

## GIS and management planning for sustainable ecotourism development: a case study of Jodhpur, Rajasthan, India.

### SIG y planificación de la gestión para el desarrollo del ecoturismo sostenible: un estudio de caso de Jodhpur, Rajasthan, India.

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#### ABSTRACT

**Background:** Ecotourism is a very fast-growing sector worldwide, connecting rural and urban people to more sustainable and alternative means of livelihood. When it comes to India, Rajasthan is well known for its tourist places worldwide because of its forts, palaces, wildlife sanctuaries, national parks, etc. Many tourist places in Rajasthan display the diversity of the entire country. Among them, Jodhpur is the most favored tourist destination. Due to cultural variability and traditional values, Jodhpur has been taken as a study area.

**Purpose:** This study aims to understand the geospatial technology and management planning for sustainable ecotourism development in Jodhpur district, Rajasthan, India.

**Objective:** (a) Identify the role of GIS and management in ecotourism's growth and planning. (b) Identifying and mapping some of the significant ecotourism hotspots using Arc GIS software and plotting the current flow of tourism in the study area.

**Methodology:** The methodology section has consists of three crucial parts in which; the first section deals with GIS planning tells us how the location-based information helps in the proper collection of GIS based data and channelization of work. The second section shows the management planning which shows how the proper management activity may lead us to an effective and efficient flow of visitors has been maintained and, lastly, sustainability details about how the GIS planning and management planning may lead us to a sustainable future of tourism called ecotourism.

**Result:** The use of GIS and management planning in tourism-related activities can significantly contribute to employment generation, revenue generation, enhancement of local market and people may understand the local tradition and culture. Effective and efficient use of all resources may lead us towards sustainable future.

**Conclusion:** GIS and management planning can do much better than we think. With the utilization of geospatial technology, the visitors flow can be managed in eco-fragile areas in more effective manner. Tourists mostly recorded in unique places, which is commendable work for the tourism sector's growth. However, the central and state

governments' combined efforts have provided a massive boost to the tourism sector by allocating proper fund. To maximize revenue generation, the Ministry of Tourism is now emphasizing GIS and Management-based plan, which helps to attain sustainable growth.

**KEYWORDS:** Ecotourism, GIS, Sustainable Development and Management Planning.

## RESUMEN

**Antecedentes:** El ecoturismo es un sector de muy rápido crecimiento en todo el mundo, que conecta a la población rural y urbana con medios de subsistencia más sostenibles y alternativos. Cuando se trata de India, Rajasthan es bien conocido por sus lugares turísticos en todo el mundo debido a sus fortalezas, palacios, santuarios de vida silvestre, parques nacionales, etc. Muchos lugares turísticos en Rajasthan muestran la diversidad de todo el país. Entre ellos, Jodhpur es el destino turístico más favorecido. Debido a la variabilidad cultural y los valores tradicionales, se ha tomado Jodhpur como área de estudio.

**Propósito:** Este estudio tiene como objetivo comprender la tecnología geoespacial y la planificación de la gestión para el desarrollo del ecoturismo sostenible en el distrito de Jodhpur, Rajasthan, India.

**Objetivo:** (a) Identificar el papel de los SIG y la gestión en el crecimiento y la planificación del ecoturismo. (b) Identificar y mapear algunos de los puntos críticos de ecoturismo importantes utilizando el software Arc GIS y trazar el flujo actual de turismo en el área de estudio.

**Metodología:** La sección de metodología consta de tres partes cruciales en las que; la primera sección se ocupa de la planificación GIS y nos dice cómo la información basada en la ubicación ayuda en la recopilación adecuada de datos basados en GIS y la canalización del trabajo. La segunda sección muestra la planificación de la gestión que muestra cómo la adecuada actividad de gestión puede llevarnos a un flujo de visitantes eficaz y eficiente y, por último, detalles de sostenibilidad sobre cómo la planificación y la planificación de la gestión de SIG pueden llevarnos a un futuro sostenible de turismo llamado ecoturismo.

**Resultado:** El uso de SIG y planificación de la gestión en actividades relacionadas con el turismo puede contribuir significativamente a la generación de empleo, generación de ingresos, mejora del mercado local y la gente puede comprender la tradición y la cultura locales. El uso eficaz y eficiente de todos los recursos puede llevarnos hacia un futuro sostenible.

**Conclusión:** Los SIG y la planificación de la gestión pueden funcionar mucho mejor de lo que pensamos. Con la utilización de tecnología geoespacial, el flujo de visitantes se puede gestionar en áreas eco-frágiles de una manera más eficaz. Turistas en su mayoría registrados en lugares únicos, lo que es un trabajo encomiable para el crecimiento del sector turístico. Sin embargo, los esfuerzos combinados de los gobiernos central y estatal han proporcionado un impulso masivo al sector turístico al asignar los fondos adecuados. Para maximizar la generación de ingresos, el Ministerio de Turismo ahora enfatiza el SIG y el plan basado en la gestión, que ayuda a lograr un crecimiento sostenible.

**PALABRAS CLAVE:** Ecoturismo, SIG, Desarrollo Sostenible y Planificación de la Gestión.

## INTRODUCTION

India, with all its geographical and cultural diversity, has always been an attraction for tourists. The mighty Himalayas, vast desert, lush green forests, and beautiful beaches intertwined with ancient temples and the majestic forts of Rajasthan make India truly an incredible destination (Font and McCabe, 2017). However, India has much more to offer than just being the 'land of tigers and temple's (Tharoor, 2007).' Its myriad tourist spots spread from the city to millions of villages known for their social and cultural diversity have immense potential to generate large revenue for the country (Qualls, 2019). In today's scenario, the tourism industry is going through a great shift in ideas and beliefs (Palmer, C. 1999). The journey's purpose has now become more relaxed and value for money-centric (Ateljevic, 2009). The new generations are more excited to learn new things and experience culture, food, traditions, etc (Yousaf and Xiucheng, 2018). By this, we clearly say that tourism is going through the global advancement stage, which is good, and India needs to change accordingly (Arun et al., 2019). Lack of resources and connectivity creates a massive barrier to the development of the tourism sector.

If we look out our study area, Jodhpur is very famous for its palaces, forts, temples, desert, etc., throughout the world (Hall, 2019). The city has two nicknames, 'Sun City' and 'Blue City,' due to its unique features. The name 'Sun City' is given due to the bright sunny weather of Jodhpur, while the word 'Blue City' is given all because of 'blue houses' located all around "Mehrangarh Fort" in the city (Arunmozhi and Panneerselvam, 2013). Throughout the year, Jodhpur is filled with national as well as international tourists (Tung, 2018). Proper management of tourists without affecting our environment is a huge challenge for local authorities; this challenge may ultimately lead us to environmental degradation (Singh Chandel and Kanga, 2018).

