taken into account (Sert, 2017). The integration of cultural heritage and tourism is one such example of special interest tourism intended to fulfill the aspirations and motivations of tourists related to cultural experiences (Kruja, Gjyrezi, 2011).

In terms of cultural heritage and tourism, there have been considerable attempts to understand tangible cultural heritage from the perspectives of social impacts such as sense of belongingness for the host population, pride, identity and so on (Butler et al., 2022), and economic impacts (Matečić, Kesar, 2019), as well as its protection and conservation (Cai et al., 2021). However, systematic attempts have been made to understand the intangible cultural heritage through the lens of tourism in recent years. The research on ICH and tourism has mainly focused on certain themes, such as planning ICH to achieve sustainable development, understanding the positive and negative impacts of tourism on ICH, and forecasting tourist motivations and behaviors towards ICH (Qiu et al., 2022). Arenghi et al. (2019) claimed that because cultural heritage is so complex, examining it from just one perspective—whether it be material or immaterial, tangible or intangible—is impractical and that a more comprehensive strategy is needed to change the way both the host communities and the tourists view it. Nevertheless, there has been less research on this integrated perspective.

Inventorying and classifying cultural heritage

The first step in appreciating the worth of tourism resources at a place is often to identify the cultural heritage. The process of identification leads to the inventorying of cultural heritage (UNESCO, 2009). Inventorying and data collection related to cultural heritage can be done at variety of geographic scales ranging from international, national, regional, local, and so on (Myers, 2016). At the national level, inventories for both tangible and intangible heritage have been prepared in India; nevertheless, the attempt is still inadequate at the district level of administration. Shah (2015) highlighted the processes that were undertaken towards the preparation of inventories for the historic world heritage city of Ahmedabad, India. Such inventories are useful databases for acquiring information pertaining to the intangible and tangible heritage sites of that place.

Spatial distribution pattern and cultural heritage

GIS offers a wide variety of tools to map the spatial distribution patterns of any phenomenon. Studies dealing with the analysis of spatial distribution patterns have been less pronounced in cultural heritage and tourism compared to those in other disciplines such as disease mapping, ecological studies, and so on. However, in recent years, there has been a growth in the amount of literature that has attempted to understand the distribution patterns of cultural heritage using GIS. Systematic analysis of the literature reveals that the entire gamut of works in this direction can be categorized based on the purpose or methodology. The purpose generally differed, ranging from tourism to preservation and conservation of cultural heritage and identification of the influencing factors, whereas in terms of methodology, studies have used different GIS techniques such as Nearest neighbor analysis, Kernel density estimation (KDE), Global and local spatial autocorrelation measures, Geodetector, and so on. In this regard, the main focus of the discussion here has been concentrated on the purpose behind using spatial distribution analysis in cultural heritage, which eventually reflects the methodology.

Studies have used spatial analysis methods like Global and local spatial autocorrelation in conjunction with other remote sensing data to assess the geoenvironmental risks (Elfadaly et al., 2018) and devise sustainable planning strategies (Elfadaly, Lasaponara, 2019) for tangible heritage sites. Researchers have also used spatial analysis methods like KDE and Nearest neighbor analysis along with other techniques to understand the spatial distribution, such as standard ellipse (Liu et al., 2022), Imbalance index (Runze, 2023; Wang et al., 2021), DBSCAN (Wang et al., 2024), Unbalance index (Gao et al., 2023), Global and local spatial autocorrelation (Nie et al., 2023; Zhang et al., 2023; Zhang et al., 2022; 2024) to find out the factors influencing the spatial distribution pattern of the intangible and tangible cultural heritage sites.

Spatial analysis gives information about the presence of the clusters that can help in evaluating tourism potential. Chang et al. (2023) used spatial analysis tools to find out the potential intangible cultural heritage clusters in the Yellow River basin in China that can be utilised for stimulating tourism. Yuan et al. (2022) integrated spatial analysis tools with buffer analysis to determine the patterns of ICH along the transport network for cultural tourism in Hunan province, China. Li et al. (2024) considered both tangible and intangible heritage in unison when determining the spatial heritage clusters in southwest China. Overall, there have been limited attempts to find out the spatial patterns, considering cultural heritage as a whole.

Transport network and cultural heritage

Tobler in 1970 formulated the "first law of geography" by stating that "everything is related to everything else, but near things are more related than distant things." This law certainly can fit the cultural heritage sites, as those located in the vicinity of the main transport network are more likely to get the attention of the visitors. Transportation and tourism have been considered to have a complimentary relationship, whereby transportation provides an initial impetus to the tourism industry; however, this symbiotic relationship is subject to policies related to heritage and environment protection (Yu et al., 2023). GIS has been utilised by researchers to formulate strategies for tourism management considering infrastructure facilities like roads, railways, and so on. Network analysis is one such tool that helps in determining the best route, and this has been used to design routes for geotourism in Safranbolu Turkiye (Keskin Citiroglu, Arca, 2023). Idajati and Nugroho (2019) attempted to create a cultural heritage tourism route using GIS in Surbaya city, East Java.

The aforementioned discussion reveals that there have been academic works focusing on classifying heritage and finding out the spatial distribution patterns of cultural heritage using different spatial statistical tools and techniques. However, it is worth noting that the majority of studies have focused on tangible or intangible cultural heritage. An integrated approach to understanding cultural heritage tourism by identifying the sites and analyzing its spatial distribution patterns at the block level has received insufficient attention. Taking all of this into account, this study sought to fulfill the following objectives: 1. Identifying and classifying cultural heritage sites in Banswara district. 2. Determine the density of cultural heritage sites and the presence of heritage clusters and hotspots in Banswara district. 3. Find out and explain the spatial distribution patterns of cultural heritage sites at block level. 4. Analyze the distribution of cultural heritage sites along the main transport network.

