Applications of GIS in Tourism Planning

Term Paper

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For
CRP 514: Introduction to GIS
Term 121

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Date: Dec. 29, 2012

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ABSTRACT

Geographic Information System (GIS) is one of the most amazing technologic advances in the planning of tourism. Both tourism and GIS share in common characteristics like crossing the application areas and the boundaries of disciplines. The tourism field uses GIS as a decision supporting tool in many tourism issues such as visitors flow management, tourism site selection, impact evaluation and sustainable tourism plans. Most studies indicated that the GIS tool is a strong and effective in tourism and recreation planning which can aid in the development of tourism industry effectively. Furthermore, GIS technology plays a significant role in the assessment of the impact of tourism activities, checking environmental conditions, and examining the suitability of locations for proposed development sites. Thus, the potential for GIS applications in tourism is significantly important. The tourism has a great impact in the economic growth in the most developing countries. The success of tourism in any country depends on the ability of that country to develop, manage and market the tourism facilities and activities sufficiently. The main objective of this term paper is to explore the potential of using GIS applications in tourism planning. This research will be supported by a comprehensive case study conducted in a well-known region for tourism in Sundarbans Bangladesh. The results of the case study show that the use of GIS in ecotourism planning improves the tourism field significantly.

1. INTRODUCTION

One of the world's largest and most rapidly expanding industries is the tourism which contributes with over ten per cent of the global *Gross domestic product* (*GDP*) and generates employments for 200 million people, according to annual research by the World Travel & Tourism Council (WTTC), Ake (2001). Technology plays a very important role in tourism and it is a crucial to the expansion of this industry.

Tourism and Information technology are two of the most active motivators of the global economy growth. Both IT and tourism increasingly offer powerful tools and strategic opportunities for economic growth, redistribution of money and development of equity around the globe. With the marvelous expansion of the Web, a wide range of tourism information is already spread over a variety of Web sites. To fulfill the tourists request for a widespread data collection it is inevitable to construct accumulated data from different accessible sources. In addition to this, tourists are also suffered from the differences regarding information presented on various web sites. Using maps (GIS) is a wonderful and easy solution for these problems which presents information in an easy and effective way. Maps are usual means of indexing and presenting tourism related information. Maps are used by the travelers for navigating routes during their travels. Moreover, maps exploit the two dimensional capabilities of human vision and present the information in a compact and "easy to read" way. As a result, GIS technology offers great opportunities for the development of modern tourism applications using maps[1].

The major importance of this research is to show the great impacts of using GIS in tourism planning. This paper will discuss the major concepts of GIS and tourism with the methodology of creating the database and attributes of tourism facilities. Then will look at a case study where it will talk about how to plan the Sundarbans regions in Bangladesh by using GIS technology for the future development of ecotourism. The advantages of using GIS as well as some limitations will be discussed in this paper. Finally, this paper will conclude with the future uses and challenges of GIS in tourism planning field.

1.1. Basic concept of GIS

GIS is a computer-based technology for analyzing and mapping characteristic measures on the earth. There are common database operations integrated in GIS technology, such as statistical analysis and query. In this tool the location-based information are managed and the analysis of various statistics of that information are displayed, including economic growth opportunities, population characteristics, and vegetation kinds. The maps and database are linked by GIS to generate dynamic displays. Furthermore, the visualization, query, and overlay of databases are provided by GIS in ways that are not possible with traditional spreadsheet. These features differentiate GIS technology from other information systems as well as they make it valuable to wide ranges of private and public projects for planning strategies, explaining events and predicting outcomes[7].
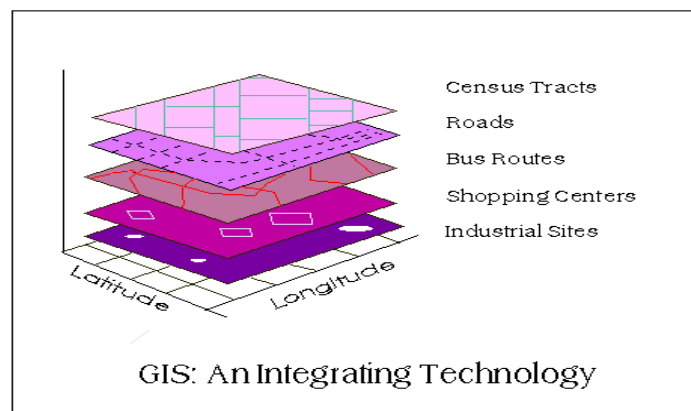
Figure 1. An integrated GIS