Environmental issues are now a big concern today because "there is no tourism without a sustainable environment." From here, ecotourism suggests a new way of tourism with a sustainable futuristic scope. Interest and growth in sustainable ecotourism and nature-based tourism have shown new alternative dimensions around the world (Borana and Yadav, 2017). Therefore, maintaining a future with a healthy environment is the need of the day (Sharma, 2015). No doubt, the Indian tourism industry is doing remarkably well, but the major challenge lies in providing adequate infrastructural, technological, and logistic support to sustain this growth momentum (Maxim, 2019).

Geographic Information System (GIS) based management planning plays a crucial role in maximizing all the things in the minimum utilization of resources (Michailidou et al., 2016). GIS is a potent tool for creating, managing, analyzing, and implementing tourism-based spatial and non-spatial data on a different platform (Heng and Low, 1990). It will store maps and plans for land use, socioeconomic data, environmental data, and applications for planning, which will ultimately lead us to a sustainable future with a healthy environment. For a sustainable environment, there is an immense need for proper management planning (Chandel, 2013). That's why GIS and management-based ecotourism planning for a sustainable future has been introduced in this paper. The paper mainly aims to know and understand how GIS and management planning lead us to sustainable growth and provide accurate information regarding different tourist spots. GIS-based mapping will also help the local management and authorities to improve and enhance the quality of services and ecotourism-based activities in the Jodhpur district. (Kanga et al., 2014). So, the Jodhpur district can get a new identity in the world, and this

will also make it easy for tourists to explore and understand the culture of Rajasthan (Kanga and Singh, 2017). "The World Travel and Tourism Council" has been analyzed that the sector generates approx. Rs. 14.02 lakh crore (U.S. 220\$ billion) or 10% of the total country's GDP in 2018 and this helps nearly 40.23 million employment, 9.3% of its total jobs for the country (Chandel, 2019). As per the Ministry of tourism, approximately 88.90 lakh (8.89 million) international visitors departed in 2008 compared to 2017 it is about 80.27 lakh (8.027 million), recording tremendous increase of 10.7% which shows good interest among the tourists. This helps to create a good brand image throughout the world and revenue generation for the country (Chandel and Kanga, 2020).

#### OVERVIEW OF ECOTOURISM:

The term ecotourism is comparatively new to the world (Regmi and Walter, 2017). Ecotourism is also a form of nature-based exploration, aiming "responsible travel towards natural areas which helps to protect the ecology of the environment, and supports the wellbeing of the local community and makes people aware of protecting the environment." (Figure: 1.) (Vinodan and Manalel, 2019). It is sustainable tourism centered on the consumption and utilization of natural resources (Kotler and Keller, 2016). It primarily focuses on learning and experiencing nature, its ecology, landscape, and their natural habitats, as well as the cultural diversity of the area. The main difference between ecotourism and tourism is the involvement with nature; ecotourism always focuses on creating a low impact on the environment and the people (Coccosis, 2017). In the case of tourism, it is not much focused on local people's wellbeing and conservation of nature (Valentine, 1993).

Ecotourism is the best way to promote the creation of jobs and education in local communities, creating a healthy relationship between the community and the environment. Ecotourism also proves that it is a useful tool for sustainable development that includes economic development and conservation strategies (Kiper, 2013).

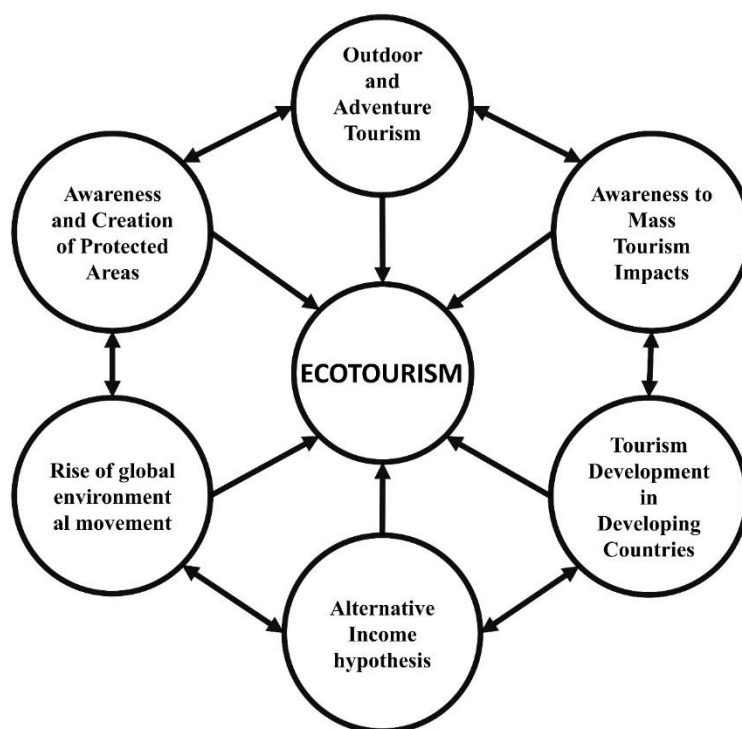


Fig. 1. The most important factors driving the growth of ecotourism (Jamal et al., 2006).

## OVERVIEW OF GEOGRAPHIC INFORMATION SYSTEM (GIS):

GIS is a totally based computer technology used to analyze and map the spatial characteristics present on the earth's surface (Ghorbanzadeh et al., 2019). (Figure: 2.). It is an emerging science that combines different subjects like computer science, management, mapping science, mathematics, geography, surveying, statistics, etc. The main advantage of (GIS) geospatial data is that it gathers, input, handles, edits, queries, models, and displays all the spatial and non-spatial information at one platform (Farsari and Prastacos, 2008). Because of its efficient data management capability, spatial analysis capability, dynamic capabilities of monitoring with multi-factor comprehensive analysis, it becomes the best administrative decision-making tool, mostly utilized in urban planning, management of land resources, mitigation and disaster prevention, development of real estate sector, commercial business purposes and other areas (Botter, 1982; Vılcea et al., 2018).