Study area

The study area (Figure 1) is situated in the southern region of Rajasthan State, India, and is known as the Banswara district. Administratively, the district consists of eleven blocks/ panchayat samiti, and based on the last census enumeration of 2011, the district has a total population of 17,97,485 with the majority (92.9%) living in rural areas relying on agriculture for their economic base. Ethnically and culturally, Banswara district consists of the Bhil tribal population, which overwhelmingly constitutes 76% of the total population of the district (Saroj, 2019). In terms of transportation, road transport is the main mode of transport available in the district due to the absence of railways. Approximately 138 villages lacked bituminous roads in 2019–20, despite the road network's total length of 4372.72 km, according to estimates taken from the Banswara district Gazetteer (Government of Rajasthan, 2022). The topography of the Banswara district varies greatly. The merging of two distinct major physiographic units—the Malwa plateau in the east and the Aravalli hills in the west—has shaped its unique character. Compared to the western portion of the district, the eastern portion is more elevated. The elevated areas have fewer hills and are more dotted with flat-topped plateaus.

The Mahi River, which enters Banswara from the east and flows to the west along the northern edges of the district boundary, is a geographical feature that has had a distinctive influence on the physical and cultural landscape of the district. The Mahi River and its tributaries have contributed to the topography of Banswara district by highly dissecting and eroding the area which is locally known by the names such as Vagad region and Chappan plains (Misra, 1967). The development of a varied historical cultural milieu has been greatly aided by topographic diversity. Many cultural characteristics, both tangible and intangible, have emerged over several centuries, demonstrating a distinct symbiosis between the environment and humans.

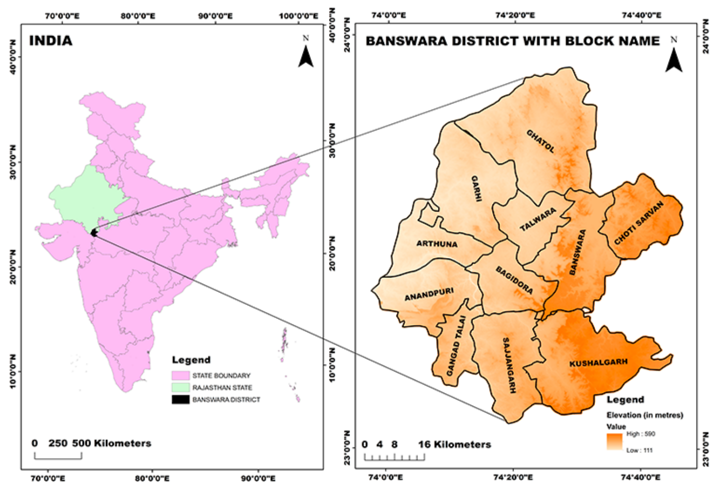

Figure. 1. Study area map

Materials and methods

Data Sources

The geographical locations of cultural heritage, both tangible and intangible, were identified by consulting experts and literature and by conducting fieldwork. Subsequently, the sites were classified according to their primary characteristics and significance. The base map for the Banswara district was produced from the data downloaded from the Survey of India website (https://onlinemaps.surveyofindia.gov.in/Digital_Product_Show.aspx). Additionally, to better understand the district's cultural heritage from a transportation perspective, the road network is derived at a scale of 1:50000 from the Open Street Map (OSM) and Survey of India topographical maps. A handheld GPS device was used to obtain the geographic coordinates of each site.

Methods used

The study of literature found a number of methods for recognizing spatial distribution patterns. There are numerous software packages that provide these tools, including ArcGIS, GeoDa, R, QGIS, and others. ArcGIS 10.7 is utilized in this work because it offers a variety of spatial analysis tools that enable the visualization and analysis of spatial distribution patterns. The goal of this study is to identify block-level clusters of cultural heritage sites in order to provide policymakers with places for micro-level tourism planning in the Banswara district. Methods that can help with both visualization and analysis were included in order to achieve this goal. On the other hand, multi-ring buffers are used to create multiple buffers along major thoroughfares, and network analysis is done to find the shortest path to each cultural heritage site. These are done to get detailed insights regarding the connectivity and accessibility component and the site's location in relation to the network of transportation.

Classifying cultural heritage

To place each site according to its primary characteristics and significance, a number of international standardised classification schemes were referred to, framed by international bodies such as the International Council on Monuments and Sites (ICOMOS) and UNESCO. In general, UNESCO has identified two subcategories of cultural heritage: intangible and tangible heritage. However, ICH has been divided into five main categories by the UNESCO convention on the "safeguarding of the intangible cultural heritage" in 2003. These categories include: (1) Oral traditions; (2) Performing arts; (3) Social practices, rituals, and festive events; (4) Knowledge and practices concerning nature and the universe; and (5) Traditional craftsmanship. These categories were being used for classifying the ICH identified during this study. Moreover, Mason and Avrami's cultural heritage value typology, which divides heritage into seven categories—economic, historical and artistic, spiritual or religious, social and civic, symbolic or identity, research, and natural—was used to further classify the tangible heritage (Mason, Avrami, 2002).

