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APPLICATION OF GEOINFORMATICS IN ECOTOURISM DEVELOPMENT IN AND AROUND SUJJANGARH FORT OF SATARA DISTRICT (MAHARASHTRA)

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Abstract:-Ecotourism can be best defined as a nature based tourism that involves education, interpretation of the natural environment and is managed to be ecologically sustainable. The Sajjangarh fort is a famous hot spot in biodiversity of Western Ghats. Sajjangarh ,meaning Fort of Good People, is located near the city of Satara, India. It is the final resting place of Saint Ramdas, a saint and social reformer in 17th century India (born 1606). His teachings and works written in books such as Dasbodh are read and followed by many people even today in the state of Maharashtra and Sajjangarh is a popular place of pilgrimage.The Sajjangarh plays an important role in the economy of the Satara districtof Maharashtra because of its natural resources and tourism activities. The high level of brittleness of the Sajjangarh fort tourism is thus due to its inherent geomorphological, climatic and bio geological characteristics. GIS can be used in study region as ecotourism planning supporting tool for maintainable ecotourism, survivor flora and fauna, impact assessment, tourist flow management and greatest route path direction. GIS helps to deeply understand the meaning of spatial information in environment and how that information can more faithfully reflect the true nature of spatially distributed processes of tourism. Tabulate eco sensitive areas where tourism will have an impact on the social, cultural and natural environment. Ecotourism planning of current study using Landsat TM, ETM & MSS satellite imagery and prepared vector maps, GIS assist in this process. This research proposed for community development and involvement for local people as a part of hospitality services in ecotourism industries in this region because they can assist tourists according to their experience as guides in the hill and forest. Motivate use of suitable local practices, materials, art, craft, architecture, food. For ecosystem protection in this study proposed a 10 km buffer zone around the Sajjangarh fort. Finally, this study proposed an outline for ecotourism planning in the adjoining Sajjangarh fort where geoinformatics assist in the planning process and make strategy and efforts to ensure long-term sustenance of the environment.

Keywords: Ecotourism, Geoinformatics, Planning, Greatest route path, Development. etc.

1.INTRODUCTION:

Tourism sector which is one of the fastest growing economic sectors in the world is an environmentally sensitive industry whose growth and success depends on quality of existing social and physical environment. Tourism as a product is often dependent upon nature and therefore negative impact upon the latter should be minimized. As a service, it delivers a great socio-economic and cultural impact on small, isolated communities inhabiting an area.

Globally, the business volume of tourism equals or even surpasses that of oil exports, food products and automobiles .From year 1950 to 2005, worldwide tourism arrivals expanded at an annual rate of 6.5per cent, growing from 25 million to 806 million travelers (http://www.unwto.org/).The World Tourism Organization (WTO) has estimated that in year 1993, nature based tourism has generated, seven per cent of all international travel expenditure, where the total annual global earning from tourism was nearly $3 trillion and 212 million people were employed (Eagle, 1997).

Sajjangarhh fort is a popular place for pilgrims in Maharashtra. Although it is not a picnic spot, but is in fact an important destination for tourist who visit here because of its spiritual and historical importance. From tourism point of view, it has lot more to offer to a tourist within ten kilometers of its radius. The present study envisages that the place has the potential to come under an ecotourism circuit with its proximity to Satara district, picturesque locations in the vicinity and places of cultural interest.

Remote Sensing and Geographical Information System (GIS) technology can be used to develop spatial database to support ecotourism planning and management for any location that has the potential to get developed as ecotourism spot. Use of appropriate technology could ascertain identifying and locating suitable sites for infrastructure development, facilities, conservation areas, best routes for tourists etc.

2. SCOPE AND OBJECTIVES OF THE STUDY

The present study discusses the application of Remote Sensing and GIS for displaying, documenting, and analyzing of tourism information for the efficient management and promotion of the tourism in Sajjangarh fort and adjoining areas. Generation of spatial database and its analysis was performed with following objectives:

1.To plan route and service area facility (Network Analysis in GIS) for ecotourism.
2.To suggest infrastructure development by analyzing topography for ecotourism promotion.
3.To generate land use / land cover map of the study area and to suggest its utility in ecotourism planning.
4.To develop Web based interface about Ecotourism potential of study area.