1.2. Basic concept of Tourism

"Tourism is a composite of activities, facilities, services and industries that deliver a travel experience, that is, transportation, accommodation, eating and drinking establishments, entertainment, recreation, historical and cultural experiences, destination attractions, shopping and other services available to travelers away from home." (Tourism and Leisure Committee, 1997).

Ghosh (1998) defined the significance of tourism as one of the major items of international trade. This business aids in facilitating the flow of foreign money amongst countries. Medlik et al. (1991) said that in developing countries the tourism is mainly seen as an expansion business as the

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flow of tourists in these countries shares out foreign currency. For example, tourism in Zimbabwe is one of the strongest industries which have a great effect on the economy because it contributes in developing of other fields. According to statistics that are conducted by SADC (1999), tourism in Zimbabwe makes about five percent to the Gross Domestic Product (GDP). The tourism sector employs about eighty thousand people directly and indirectly. This sector generated two billion Zimbabwe dollars in 1996/1997 for the country. Developing countries take almost 30 per cent of globe tourism receipts [7]. This makes it the third highest earner of foreign currency, after mining and agriculture industries.

2. LITERATURE REVIEW

This section provides a description of the literature. The application of GIS in tourism research has been discussed over decades (Gunn and Larsen, 1988). The GIS technology has been used in several tourism aspects such as suitable location identification, facility monitoring, recreation and park management, ecotourism planning, visual resource assessment and management. The recent researches have begun using GIS in applications relating to tourism marketing [3].

Culbertson et al. (1994) illustrated the use of GIS in tourism planning in the case of Banff, Canada and Colorado, USA. Culbertson et al. (1994) explained the great impacts for using GIS technology in planning for sustainable development and environmental analysis. Berry(1991) provided an early illustration of the effectiveness of this kind of map analysis in the US Virgin Islands' (Bahaire & Elliot-White, 1999, p. 163) [3].

The most important use of GIS in tourism planning is the tourism place selection. For example, it is easy to recognize possible areas for more tourism expansion by utilizing appropriate place identification topology and tools. These tools are also used to identify visitor management, facility monitoring and recreation areas, and so on. Butler and Boyd (1996) explained how GIS was used to recognize sites fitting for tourism in Northern Ontario. GIS was used to trace and investigate tourism resource inventory information in British Columbia bay Williams et al. (1996).

A brief explanation of a variety of using GIS applications in tourism planning in the United Kingdom has been provided by Bahaire and Elliott-White (1999). These applications have been used for data management and integration (for instance data on tourism destinations and

accommodations), tourism fitness analysis, description of tourist areas in terms of use levels, scene resource inventory, and pre- and post-tourism visual impact analysis [5].

Practical opportunities for using GIS in tourism planning such as tourists flow management, facilities list and resources use and assessing impacts of tourism development were mentioned by Farsari and Prastacos, (2004). GIS can be used to display tourism impacts on various industrial sectors in a spatial format and time-series (Chen, 2006).

3. GIS in tourism planning

The applications of GIS in tourism determine the perfect future tourism areas which involve a complex set of criteria. Although the development of tourism is a geographical action with serious implications for target areas, some researchers have implemented GIS in tourism planning and management activities. Farsari and Prastacos, (2004) proposed a set of opportunities for GIS applications in tourism planning which are as follows:

3.1. Tourists flow management

This includes the use of GIS for identifying the main places for tourism activities within a destination and the flows among destinations. Countries may apply strategic plans for better infrastructure such as constructing public transportation systems and linking various tourist activity sites.