Analysing point distribution patterns

Kernel density estimation is selected over methods such as Standard deviation ellipse because of its better output, showing the hotspot locations. The density surface generated by Kernel density estimation provides a better visualization than point data and more possibilities for grasping spatial patterns (Krisp, Špatenková, 2010). However, the KDE findings are dependent on the bandwidth choice, and the output leaves room for subjective interpretation as it does not reveal whether the pattern is dispersed, random, or clustered. A variety of methods, including the Imbalance index, Geographic concentration index, Nearest neighbor ratio, Global and Local spatial autocorrelation, and others, can be used to analyze patterns, such as whether point locations are clustered or dispersed. The Nearest neighbor ratio, as well as Global and Local Spatial Autocorrelation measures are used in this study. The Nearest neighbor analysis uses the distance component to determine whether the distribution pattern is clustered or random, whereas the global and local spatial autocorrelation measures use the attribute value in addition to the distance to determine the pattern. To determine whether or not the patterns are statistically significant, P values and Z scores are also offered by each of these approaches. Two global spatial autocorrelation methods, Global Moran's I and Getis Ord General, were utilized, whereas Anselin Local Moran's I and Getis Ord Gi* were used for local spatial autocorrelation. By taking into account variables like area, time, and distance, spatial autocorrelation assists in determining how the objects under study are correlated in a specific space (Sobari et al., 2023). Furthermore, global measures such as Moran's I and Getis Ord General offered global values, while local measures such as Anselin Local Moran's I and Getis Ord Gi* assisted in decomposing global values, allowing for site-specific visualization. This study used the block-wise number of cultural heritage sites as the attribute value/weights to derive results from Global and Local spatial autocorrelation measures.

A) *Kernel Density Estimation (KDE)*

In this study, the kernel density surface is derived using the kernel density spatial analyst tool in ArcGIS 10.7. KDE is a non-parametric statistical technique (Wang et al., 2015) that aids in smoothing the spatial x and y coordinates so that a probability density surface can be produced (Makhadmeh et al., 2020). The degree of smoothing is determined by choosing the appropriate kernel width; this process is frequently referred to as bandwidth selection (Medrano et al., 2021). In this study, ArcGIS 10.7's Silverman rule of thumb is used to derive bandwidth. Silverman's rule is considered robust for spatial outliers. Kernel density is computed for the chosen cultural heritage sites using the following formula (Yuan et al., 2022).

$$fn(x) = \frac{1}{nh}\sum_{i=1}^{n} K\left(\frac{x - xi}{n}\right) \tag{1}$$

where K is the nuclear function; $h>0$, for bandwidth; and (x- xi means the distance from valuation point x to the event $x1$.

B) *Nearest Neighbor (NN) analysis*

To determine how evenly distributed or clustered the locations of cultural heritage sites are in the study area, the present study has utilized ArcGIS 10.7's average NN tool. Using the NN tool, one can determine whether a distribution pattern is dispersed or clustered by averaging the distances between each centroid feature and its neighboring centroid location (Aziz et al., 2012). The values that are derived by calculating NN are the Nearest neighbor ratio, the average Distance expected (D_E), the Distance observed (D_O), Critical value (z score) and Significance level (p value). The ratio in NN is calculated by dividing the D_E by the DO (Hazrin et al., 2016). If the ratio is less than one, then the pattern exhibits clustering, whereas if it is greater than one, then there is the presence of a random pattern (ESRI, 2009).

$$NN = \frac{D_O}{D_E} \tag{2}$$

where D_O is the observed mean distance between each feature and their nearest neighbor expressed as

$$D_O = \frac{\sum_{i=1}^{n} di}{n} \tag{3}$$

and D_E is the expected mean distance for the features, which are in a random pattern calculated as

$$DE = \frac{0,5}{\sqrt{\frac{n}{A}}} \quad (4)$$

A spatial pattern is categorized as clustered if the average observed distance is smaller than the average expected distance and dispersed if the average observed distance is larger than the average expected distance (Mansour, 2016).

C) *Global Morans I*

Global Morans *I* help in comprehending the clustering between the feature datasets using the feature location and its attribute value using the given formula (Anselin, 1995). The values derived were Moran's *I* index, z score, and p value.

$$\text{Global Moran's } I = \frac{n}{S_O} \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} w_{i,j} z_i z_j}{Z_i^2} \quad (5)$$

Here Z_i is considered the deviation of an attribute for feature I from its mean (x_i-$\overline{X}$), while S_o is the aggregate of all spatial weights.

$$SO = \sum_{i=1}^{n} \sum_{j=1}^{n} w_{i,j} \quad (6)$$

The Z_i score is computed using the following formula:

$$Z_i = \frac{I - E[I]}{\sqrt{V[I]}} \quad (7)$$

Where,

$$E[I] = \frac{-1}{(n-1)} \quad (8)$$

$$V[I] = E\left[I^2\right] - E[I]^2 \quad (9)$$

The block-wise total number of cultural heritage features in Banswara is the attribute value chosen for this study. The range of values for global autocorrelation is -1 to 1, where a value of 1 denotes positive spatial correlation and a clustered pattern, -1 denotes negative spatial correlation and randomness in the spatial distribution, and 0 denotes dispersal (Kianfar, Mesgari, 2022).

D) *Getis Ord General*

While the Global Moran's *I* give information about the presence or absence of clustering, the Getis Ord General helps in knowing the degree of clustering between the cultural heritage sites using the following equation:

$$G = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{i,j} x_i x_j}{\sum_{i=1}^{n}\sum_{j=1}^{n} x_i x_j}, \forall j \neq i \quad (10)$$

Here, x_i and x_j are attribute values for features i and j; $\forall j \neq i$ indicates no similarity between j and i

The Z_G score is calculated using the following equation…

$$Z_G = \frac{G - E[G]}{\sqrt{V[G]}} \quad (11)$$

where:

$$E[G] = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{i,j}}{(n-1)}, \forall j \neq i \quad (12)$$

$$V[G] = E\left[G^2\right] - E[G]^2 \quad (13)$$

The obtained values comprise the Getis z score, the observed G, and the expected G. A positive Getis z score and a value of observed G greater than the expected g value tend to indicate a higher clustering scenario, contrary to this scenario, which indicates lower clustering (Zheng et al., 2023).