GIS = Geographic + Information + System

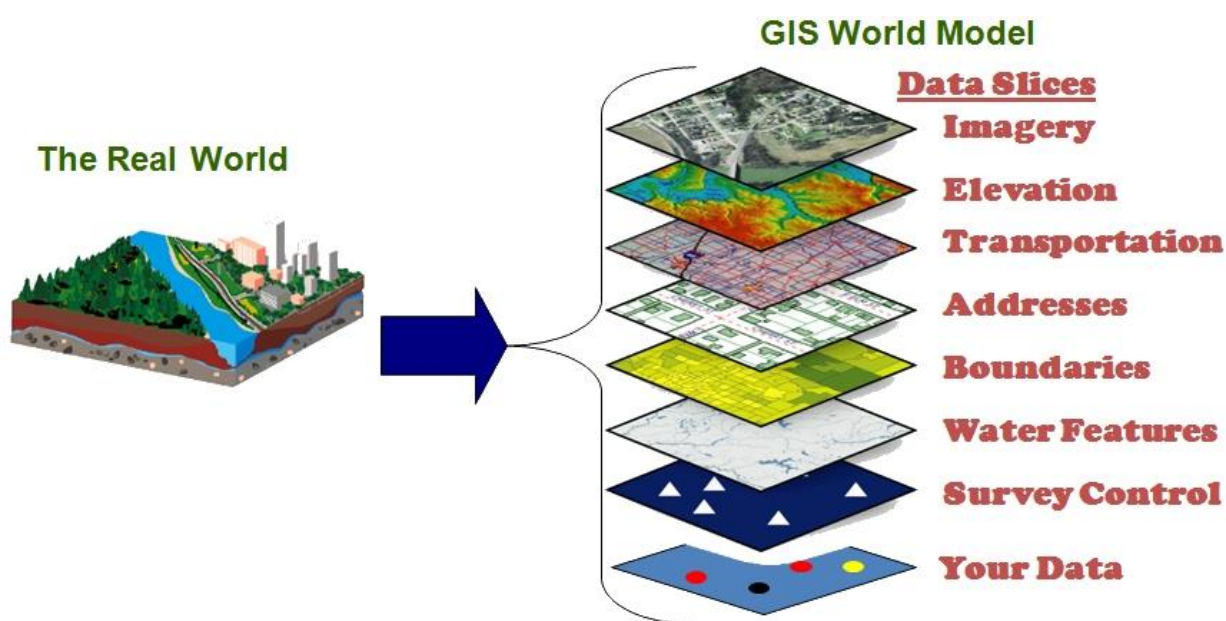


Fig. 2. Main Concept of GIS. (Source: <https://www.esri.in/>)

### MAIN OBJECTIVE:

The primary objective of writing this paper are follows:

- Identify the role of GIS and management in ecotourism's growth and planning.
- Identifying and mapping some of the major ecotourism hotspots using Arc GIS software as well as plotting the current flow of tourism in the study area.

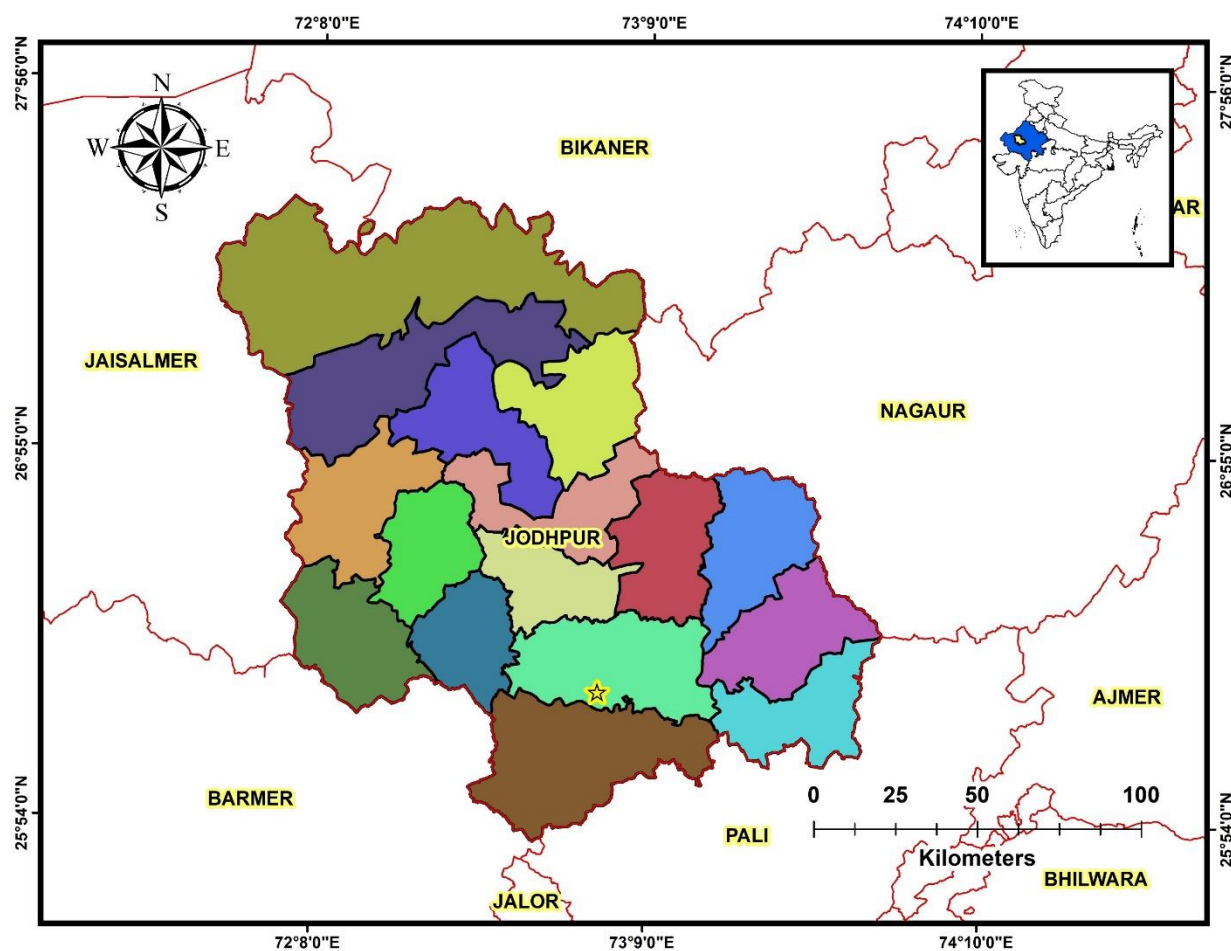


Fig. 3. Location Map of Jodhpur (Source: Author<sup>1</sup>)

#### DESCRIPTION OF STUDY AREA:

Jodhpur district takes its name from its principal city founded by Rao-Jodha in 1459 A.D., which at present headquarter of the district. Jodhpur district is in Rajasthan western part. The boundary stretches from  $26^{\circ} 0'$  and  $27^{\circ} 37'$  North latitude,  $72^{\circ} 55'$  and  $73^{\circ} 52'$  East longitude. The district's maximum length from north to south is 197 km and the maximum breadth is 208 km from east to west. It shares its border with five other districts of Rajasthan, namely, North by Bikaner, South by Barmer and Jaisalmer, East by Nagaur and Pali, and west side by Jaisalmer districts (Figure: 3.). The district resembles a rectangular shape, whose longer sides are slightly square. The location of Jodhpur belongs to a barren land with a minimum water supply that has never posed any major issues in the prosperity of the Jodhpur city despite its location. Jodhpur is a second-largest city, the most famous metropolitan town of the state. Traditionally, Jodhpur was the capital of the Kingdom of Marwar, which is currently a part of Rajasthan. Jodhpur is a popular tourist destination in the stark scenery of the Thar Desert, which includes many palaces, forts, and temples. Jodhpur is also famous for being the cultural center of the state of Rajasthan.