3. STUDY AREA

The present study covers ten km buffer area in and around Sajjangarh fort in Satara district. The region located north-west of district headquarter, covers an area of two hundred and thirteen sq km and geographically extends between 17°33'15" to 17°44'10" N latitude and 73°48'46" to 73°49'00"E Longitude respectively. The fort is well connected to national highway number four (Mumbai-Bangalore highway) and is a popular pilgrim destination for tourists. In general, the area is underdeveloped due to poor agricultural economy and industrial base. The district has distinct landscape with high hilly area in the west river basins (Present study area) and small plateaus in the east. The study region can be classified on the basis of the river basin as follows: a. Urmodi basin b. Krishna-Koyana basin

4. RESRARCH METHODOLOGY

4.1.DATA USED

1.Satellite data: Google Imagery.
2.Survey of India (SOI) Toposheet at scale 1:50,000 (No. 47 G/14, 47 K/2).

4.2.GENERATING BASE LAYERS

Once the dataset (i.e. Google image and toposheet) is brought to a common projection system, the next step was to generate a digital database layers like contour, road, water bodies, settlement, Villages, Fort, Hotel, Hospital, ATM, Windmills, and LULC Layer etc. so as to take into the account real time condition.

4.3.VISUAL INTERPRETATION AND FEATURE CODING OF IMAGE

Interpretation of geographic features was carried out on the image in Arc GIS software to extract existing Land Use Land Cover classes in polyline mode. Once feature extraction was completed, topology operation were performed to remove topological errors like undershoot, overshoots. Now, feature coding was done for each polygon based on visual interpretation and ground based knowledge. Finally a Land Use Land Cover map was generated for the whole area. Area for each class was calculated running a pre-defined visual basic script in Arc GIS.

4.4.ROUTE PLANNING FOR ECOTOURISM

Roads are most viable mode of transportation. They provide approach and connectivity between any two locations. In Ecotourism sector, it is important that basic infrastructure like quality of roads, hotels, recreational area, hospitals, eateries and basic amenities must be good, so that visitors will be able to enjoy their visit.

Although the present study area is quite underdeveloped, in respect of quality aspects discussed above, still the area has the capacity to offer modest facilities to tourist. Tourism will flourish in the area, if ecotourist are made aware of best route that is shortest, cost effective, time saving and is well connected with all important tourist locations. However, distance, cost and time altogether act as hindrance (impedance) and it is practically not possible to balance their collective impact about reaching a destination. The best route is the one that is subjected to lowest hindrance in terms of any of the above.

Using ArcGIS network analyst option, the impedance could be addressed by the tourists themselves depending upon

their preference about the journey. For instance, Fig. 1 shows the preference of tourist and the impedance factor.

From tourist point of view, following queries were addressed under network analysis as:

1. What is the best route for tourists from Satara city to reach Sajjangarhh fort?
2. Which is an ideal starting point for the tourist group to cover all locations; Sajjangarhh fort or Satara city?
3. Service area of existing hospitals within specified impedance i.e. the area that can be reached within the specified time from the hospital.