E) *Local Moran's I*

Local patterns are undermined by global-level measures of spatial autocorrelation because they are not identified (Elfadaly et al., 2023) and are expressed as a single value (Fan & Myint, 2014). Therefore, Local Moran's I was used in this study in order to understand the local patterns of cultural heritage. It is calculated using the following equations:

$$I_i = \frac{x_i - \bar{x}}{s_i^2} \sum_{j=1, j \neq 1}^{n} w_{i,j} \left(x_j - \bar{X}\right) \quad (14)$$

Where x_i is an attribute of the i feature, $\bar{X}$ represents the mean of the corresponding attribute.

$$s_i^2 = \frac{\sum_{j=1, j \neq 1}^{n} \left(x_j - \bar{x}\right)^2}{n-1} \quad (15)$$

n equates to the total number of features.

The computation of the Z score is done using the following equation:

$$ZI_i = \frac{I_i - E[I_i]}{\sqrt{V[I_i]}} \quad (16)$$

where:

$$E[I_i] = \frac{-\sum_{j=1, j\neq 1}^{n} w_{i,j}}{n-1} \quad (17)$$

$$V[I_i] = E[I_i^2] - E[I_i]^2 \quad (18)$$

Local Moran's I give an opportunity to visualize the patterns through the representation of clusters and outliers (Fatima et al., 2021). Attributes having higher values are represented as High-High clusters, whereas those with low values are given as Low-Low clusters. Some attributes having higher values but surrounded by low values are considered as outliers, whereas those with low values surrounded by high values are shown as Low-High outliers.

F) *Getis Ord Gi**

It is also a tool for identifying local patterns. It gives specifics about where hot and cold spots are located. A location with higher values than the surrounding area is referred to as a hotspot (Kim et al., 2021). It is computed using the following formula.

$$G_i^* = \frac{\sum_{j=1}^{n} w_{i,j} x_j - \bar{x} \sum_{j=1}^{n} w_{i,j}}{S\sqrt{\frac{\left[n\sum_{j=1}^{n} w_{i,j}^2 - \left(\sum_{j=1}^{n} w_{i,j}\right)^2\right]}{n}}} \quad (19)$$

where x_i is the attribute of j.

$$\bar{X} = \frac{\sum_{j=1}^{n} x_j}{n} \quad (20)$$

$$S = \sqrt{\frac{\sum_{j=1}^{n} x_j^2}{n} - (\bar{X})^2} \quad (21)$$

Coupling cultural heritage and transport network

The ability to choose and define a region surrounding a specific point of interest for multiple analyses is made possible by GIS technology. This study looks into the distances between cultural heritage sites and roads to find out how near the locations are to the main hub of transportation. Buffers at various distances can be created using the multiple ring buffer tool. This study has mapped the spatial distribution of cultural heritage sites at 1, 2, 3, 4, and 5 km from major thoroughfares. Since there are no other modes of transportation in the Banswara district other than roads, shortest path analyses are conducted by incorporating all the roads within the study area. Banswara city is used as the primary hub from which connectivity to the sites is obtained in order to determine the shortest route to each and every cultural heritage site. The main reason Banswara city was chosen is that it serves as the central administrative hub, making it possible for any visitor to determine the best means of transportation to any given location. Network topology and network datasets were then created in order to perform shortest path analyses in ArcGIS 10.7.

Results and Discussion

Classification of cultural heritage sites in Banswara

Figure 2 shows the number of cultural heritage sites in each of the nine categories of cultural heritage. Out of the 59 locations that have been identified, 42 are categorized as intangible cultural heritage, and the remaining 17 are classified as tangible cultural heritage. Festive events and traditional knowledge each account for ten of these 42 intangible cultural heritage sites, with social practices accounting for the highest number at 14. The customs of "Gadhbhedan" and planning weekly haats for socioeconomic and cultural exchanges are two significant social practices. Festive events encompass the diverse methods used by the native tribal community to celebrate the Holi festival, as extensively documented by (Sharma, 2019).

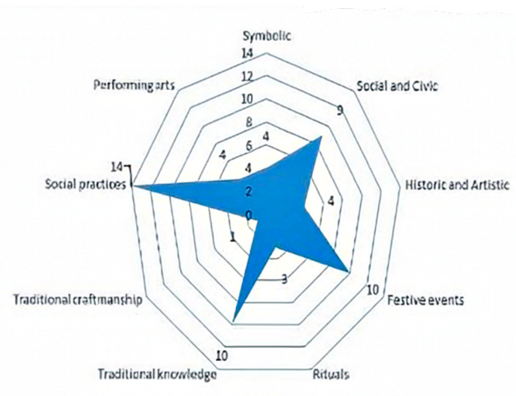

Figure 2. Cultural heritage typology in Banswara district

One aspect of traditional knowledge that is passed down as a legacy is the local tribal community's awareness of the therapeutic value of the nearby botanical resources. Singh, (1983) and Rana et al. (2019) have both documented the variety of botanical resources that the indigenous community uses. The tribal people's ceremonial dances, which fall under the performing arts category, were observed at four documented locations on special occasions. The fairs at Beneshwar Dham, Ghotia Amba, and the Raj talav lake are three significant rituals that the people of Banswara observe on special occasions and at distinctive locations.