METHODOLOGY ADOPTED:

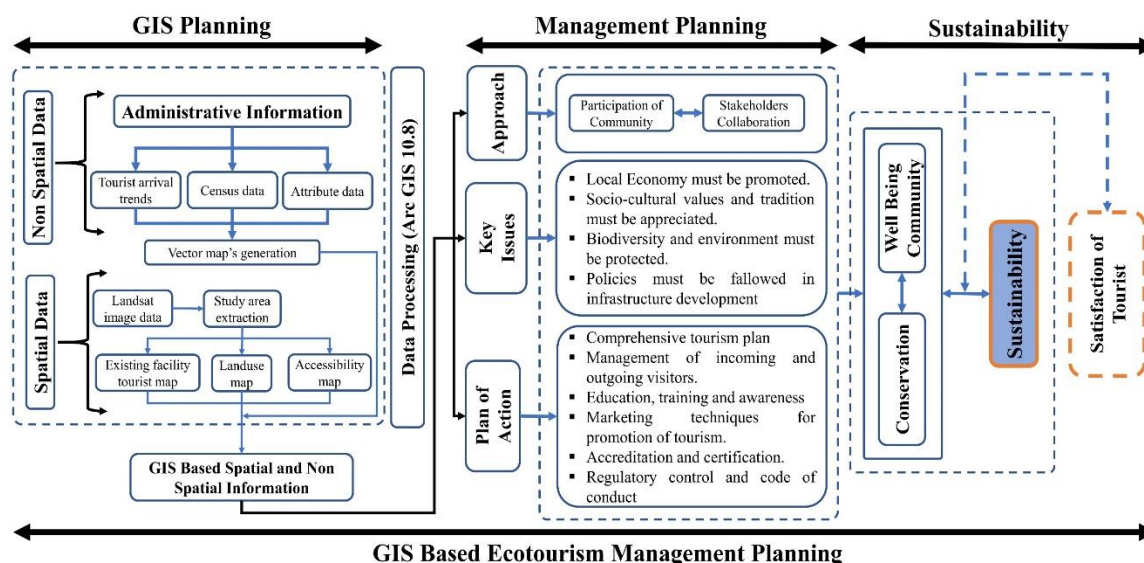


Fig. 4. Methodology Adopted (Source: Author<sup>1</sup>)

Ecotourism is a vast sector for revenue generation. In this regard, GIS and Management play a very crucial role in detecting, analyzing, and implementing different plans. With the help of a geospatial approach, we can clearly identify many ecotourism sites for further development and management, which also give proper support to explore, formulate and implement different business strategies with a sustainable environment. Ultimately it generates employment and a large amount of revenue for local people and government. According to a recent analysis, tourism contributes 2.7 percent (5.2 percent after adding indirect effects) in Gross State Domestic Product (GSDP) and 1.9 percent (7.2 percent after adding indirect effects) in state employment. Compare to other cities; Jodhpur is neglected at a wide scale in the means of a tourism destination. As we see in today's scenario, the visitors have a vast variety of tourism hotspots for many activities to choose from in the district, which boosts tourism overall experience. The primary goals of ecotourism and GIS are to provide visitors with an understanding of the effects of human interference on the environment, as well as to inspire visitors to build and respect natural environments (Figure: 4.).

## GIS IN ECOTOURISM

### 1. Spatial Database Creation:

The tourism sector is increasingly becoming the leading economy in most developed countries. Many economists are making way for significant investments in this industry in order to expand and diversify it so that it can become a major driver of the country's economic development. In addition to these, governments have their tourist locations completely commercialized and explored. One of the most significant activities is to establish a spatial database for tourist sites to facilitate visitors. For that, here are some steps which need to be followed at a large scale:

1. Constructing graphical maps covering the target region.
2. Digitalization of paper maps by making them into digital form.
3. Building a topology to establish a connection between the characteristics of the map.
4. The Real-world must be transformed into coordinates.

## 2. Creation of Attribute data:

Data on the attributes of various tourism facilities are correlated with their respective spatial characteristics. This relation may be rendered as follows:

1. Adding and compiling text-based information to feature locations in tables
2. Text labels can be Edited and developed through images and pictures.
3. Attachment of photographs and pictures to their signature positions.

## 3. Application Scenarios:

1. Tourists primarily use the GIS-based program to scan and query those tourism facilities to discover and explore them on a wide scale.
2. It offers a simple way to integrate tourist attributes of such object class like hotels, restaurants, palaces, event location, etc.; the main field for filling attribute data are object name, category, sub-category, Lat-Long, physical address, postal code, etc. (Figure: 5).

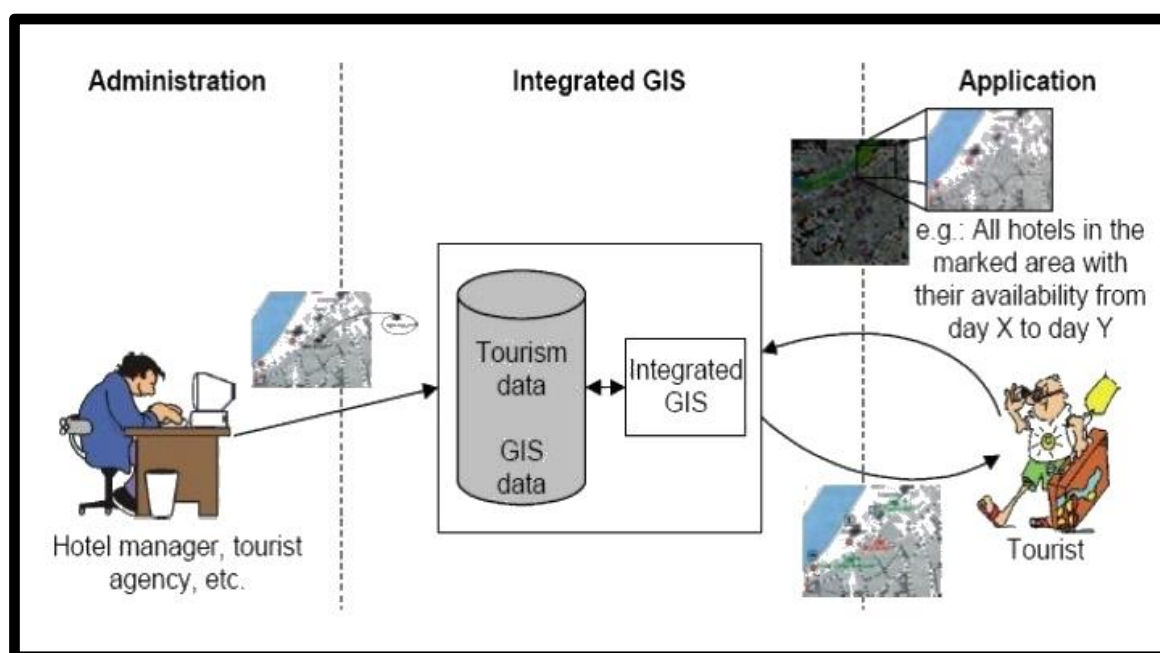


Fig. 5. Integration of GIS System in Ecotourism (Wahab and Soonthodu, 2018)



## GIS BASED ECOTOURISM MANAGEMENT PLANNING:

Ecotourism management planning (EMP) is a useful tool to guide tourism-based developmental plans in eco-sensitive areas by synthesizing and representing all the stakeholders' vision while fulfilling the site's conservation objectives. As a tool GIS gives a way to create, analyze, manage, store and implement utilizing personal geodatabase (PGDB). Based on various observations, here are some proposed sets of opportunities for GIS applications in ecotourism planning and management.