THE SUJJANGARH FORT

THE PREFERENCE OF TOURIST AND THE IMPEDANCE FACTOR

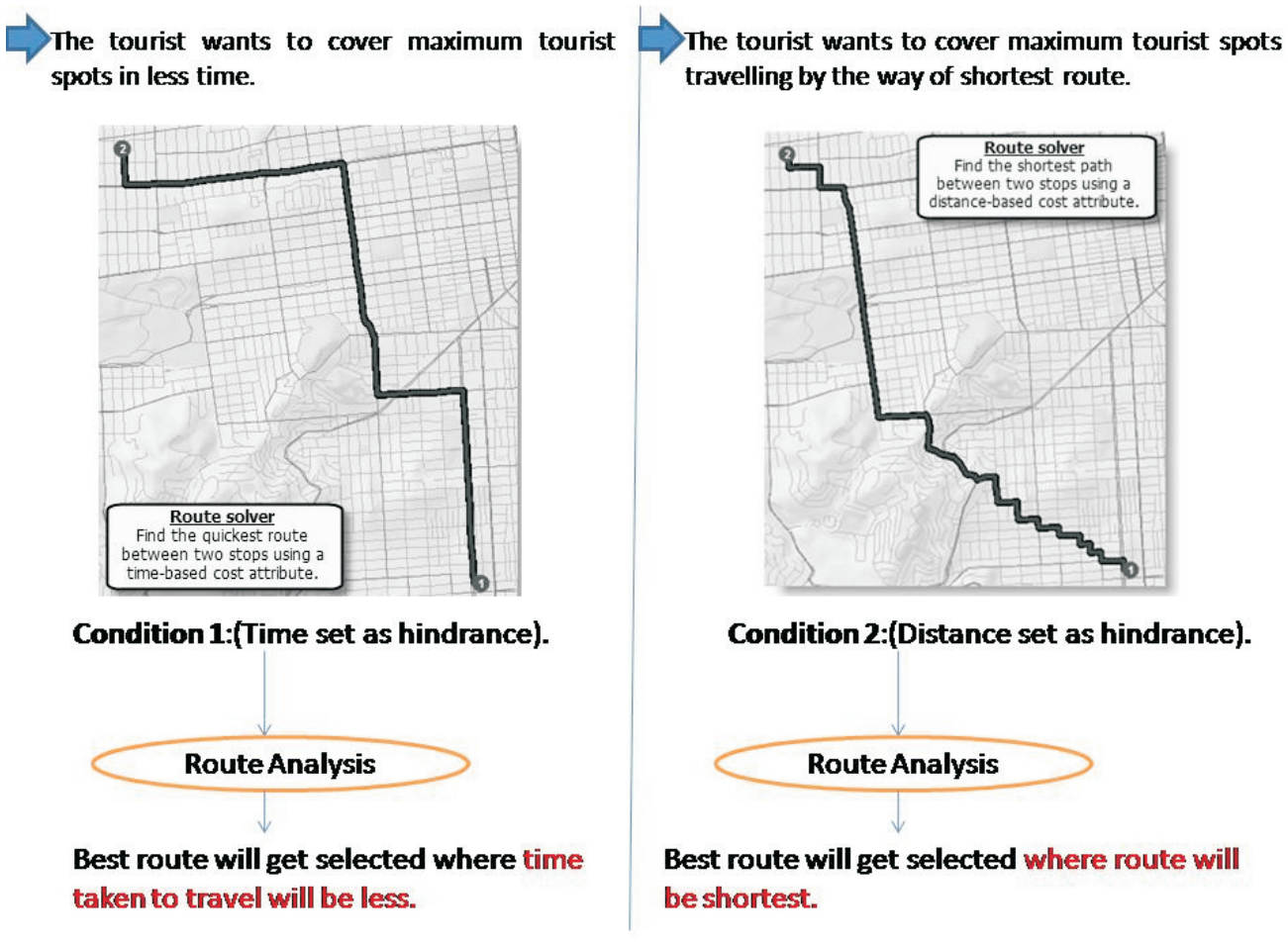

Fig.1

5. RESULTS AND DISCUSSION

5.1 LAND USE LAND COVER MAP OF STUDY AREA

Using visual image interpretation method, in total twelve Land Use Land Cover classes, were identified for the study area. Fig.2 shows, Land Use Land Cover map generated for the study area. Area statistics were also calculated as shown in Table 1 It was found that, maximum area was covered by the agricultural land that constitutes 17821 Area (In Hectare) whereas, the minimum area was found to be of plantation class with total area covering Area (In Hectare).

5 .ROUTE PLANNING FOR ECOTOURISM

What is the best route for tourists from district headquarter to reach Sajjangarhh fort?

Finding the best route to reach a destination is always a preference in human life. Such route saves time, cost and is convenient to the traveler. In the present situation, to fulfill this condition, under network analyst (best route) option, in ArcGIS 10.1, distance was set as impedance so that the route planner will give the shortest route (i.e. least distance will be required to travel).