The Sompura community's sculpting tradition in Talwara, Banswara, is the final subcategory of intangible cultural heritage. This is the only known traditional craftsmanship identified in Banswara during the course of the investigation. The Banswara district's four "historic and artistic heritages" include Solanki-era temples in Arthuna and Talwara, as well as early medieval Paramaras. The four Maharawal symbolic heritages, on the other hand, hold great symbolic value for the local populace. Banswara District's social and civic heritage includes stepwells. These stepwells were built utilizing information about the Mahi River's high water table, and in many cases, they still bear the imprint of common ownership.

The classification of cultural heritage sites into tangible and intangible cultural heritage can aid in gaining a better understanding of the cultural fabric of the area. The study, through an attempt to identify and thereafter classify the intangible and tangible cultural heritage, can provide an opportunity for the policymakers and stakeholders to evaluate all the cultural tourism resources and formulate a sustainable strategy so that it can benefit the local community. Tangible heritage sites can attract year-round tourism, but this may not be the case for intangible cultural heritage, which includes fairs and festivals held at specific times of the year. As a result, policymakers may need different strategies for preserving and promoting tangible and intangible heritage.

Spatial distribution of cultural heritage sites

A) *Kernel Density Estimation*

The spatial distribution of cultural heritage sites in the study area is being understood through the application of various methods. Spatial distribution patterns helped reveal the processes acting behind them. As demonstrated in Figure 3, the kernel density tool in ArcGIS 10.7 is used to derive the density distribution. It shows the core area of concentration of cultural heritage sites in Banswara district.

The central part of the district, specifically the Talwara and Banswara blocks, is home to a high density zone with numerous tangible and intangible cultural heritage sites, according to

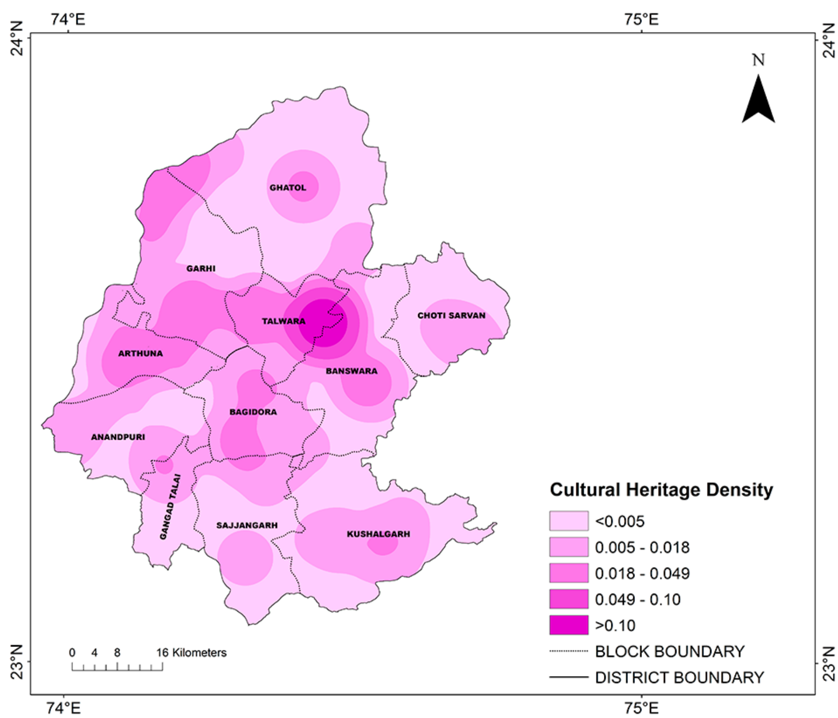

Figure 3. Banswara District's cultural heritage site density

the findings. There is a medium density zone in Banswara block to the south of the high density zone. There are medium density zones in Talwara, Arthuna, and Bagidora blocks. There are two significant medium-density zones in the Garhi block. Other blocks like Ghatol, Kushalgarh, Sajjangarh, Gangartalai, Anandpuri, and Choti Sarwan have low density zones showing less concentration of cultural heritage sites.

B) *Nearest Neighbor Analysis*

Average Nearest Neighbor (NN) was used on 59 cultural heritage sites of Banswara district to determine whether the sites are scattered, random, or clustered. The result derived shows the nearest neighbor ratio of 0.74 (with a z score of -3.74 and a $p < 0.01$), whereas the D_E and D_o are 4173 and 3164, respectively, which makes it evident that the observed pattern is clustered.

C) *Global Moran's I*

By computing Global Moran's I, values like the p value, z score, and Moran's *I* were generated. The positive z value (16.33) and Moran's I of 0.53 at $p<0.01$ indicate the spatial clustering of cultural heritage features in Banswara District.

D) *Getis Ord General*

After using Global Moran's *I* to confirm the existence of clustering, the Getis Ord General statistic or high/low clustering was used to determine the degree of clustering. A variety of values, such as observed *G*, expected *G*, z score, and p value, are obtained from the General *G*. There are high clusters among the cultural heritage sites in the Banswara District at $p<0.01$, as indicated by the derived observed *G* value of 0.48, which is significantly higher than the expected *G* value of 0.28.

E) *Local Moran's I*

Cultural heritage sites in Banswara district are spatially clustered significantly, as shown by the results of global spatial autocorrelation measures. The Anselin Local Moran's *I* provide information about the presence of clusters and outliers at the block level by decomposing the global value (Figure 4). Locations with similar values form clusters, and those with different values form outliers.