1. Flow management of visitors
2. Use of resources and inventory facilities
3. Assessing the results of the growth of tourism
4. Marketing tourism

### 1. Flow management of visitors:

One of the most important issues of today is the handling of tourist flows. Tourism is generally seen at the level of local and regional growth. Its development could negatively affect the local climate or the cultural heritage of a destination, altering the most important social and economic conditions and affecting the local population's standard of life (Mach et al., 2018). However, tourism has a detrimental effect that could affect the viability and popularity of Jodhpur's main heritage sites. Due to this, the management of tourism flows becomes a major concern. To deal with this, we can use tourist carrying capacity management, which can give us many positive effects, which expresses how many visitors are acceptable at a destination site (Li et al., 2017a). According to UNWTO - United Nations World Tourism Organization has defined that the tourism carrying capacity as the highest number of people who may access heritage sites at a given period, without damaging the physical, socio-cultural, economic environment, which results in an unsustainable drop in the quantity of visitor's satisfaction (Coccosis and Mexa, 2004; Mustățea, 2019).

### 2. Use of resources and inventory facilities:

Tourism is a very big service sector; it totally depends on visitors coming from inside and outside the country. During any visit, peoples may utilize many types of governmental services and equipment (Jensen, 2018). The utilization of services and equipment offered by the government is already a big concern. Misuse of these services is a serious problem. The government has taken many steps to deal with this, but due to a lack of awareness and management, all efforts are in vain. Applying resource management through a proper channel is a way to increase tourism-based activity, which will help us in solving a lot of problems, but we will have to keep trying continuously for stability.

### 3. Evaluating the impacts of tourism development:

Tourism is the 3rd largest foreign exchange earning sector in the country. It is not just a cultural heritage and historical heritage; its portfolio has expanded to other events like adventure tourism, cruise tourism, film making, luxury tourism, religious tourism,

medical tourism, and pilgrimage tourism (Woo et al., 2015). This is the reason that every year the number of tourists in the tourism sector is also increasing. Due to this, there is an essential need to evaluate both the prospects, whether it is positive or whether it is negative (Table: 1.).

#### 4. Tourism Marketing:

The hospitality business includes travel and tourism. The tourism sector is also referred as travel industry, which is related to the concept of people traveling for fun, social, or commercial reasons to other destinations, either domestically or globally (Li et al., 2017b; Dobrila et al., 2018). It is strongly related to the hotel sector and the catering industry, which is fooding and lodging, all of it is focused on keeping visitors highly satisfied, busy, and ready with the commodity they need during the time away from home (Sharma et al., 2018). Tourism offers a wide range of advantages, including economic gains for the country that draw huge amounts of tourists because of the money they invest not just on their actual stay but also on local businesses (Sridharan et al., 2019).

Table 1. Explains both Positive and Negative aspects of tourism

	Positive	Negative
Economic	It contributes to income and standard of living	It increases the price of goods and services
	It improves the local economy	It increases the price of land and housing
	It increases employment opportunities	It increases the cost of living
	It increases tax revenues	It increases the potential for imported labor
	It creates new business opportunities	It is seasonal tourism creates high-risk, under-or unemployment issues
Environmental	Protection of selected natural environments or prevention of further ecological decline	Pollution (air, water, noise, solid waste, and visual)
	Preservation of historic buildings and monuments	Loss of natural landscape and agricultural lands to tourism development
	Improvement of the area's appearance (visual and aesthetic)	Loss of open space
Social/Cultural	Improves quality of life	Destruction of flora and fauna
	Facilitates meeting visitors (educational experience)	Language and cultural effects
	Positive changes in values and customs	Unwanted lifestyle changes
	It promotes cultural exchange	Displacement of residents for tourism development
	It increases the demand for historical and cultural exhibits	Negative changes in values and customs
		Exclusion of locals from natural resources

It also offers a vast number of workers, among others, for people employed in the travel and hospitality industries. Marketing of travel and tourism business is an organized and structured execution of corporate policy. Moreover, the scope of marketing business

is very broad, complex, sophisticated, and very much competitive. Because of this, travel companies are trying to become more larger, more automated, and more sophisticated in management processes. In the same way, visitors are also becoming more experienced, trained, and demanding, asking for high-quality packages and services. Therefore, in this uncertain traveling business environment, marketing skills and knowledge are more requisite ingredients than product knowledge, and enthusiasm is required for travel companies' long-term survival and growth. Thus, this has led to the use of tourism marketing as a more reliable tool for the futuristic growth tourism industry.

#### SOFTWARE AND DATA USED:

Both primary and secondary data sources were used extensively during the study to provide accurate qualitative and quantitative information. All the vector-based layouts and calculation has been done on ArcGIS 10.8 whereas ERDAS Imagine 2015 software used for raster-based Landsat 8 data analyzing, organizing, cropping, etc. purposes. Arc GIS and ERDAS Imagine software has mainly been used as a tool for generating different types of map outputs, which helps in the proper analysis of the outcomes.

#### THE PRESENT SITUATION OF TOURISM IN JODHPUR

Tourism accounts for more than 15 percent of Rajasthan's economy and receives more than 10 percent of international visitors to India every year (Figure: 6.). Jodhpur is one of the major attractions of Rajasthan. It has developed a lot in the field of tourism. The hotel industry is already well organized and setup, including all types of facilities. Compare to other cities, Jodhpur is neglected at a wide scale in the means of a tourism destination, and some selected tourist spots had heavy flow of tourist if go through the tourism record trend annually, arrivals were restricted to a few thousand, which is commendable work for the growth of the tourism sector. It is, therefore of the utmost importance for this area to establish a solid guideline for ecotourism planning and visitor management. This is a critical problem for fostering the sustainable management and growth of tourism.