LAND USE LAND COVER MAP OF STUDY AREA

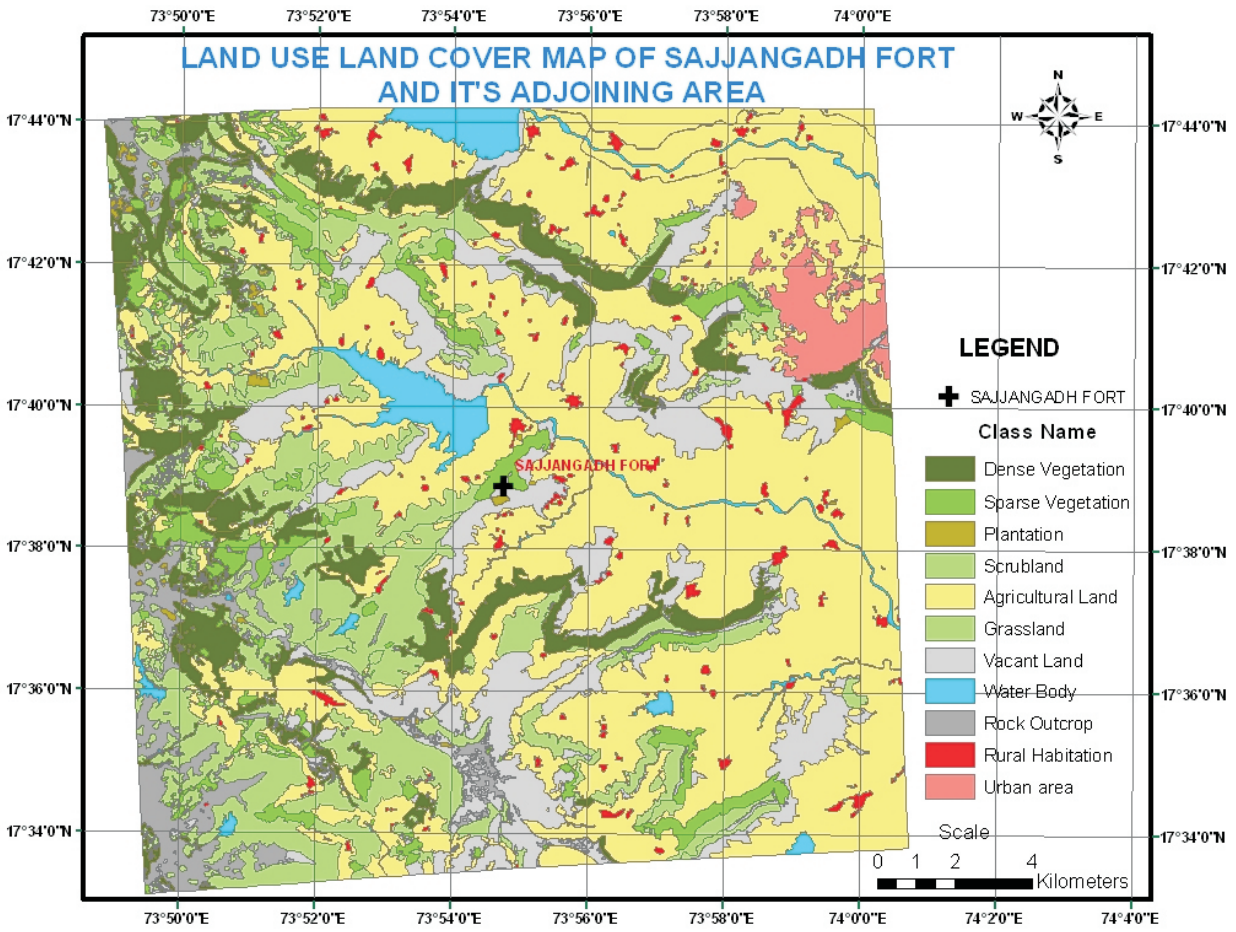

Fig. 2

It was found that the route originating from Satara city is the best route to reach the fort. The total covered distance calculated under this route is sixteen kilometers and the total time to reach the place is twenty eight minutes at a constant speed of thirty five kilometer per hour. The constant value of speed is based on average speed achieved by vehicles travelling in the area, since majority of the area is undulating. Fig.3 shows the best ecotourism route from Satara to Sajjangarh fort.

Table .1
Area statistics of Land Use Land Cover classes

Code	Class Name	Area (In Hectare)
1	Dense Vegetation	3703
2	Sparse Vegetation	1931
3	Plantation	133
4	Scrub Land	2766
5	Agricultural Land	17821
6	Grass Land	4381
7	Vacant Land	4816
8	Water Body	1177
9	Rock Outcrop	1317
10	Rural Habitation	557
11	Urban Area	712
	Total	39314

Although, it is not an unknown fact for the people regularly visiting the area, since there is only one route that well connects the fort area to the district headquarter. However, the same is justified here with the help of GIS. Table 2 shows junction wise route (with time taken and distance travelled) from Satara to Sajjangarh fort.