3.2. Resource use and facilities inventory

This involves the use of GIS in association with the subject of environmental fairness that is the fact that tourism may not benefit all sectors of society uniformly. Furthermore, it includes the developing resources inventory in order to recognize conflicting but also it balances land use activities, natural resources, and available infrastructure.

3.3. Evaluating impacts of tourism development

GIS is used to show the impacts of tourism on different business sectors in a spatial format and time-series (Chen, 2006). In this regard, the analysts can use all or several of the previous categories by employing the ''what-if'' tool of GIS. This tool allows the development of scenarios for predicting the effects of a change in a certain variable(s) the destinations [3].

3.4. Tourism marketing

The shopping in the tourism is a crucial activity in over the entire world. The Travel Industry Association of America (2004), stated that in the year 2004 there were about 63% of tourists took a shopping tour throughout their journey, and the average of their spending was almost 333$. In recent years the tourists have become the backbone for the growth of economy and increase the number of malls in everywhere. For example, the Malls Corporation of Chicago and General Growth Properties stated that the tourists constituting nearly 31% and 25% of their mall visitors respectively (Gentry, 2001).As a result, it is very important for the shopping mall business to develop several techniques to attract the tourism customers to their malls for a first shopping in addition to develop strategies to encourage repeating the visits to their malls. The GIS can be used to guide the tourists to the nearest mall in their journey easily. These are the most important categorizations that demonstrate the use of GIS in tourism planning [6].

4. IMPLEMENTATION OF GIS

4.1. Creation of Spatial Database

The industry of tourism is rapidly becoming the leading of economic in the most developing countries. Many governments pay a lot of money to develop and expand this sector to be a major source for the development of economy in their countries. Furthermore, those governments tray to make their tourism places fully marketed and explored. One of the most important procedure is to develop spatial database for their tourism sites as follows:

❖ Building graphical maps that cover the target region.

❖ Digitizing the paper maps by converting them into digital maps.

❖ Constructing the topology to make relationships between the features of maps.

❖ Conversion into real world coordinates.

In order to build tourist maps there are many objects that must be integrated such as textual information, images, and vector graphic shapes. Each of these objects is represented as a thematic layer. Each layer combines associated items like building, roads, or watercourses. To incorporate tourism data the traditional layers model like buildings, roads and watercourses vegetation, must be widened with additional tourism layers like sights, restaurants, hotels, and further infrastructure layers. (Fig.2) clarifies this idea [1].
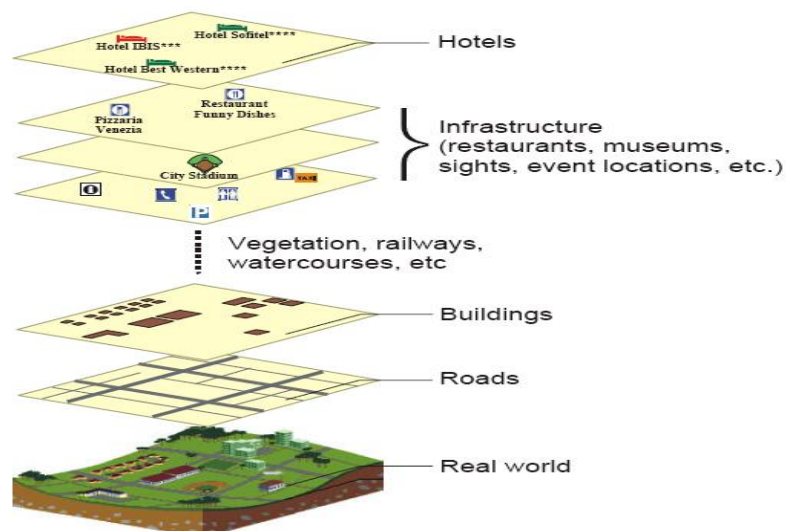

Figure 2: Extended Layer Model

4.2.   Attribute data creation

Attribute data of different tourism facilities are associated to their relevant spatial features.