Figure 4 depicts the presence of high-high clusters in the central Banswara district, primarily in Talwara block. Low-high outliers are areas with low values surrounded by high values. These locations can be seen in the Banswara block, and the south-east part of Ghatol block. The sites of the remaining Ghatol and Garhi, Arthuna, Sajjangarh, and Choti Sarwan blocks do not form clusters or outliers. This could be owing to its greater distance from the center high-high cluster. These blocks primarily have intangible cultural heritage sites, with the exception of one tangible heritage site each in Garhi and the Arthuna block, which contains archaeological monuments such as the Parahera temple and the Arthuna temple complex. The blocks of Bagidora, Kushalgarh, Anandpuri, and Gangadtalai contain low-low clusters. Most of these blocks are also associated with intangible cultural heritage.

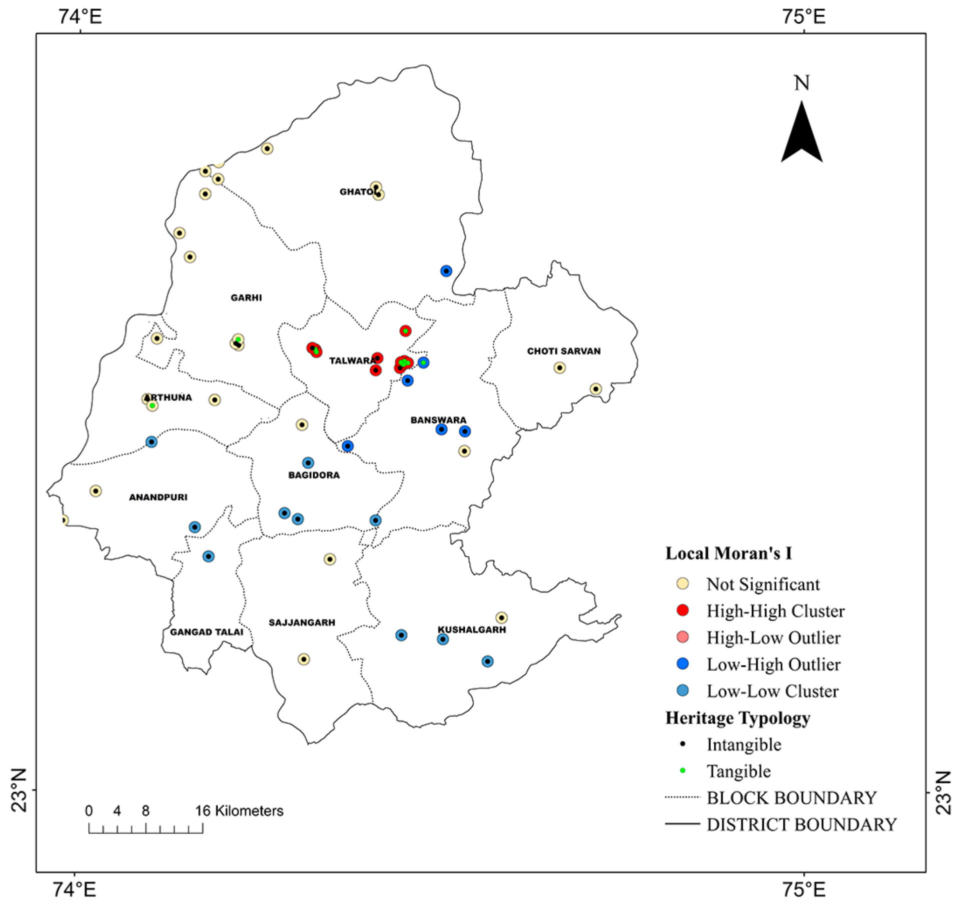

Figure 4. Block-wise tourism clusters

F) *Getis Ord Gi**

While the global values produced from Getis Ord General results suggest that Banswara district has a high concentration of cultural heritage sites, the Getis Ord Gi*, which offers local values, demonstrates the presence of statistically significant hotspots and coldspots (high and low values). These are derived with three different confidence intervals of 99, 95, and 90%, respectively. Getis Ord Gi* provides the decomposed values for the Getis Ord General measure. The locations of these hotspots and coldspots are shown in Figure 5.

Hotspots with a 99 % confidence interval are found in Talwara and Banswara blocks. These hotspots contain both tangible and intangible cultural heritage. Cold spots are found in Kushalgarh, Bagidora, Choti Sarwan, Gangadtalai, and some parts of Anandpuri and Sajjangarh blocks, respectively. However, only in Bagidora, a cold spot with a 99% confidence interval is visible; rest of the cold spots are associated with lower confidence intervals. In consonance with the results of Local Moran's *I*, Garhi, Arthuna, and most of the area of Ghatol block does not have either of the hotspots or coldspots. These blocks have sites of intangible cultural heritage. Therefore, it can be seen that the sites of intangible cultural heritage show a more random pattern than the sites of tangible heritage.