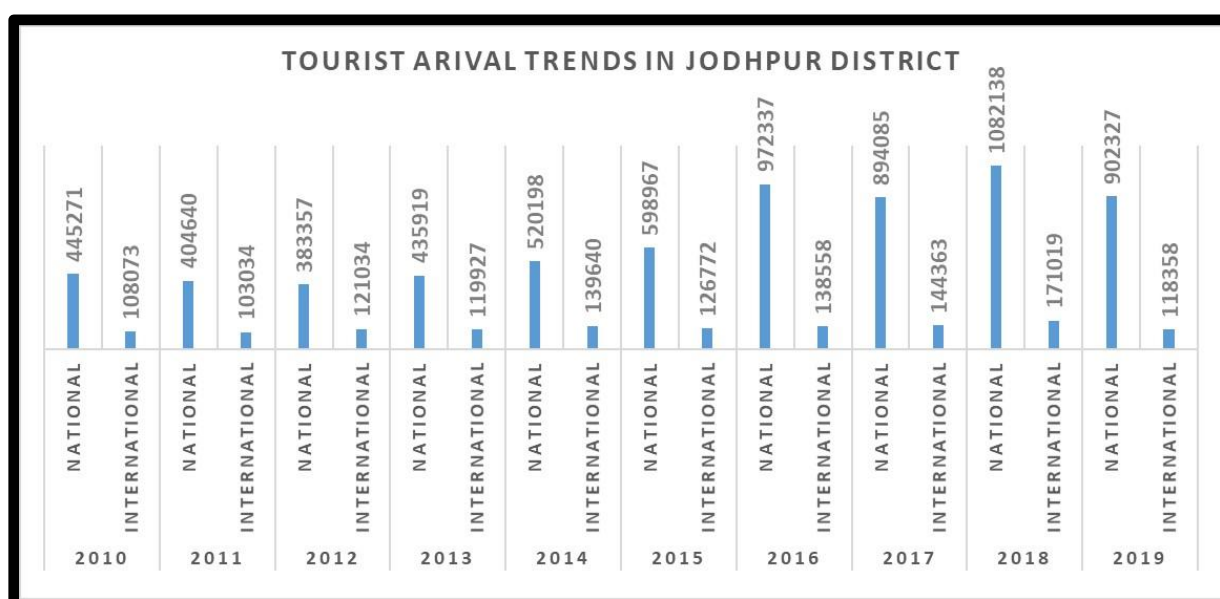


Fig. 6. Tourist Arrival Trends in Jodhpur District.  
 (Source: Tourism Department Annual Progress Report 2017 - 19)

## RESULT AND DISCUSSION

Sustainable ecotourism is tourism that aims to have a limited effect on the local community and the climate, thus seeking to create potential jobs for residents. The aim of sustainable ecotourism is to ensure that growth brings a good experience among residents, tourism companies, and the visitors themselves. On the other way, tourism planning is a dynamic process of establishing goals in which systematically and organized way for choosing alternative courses of actions to maximize the output and careful execution of the chosen alternatives later it will determine whether it is successful or not, helps in the tourism development process. Tourism can strengthen connections between nation and states through corporations, build possibilities for entertainment and leisure, and improve the currency value. It can open opportunities for cultural interaction, although it can contribute to enhanced happiness and wellbeing for visitors. Although the performance of every tourism sector is decided primarily by tourism preparation, tourism growth, research, and tourism marketing. GIS technology provides a broad range of possibilities to create ecotourism-based maps. This integration of technology utilizing database-based operations, like query building and visualization of geographic analysis, advantages offered in the form of different types of maps. These maps suggest the best way to reach the destination in a minimum time (Figure: 7 to 12). The integration and implementation of GIS data through tourism data through the management process is a huge problem for the tourism industry. The use of technology-based on GIS has produced a successful outcome this emphasizes the significance of technological knowledge. The reality of geographic data in the real world come in many different formats.

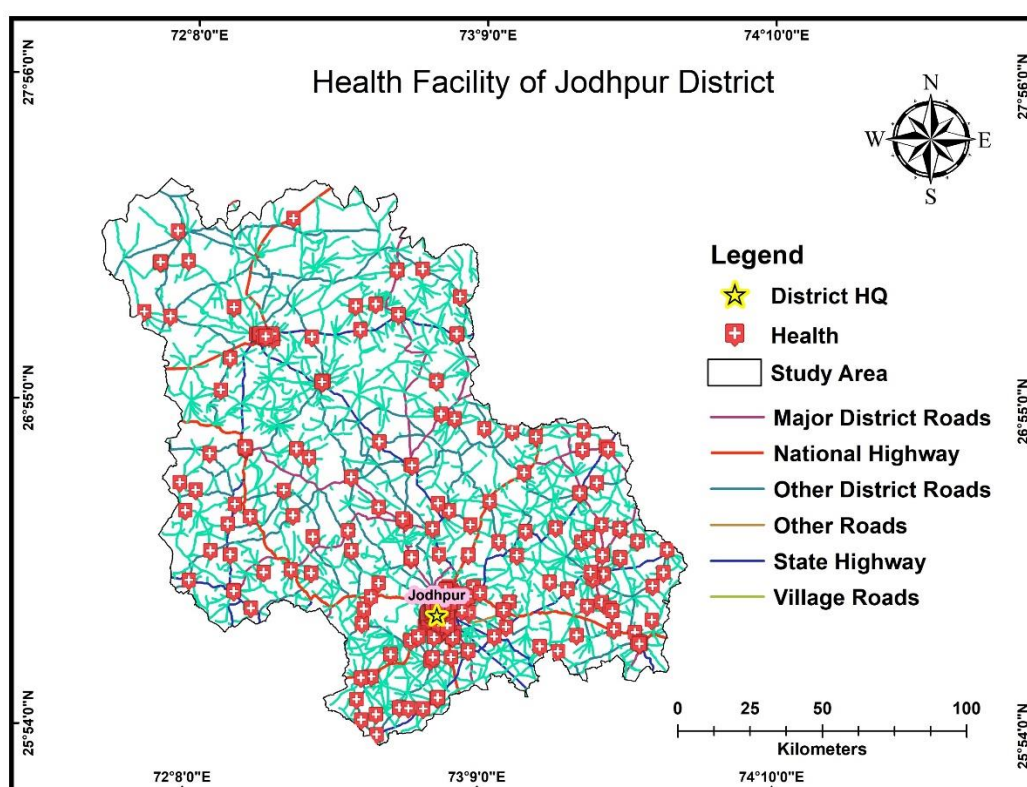


Fig. 7. Representing Health Facilities. (Source: Author<sup>1</sup>)