Another query addressed under route planning was to derive the most efficient route, to cover all major tourist destinations for ecotourist. Satara city and Sajjangarh fort was considered as two different origins/starting point to begin the journey. For each starting point distance was kept as impedance, so as to find out which route will cover least distance to cover all destinations. A similar approach (as applied in the selection of best route to reach Sajjangarhh fort) was followed for the analysis. Later on, both the routes were compared based on the total distance travelled and the time taken for each. Fig. 4 and Fig. 5 shows Sajjangarh fort and Satara city, as starting point considered for ecotourism route. It was found that considering Sajjangarh fort as starting point for the route, the total time taken by the tourist to cover all major destinations comes to two hours thirteen minutes as compared to the time taken i.e. two hours thirty two minutes, while keeping Satara city as starting point .Similarly, the distance travelled for these routes were calculated (seventy seven and half kilometers in case of Sajjangarh fort and Eighty eight and half kilometers in case of Satara city).

Best Ecotourism Route from Satara City to Sajjangarh Fort

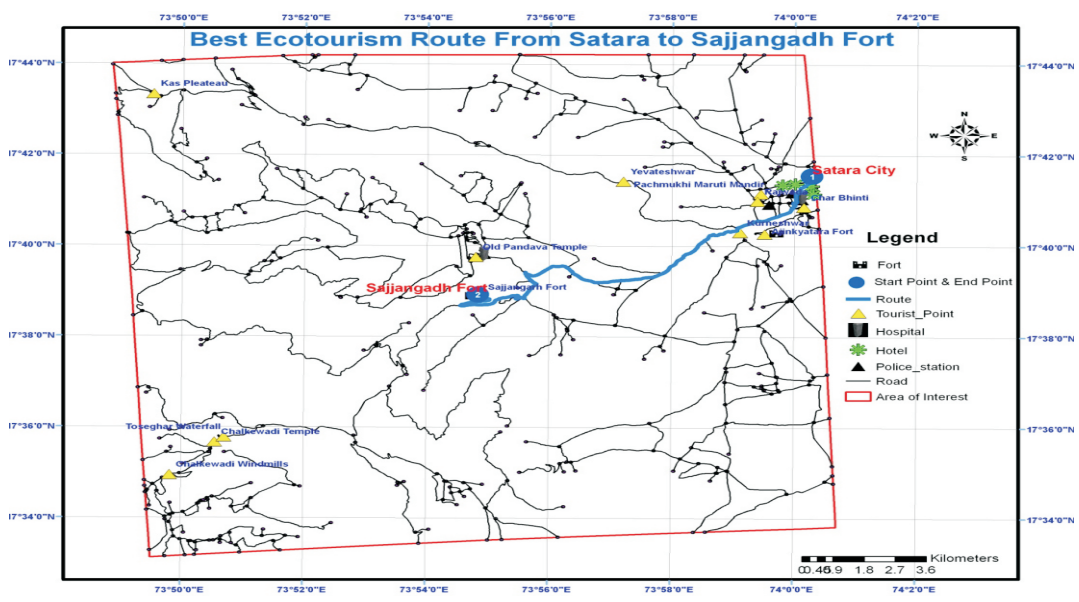

Fig. 3

Which is an ideal starting point (most efficient route) for the tourists to cover all locations; Sajjangarh fort or Satara city?

Table 2
Junction Wise Route (With Time Taken and Distance Travelled) from Satara to Sajjangarhh Fort.

−]	Route: Graphic Pick 1 - Graphic Pick 2	16.2 km	28 min	
	1: Start at Graphic Pick 1			Map
	2: Go east	3.3 km	6 min	Map
	3: Turn left	1.8 km	3 min	Map
	4: Make sharp right	7.5 km	13 min	Map
	5: Make sharp left	2.1 km	4 min	Map
	6: Turn left	0.1 km	< 1 min	Map
	7: Turn right	< 0.1 km	< 1 min	Map
	8: Turn left	0.4 km	< 1 min	Map
	9: Turn right	0.7 km	1 min	Map
	10: Turn left	0.2 km	< 1 min	Map
	11: Finish at Graphic Pick 2, on the left			Map
	Total time: 28 min Total distance: 16.2 km			

CASE I: STARTING POINT SAJJANGARH FORT

Ecotourism Route Considering Sajjangarhh Fort As Starting Point.