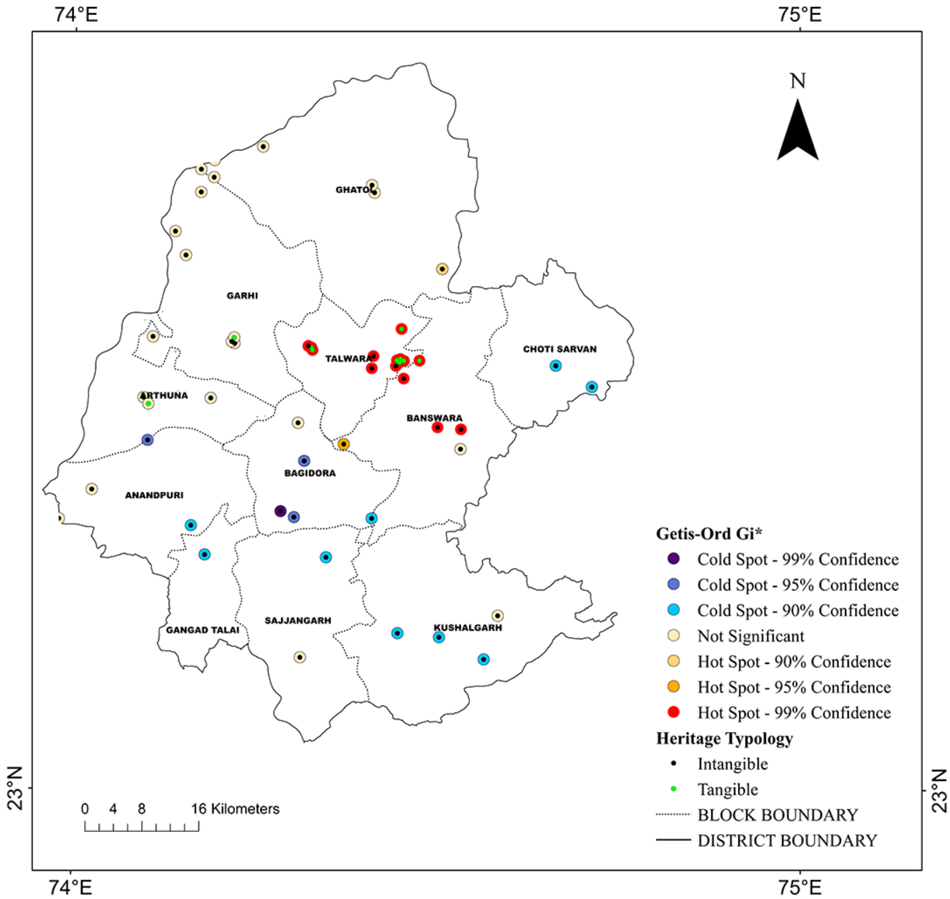

Figure 5. Block-wise hotspots and coldspots

The district's center area contains 17 cultural heritage sites, both tangible and intangible. The Talwara block includes medieval archaeological structures like the Dwarkadheesh and Mahalaxmi temples, as well as intangible assets such as Sompura sculptors' work and customs. The eastern portion of Banswara block contains a number of stepwells, as well as the 16th-century structure at the core of Banswara city, which served as an administrative and strategic nucleus in previous centuries. The structure comprises a bastion, rampart, watchtower, gates, and other features built by the Maharawals, who were the rulers of Banswara state in earlier eras. The relationship between human activity and the physical environment is revealed by the overall distribution pattern of these cultural heritage sites. Both affect and restrict each other (Lin et al., 2022). The distribution pattern reveals that while intangible cultural tourism heritage is primarily found farther from urban centers in more condensed rural settings, urban areas are primarily associated with tangible tourism heritage, such as ancient temples, palaces, stepwells, and so on. Historically, the forest tracts that served as the primary source of the botanical plants and herbs were found in areas that were remote from urban centers. These are also the locations of the places where fairs and festivals have been held in close proximity to natural features like waterbodies.

Findings from global and local spatial autocorrelation measures can help planners prioritize places with high-high clusters and hotspots for cultural heritage tourism. The low-high outliers, which are sites with low values surrounded by locations with higher values, can also be prioritized because they are close to the high-high clusters. This type of analysis allows policymakers to design tourism circuits that efficiently connect a number of sites, saving tourists from having to travel longer distances to view a single site. The introduction of museums at locations where there are clusters and hotspots can promote local knowledge, skills, customs, and crafts. This can raise tourists understanding of the local culture and encourage them to visit certain locations. Furthermore, it can help foster a sense of self-pride and communal ownership, which can eventually lead to the preservation and conservation of intangible cultural heritage.

Spatial distribution of cultural heritage sites along the transport network

In the context of culture and tourism, spending more time at the sites rather than on the roads is essential (Yuan et al., 2022). Since the roads are the only available mode of transportation in Banswara district, an effort has been made to comprehend the cultural heritage sites in relation to their distances from the roads. Multiple buffers were created at distances of 1, 2, 3, 4, and 5 km along the major highways of the district. The location of the cultural heritage sites as seen through these buffers is depicted in Figure 6, 32 cultural heritage sites, or roughly 54.2% of the total, are situated within a one-kilometer buffer from major highways, while three sites, or 5% of the total, are situated between one and 2 km from the major highway network. The two- to three-kilometer buffer zone includes five sites, or 8.4% of the total number of sites. Moreover, 3 sites—or 5% of the sites—are included in the buffer zone of three to 4 km. Six cultural heritage sites (10%) are located within the 4 to 5 km buffer zone. There are ten sites that are located outside of the 5km search radius, making up roughly 16.9% of the total.

Using shortest path analysis, the shortest path between each cultural heritage site and Banswara city, which is the district headquarters of Banswara district is, determined. Following that, the shortest path analysis results were divided into six groups. Based on table 1, it can be inferred that approximately 9.52% of sites classified as intangible cultural heritage are situated within 10 km of Banswara city. The number of intangible cultural heritage sites rises with the distance from Banswara city. 19.04% of the sites are located 10 to 20 km from the district headquarters. Of all the sites, 7.14% are located between 21 and 30 km away from Banswara city, and 19.04 % are located between 31 and 40 km away. About 30.95% of the total intangible cultural heritage sites are located between 41 and 50 km from Banswara city. The remaining intangible cultural sites, which make up 14.28% of the total, are located at a distance of more than 50 km from Banswara city. On the other hand, 70.58% of the sites that make up the tangible cultural heritage are located within 10 km of the district headquarters. The number of tangible heritage sites decreases with increasing distance from Banswara City.