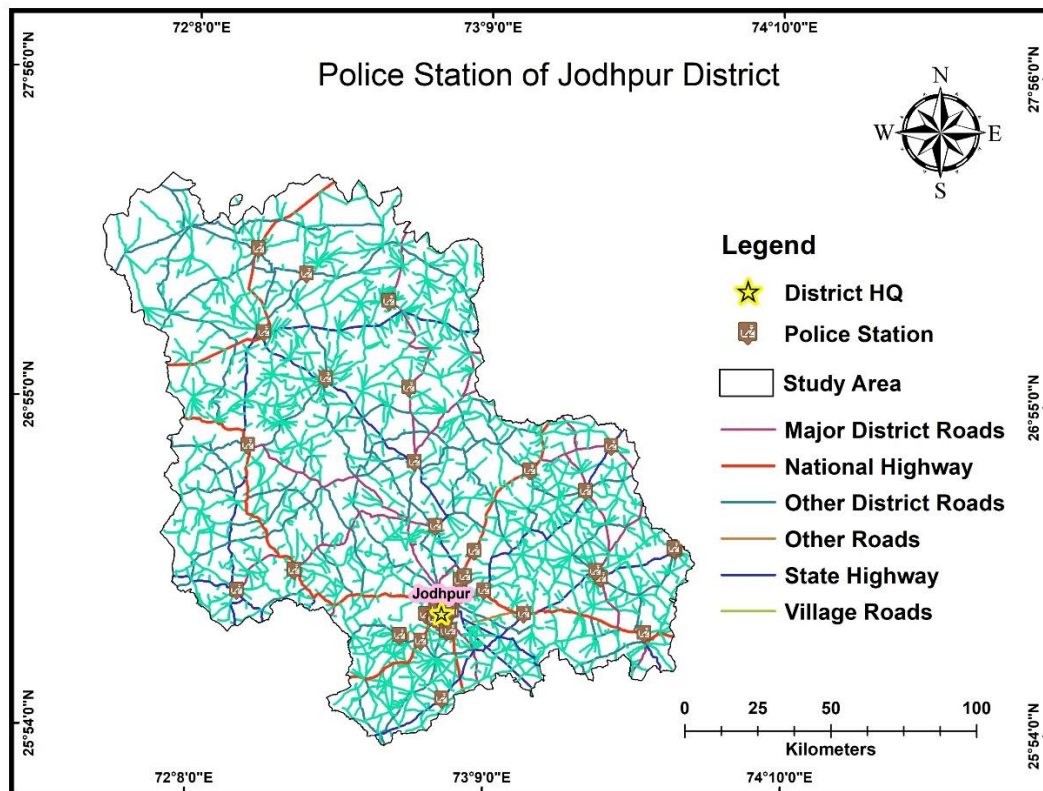


Fig. 8. Representing Police Station. (Source: Author<sup>1</sup>)

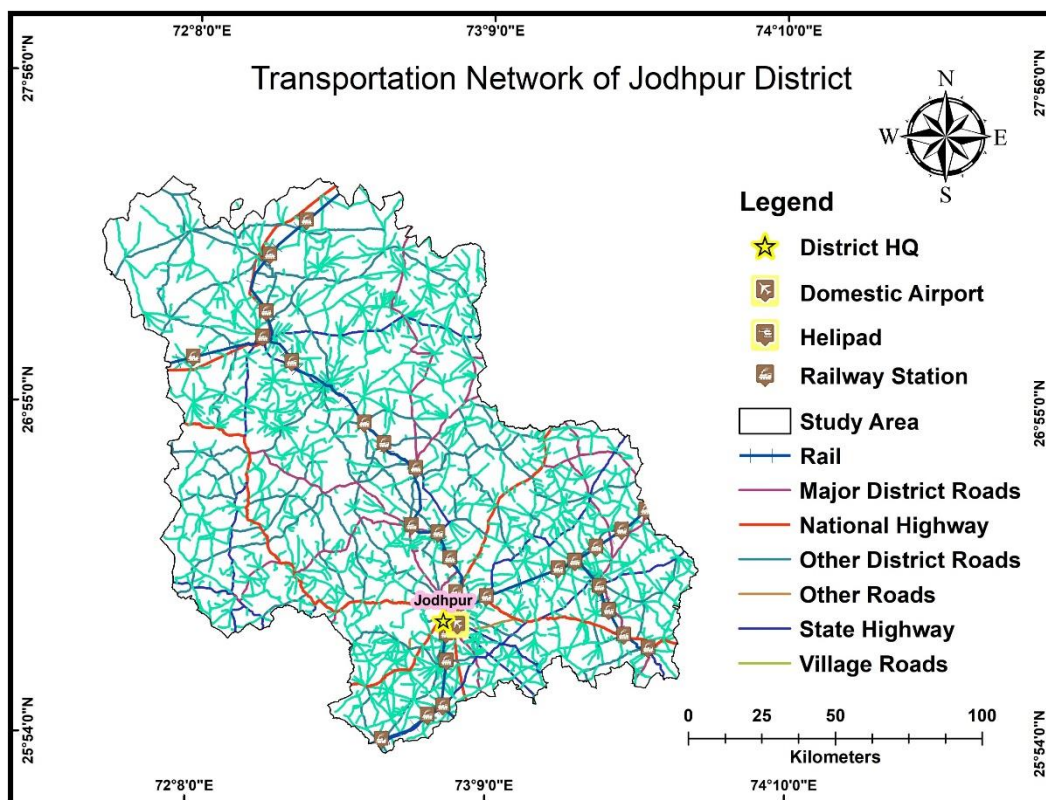


Fig. 9. Representing Transportation Network. (Source: Author<sup>1</sup>)

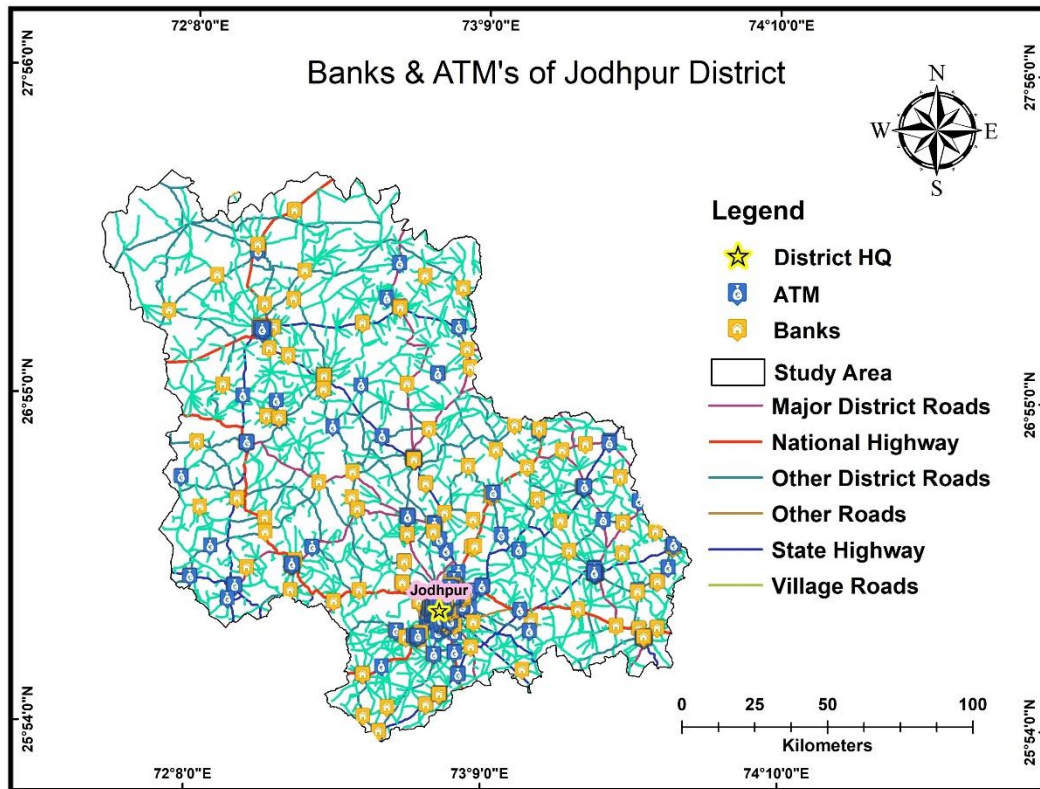


Fig. 10. Representing Bank and ATM's (Source: Author<sup>1</sup>)