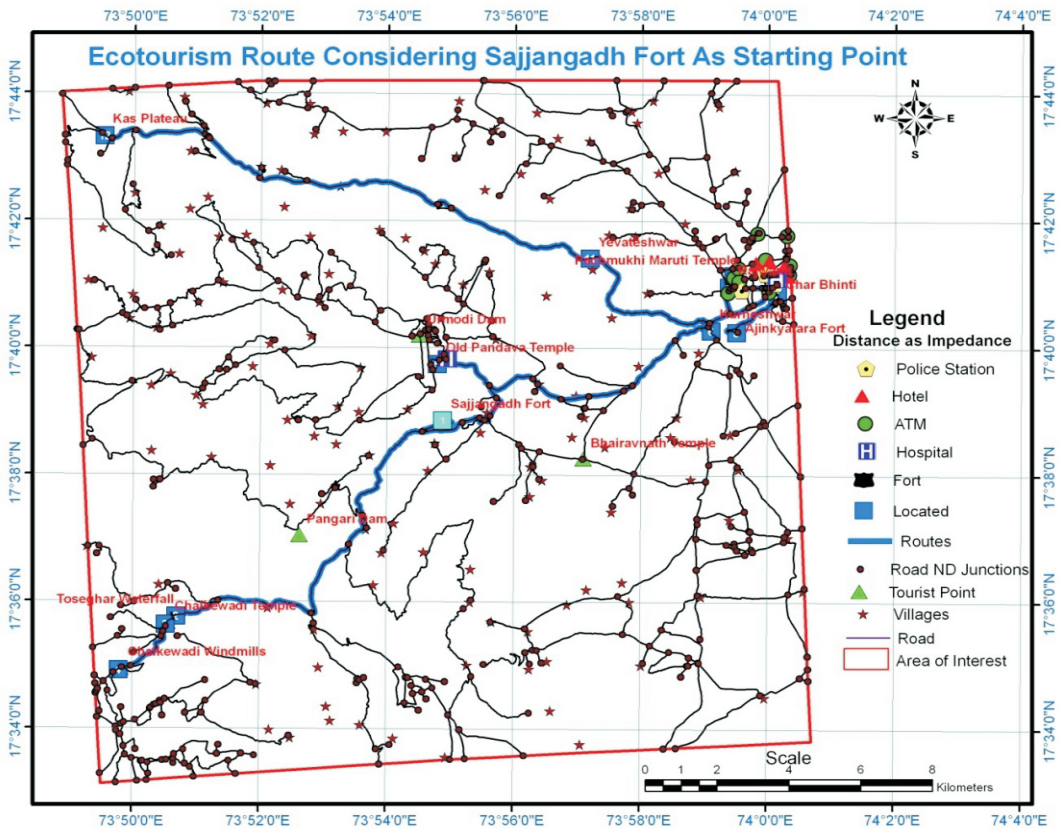

Fig.4

CASE II: STARTING POINT SATARA CITY

Ecotourism Route Considering Satara City As Starting Point.