The tangible cultural heritage sites are closer to the district headquarters than the intangible cultural heritage, and transportation is the only means for transportation available in Banswara district. As a result, to make the best use of the road transportation network available to reach cultural heritage sites, policymakers can use the shortest path analysis results to prioritize the setting up of specialized transportation vehicles as direct connectivity from district headquarters to certain intangible cultural heritage sites based on their significance at specific times of year.

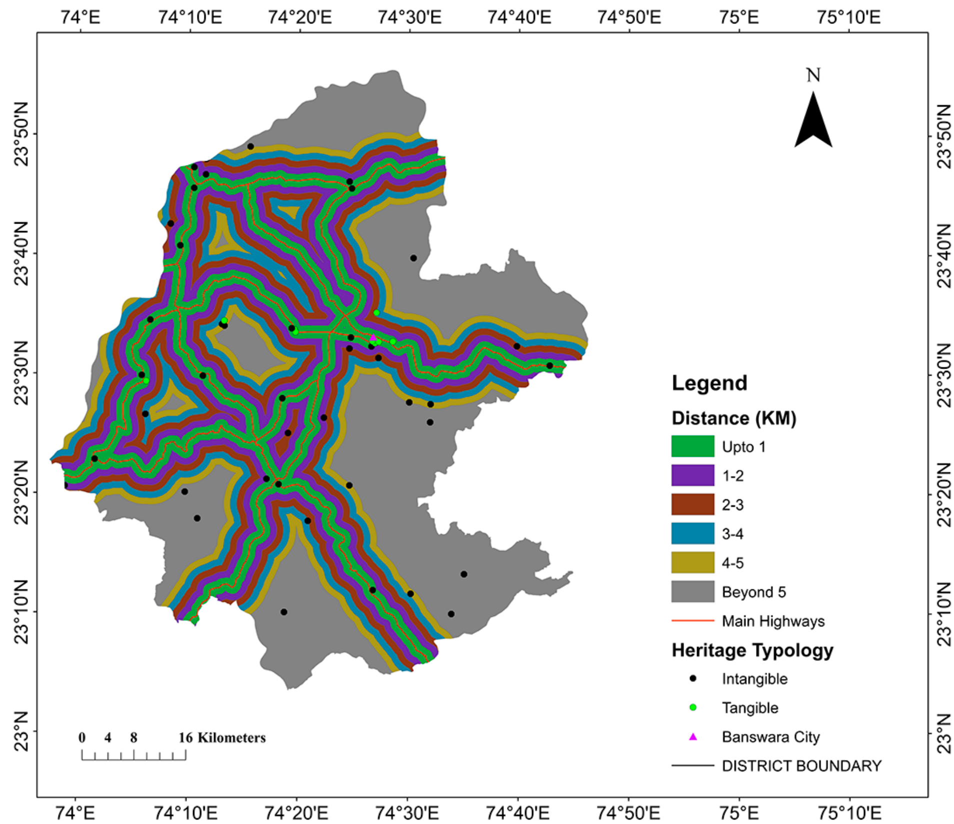

Figure. 6 Coupling cultural heritage and transport network using multiple buffer technique

Table 1. *Sites classified based on their shortest path*

DISTANCE (in km) / NUMBER OF SITES	<10	10-20	21-30	31-40	41-50	>50	Total
INTANGIBLE	4	8	3	8	13	6	42
TANGIBLE	12	2	1	0	1	1	17

Conclusion

This study used a variety of approaches to explore the spatial distribution patterns of intangible and tangible cultural heritage in Banswara district of Rajasthan, India, providing new geographical perspectives that can help plan cultural heritage tourism in the area. In this regard, the sites were first identified and classified based on their distinctive characteristics, and then their block-wise distribution was examined using a variety of tools, including Kernel density estimation, Average nearest neighbour, and Global and Local spatial autocorrelation. Additionally, this study tried to figure out how well the current road transport network could serve cultural heritage tourism in the Banswara district by employing buffer and shortest path analysis. The findings show that the central part of Banswara district, which includes the Talwara and a portion of Banswara block, exhibits clustering and hotspots of cultural heritage. Based on the heritage typology, tangible heritage demonstrates spatial clustering and is more related with hotspots, whereas intangible heritage sites show dispersal and random pattern and are shown to be less associated with hotspots. The majority of tangible cultural heritage sites are located near the main transportation routes; however, some intangible cultural heritage sites are located far away from the highways, necessitating tourists to use district and village roads to reach there. This study can serve as a benchmark for future research on cultural heritage tourism in the Banswara district. The identification of hotspots and clusters in this study may serve as a starting point for policymakers to concentrate on the most important locations for promoting cultural heritage tourism in the region. The identification of cultural heritage sites was done through the use of literature and consulting with experts. A thorough survey conducted at the village level can uncover more sites of this kind and provide a deeper insight into the region's cultural fabric. As a result, more sites may be discovered in the future, providing ample opportunities to identify new hotspots and clusters. This study chose the block-wise number of cultural heritage sites as the attribute value/weights for deriving outcomes from Global and Local spatial autocorrelation measures. The use of global and local spatial autocorrelation for planning cultural heritage tourism in this area can be made more effective by exploring other attribute value/weight that can provide a more thorough picture of clustering or dispersion of these sites. Future research might study the significance of geographical elements in the distribution of cultural heritage sites by taking into account a variety of characteristics, including terrain, climate, population distribution, rivers, and others.

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