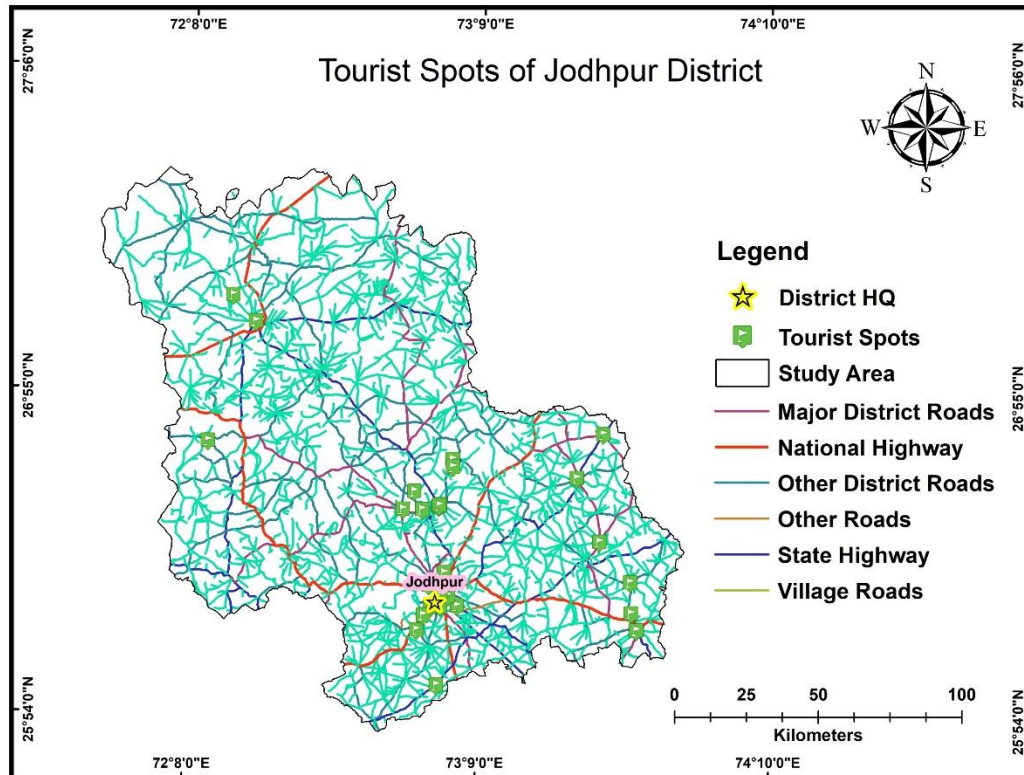


Fig. 11. Representing Tourist Spots (Source: Author<sup>1</sup>)

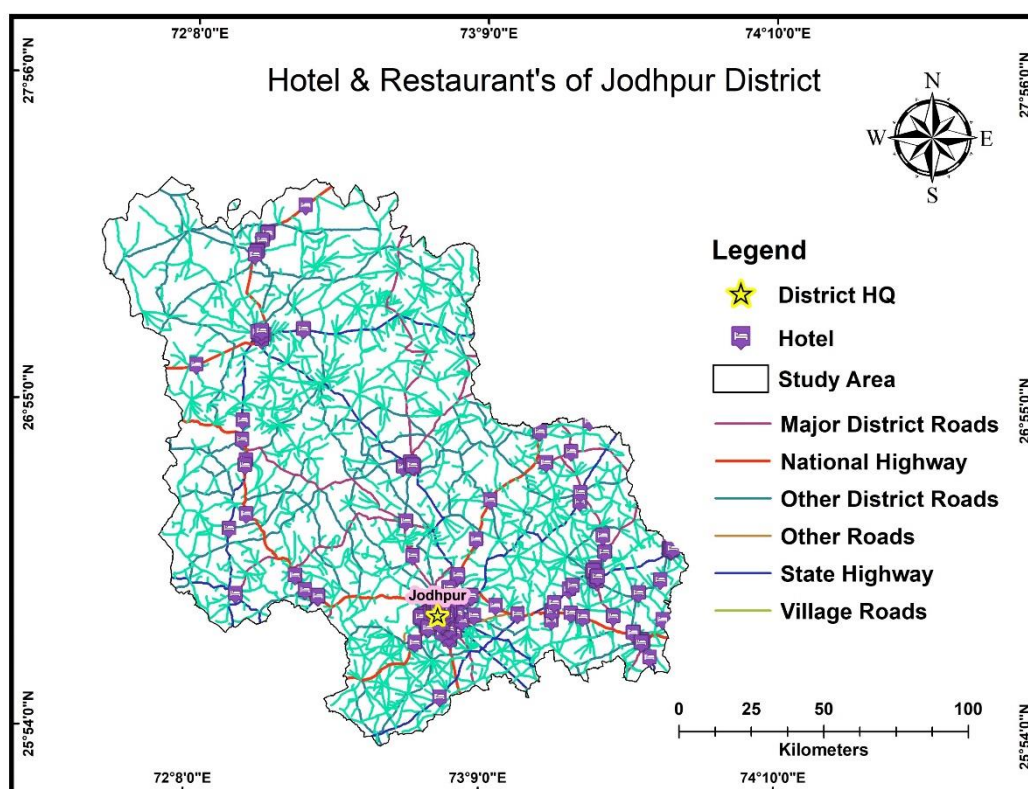


Fig. 12. Representing Hotel and Restaurants (Source: Author<sup>1</sup>)

## CONCLUSION

In this paper, management and GIS have taken as a tool for gathering, studying, modeling, and visualizing visitors' data on a vast scale, which ultimately helps in ecotourism planning. GIS is an effective and efficient tool for bringing the geo-referenced data to one place; it supports both forms of spatial and non-spatial data. The GIS-based management system is a quickly expanding sector. It allows the creation of a variety of applications that manage and govern geographic data, as well as the integration of various media types to produce accurate and knowledgeable output in a variety of formats. GIS can also be a very smart and valuable tool for querying and analyzing the different types of questions that pertain to tourism management and development, which mainly include current location, condition of the locality, changes, and trends, and patterns mainly associated with the various resource. GIS can be very powerful tool in providing information of different outputs to many sectors, primarily in the form of digital files for the purposes of mapping and analysis, digital forms of maps, digital files for mobile modelling and mapping, digital form of multimedia, etc. Based on this study, here are some suggestions that must be followed by the government, administrators, and different policymakers.

## SUGGESTIONS

1. Collaborative measures must be taken with other governments to enhance tourism-based activity on a wide scale.

2. Without proper planning and management, the large volume of tourists to vulnerable natural areas will endanger the habitats and local culture.
3. Tourist traffic in environmentally sensitive regions may result in severe environmental degradation.
4. Ecotourism growth is a societal need, therefore management and information exchange is required to respond to economic development.
5. It is critical for the holistic growth of ecotourism that the states combine their efforts and offer comprehensive services and solutions.
6. The states need to explore maximum tourism possibilities by initiating dialogue with key states and countries by creating roadmaps to implement different governmental strategies.

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#### CONFLICT OF INTEREST:

The author declares that there is no conflict of interest regarding the publication of this manuscript.

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