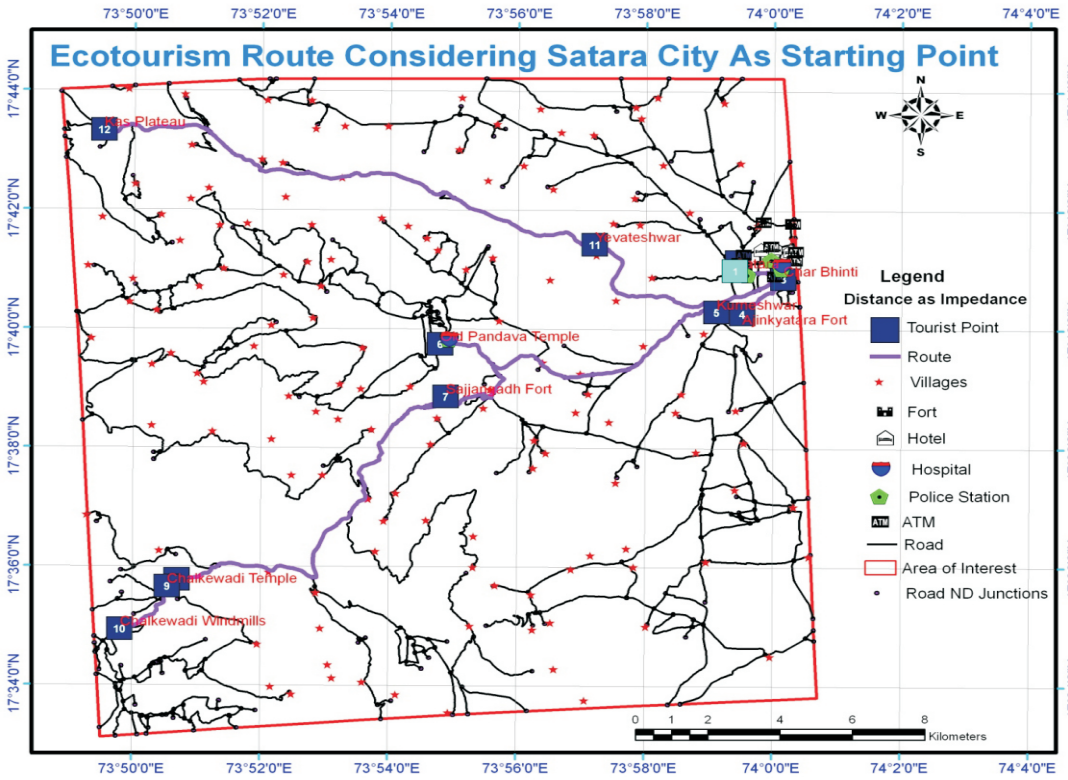

Fig. 5

SERVICE AREA OF EXISTING HOSPITALS WITHIN SPECIFIED IMPEDANCE

Availability of necessary facilities is a matter of concern for a potential ecotourism destination. Mishaps like road accidents, landslides are common phenomenon in hilly regions. So, prior information regarding outreach of facility like Medical aid at the time of emergency has to be derived and made available for tourists visiting an area. In addition to this, the outreach depends on the availability of road network in the area. Where there are no proper modes of transportation, it may cause delay in the service that will prove fatal to the injured.

In the study area, two government hospitals are located one at Parali village, near Sajjangarhh fort and another in Satara city. However, considering the undulating topography and the varying amount of time required for medical aid to reach in every nook and corner of the region, it was important to calculate the outreach of these hospitals, setting time as impedance. For each of the hospital, time impedance value was set at different range i.e. 10 minutes, 20 minutes, 30 minutes, 40 minutes and 50 minutes respectively.Here, the speed of the vehicle was kept constant (i.e. thirty five kilometers per hour) considering the average speed of vehicles in the area. Buffers (i.e. the area covered by hospital for each time value) were generated for showing facility area for both hospitals as shown in Fig. 6.

Service Area of Existing Hospitals Within Specified Impedance

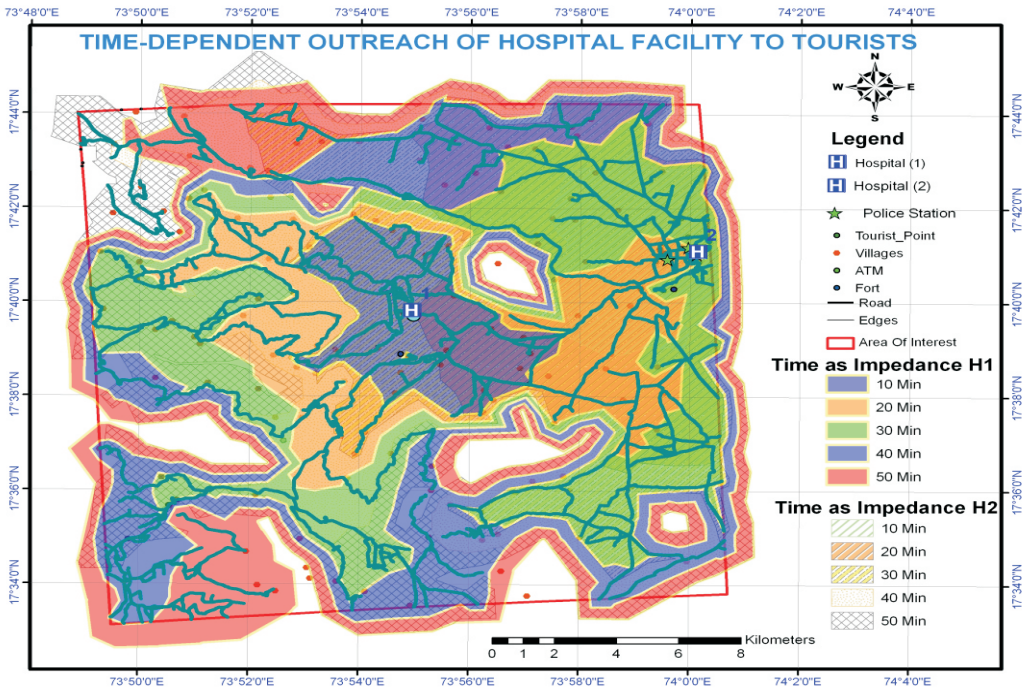

Fig.6

6. CONCLUSION AND SUGGESTIONS

6.1 LAND USE / LAND COVE MAPPING

By identifying areas that are economically valuable rather than simply ecologically important, alternative uses for these areas can be developed, and protection of these resources may be able to benefit nearby communities or residents. Though tourism is not necessarily the best or only option for protecting these resources, it is definitely an option.

Table 3
Suggests Class-Wise Land Use Land Cover Suitability For Ecotourism Purpose.

Sr. No.	LANDUSE CLASS	Area (per cent)	Area (In Hectare)	LANDUSE SUITABILITY
1	Dense Vegetation	9.42	3703	Highly important for ecotourism, can serve as main ecotourism attraction, area need to be conserved.
2	Sparse Vegetation	4.91	1931	Need to be managed, properly with possibilities of new plantations. Important from point of view of medicinal plantations and agro-forestry scheme
3	Plantation	0.34	133	Plantation areas should be properly monitored and protected form and any encroachment.
4	Scrub Land	7.03	2766	Need to be managed, properly with possibilities of new plantations. Important from point of view of medicinal plantations and agro-forestry scheme
5	Agricultural Land	45.33	17821	It can be used fore agro-forestry scheme, land reclamation, for agricultural use.

6	Grass Land	11.14	4381	Not suitable but can be reclaimed and used for building tourism infrastructure.
7	Vacant Land	12.25	4816	Very important for ecotourism, area needs to be managed and conserved properly to attract ecotourism as well as general tourist.
8	Water Body	2.99	1177	Active Recreation as boating, park and natural zoological park.
9	Rock Outcrop	3.33	1308	Not suitable.
10	Rural Habitation	1.42	557	Suitable for ecotourism Infrastructure development.
11	Urban Area	1.81	712	Suitable for ecotourism Infrastructure development.
	Total	100	39314	Area planning for Ecotourism

Table No.3 Land Use/Land Cover Statistics and Utility

6.2 ROUTE PLANNING FOR ECOTOURISM

1.Tourist or Visitors will get best route to reach Sajjangarh fort.
2.They will also be able travel through the most efficient path to cover all tourist points and it will be more comfortable for their Journey.
3.The service area covered by Parali village hospital within the specified time factor was found more convenient to the tourist as compared to hospital located in Satara city.

6.3 GENRATING RELIEF MAPS

1.From the slope map generated, it was concluded that the slope in the study area ranges from gentle to steep slope. Hence, the area provides a blend of topographic variations which mesmerizes the visitor through scenic locations like forests, valleys, waterfall, wildlife spotting etc.
2.Using Digital elevation model, tourist can easily spot destinations in three dimensional views.

6.4 SITE SELECTION ANALYSIS FOR INFRASTRUCTURE DEVELOPMENT

Topography	Specific use
Slope	For infrastructure development slope below 25 percent was found suitable.
Aspect	For construction suitable aspect was found to be NE to SE facing (45^0 to 135^0).
Housing Suitability	2365.39 Hectare area was found good for infrastructure.

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