This association can be done as follows:

- ❖ Addition and compilation of text information to feature locations in tables
- ❖ Editing and developing images and pictures to text labels
- ❖ Linking of images and pictures to their own characteristic locations
- ❖ Audio guidance on some chosen features that are recorded in digital form was also connected to their own attribute locations.

The link to the feature map displays the image associated with that feature as well as the audio that describes a certain feature. The audio description may include some explanations such as available facilities, brief history of that feature, and what the experience that the tourists expected to gain from their visit [1].

4.3.   Application scenarios

The GIS application is used by tourists to search and query for certain tourism facilities. It provide an easy way to combine touristic attributes such as object type(restaurant, hotel, event location, etc),object name and category of hotels, with geographic criterion like the closeness, location or distance. The integration of tourism information like facility type, name and category in one home page would be the simple way for the tourists to query for further details provided by GIS data to build the complete tourist maps. The query for hotels can be more obvious by extending the maps with more detailed information of rooms (e.g., the color of the hotel icon highlights its availability). There are many easy features that guarantee a sensible use for users like zoom in/out of the map to change the desired scale, scroll on the map as well as printing it. When the map is requested to the tourist, just the queried layers are set to be observable (Fig.2) to present the tourist with good impression of where facilities are, which things can be nearby, how they can be reached. Scalable Vector Graphics (SVG) supports many options to turn layers on/off to generate the desired presentation for the user. All layers can be joint to achieve the goal of the user without any restrictions (figure.3) illustrate the application scenario [1].
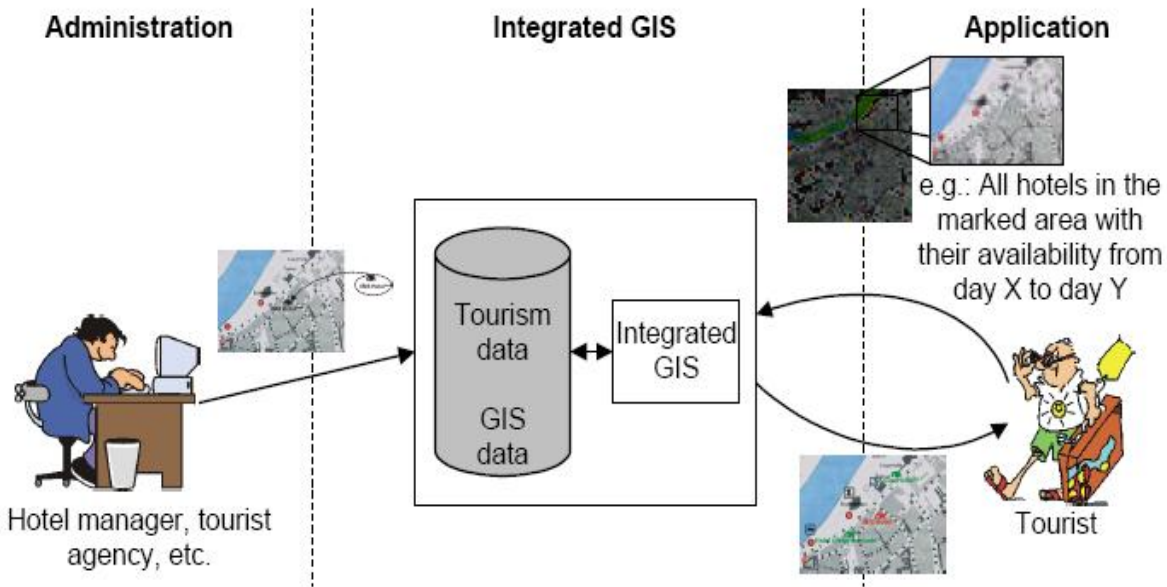
Figure 3: Integrated GIS system

5. CASE STUDY

Azizur Rahman, (2010) has conducted a case study on application of GIS in ecotourism development in sundarbans, which is the largest mangrove forest region of the world, located in the southern part of Bangladesh. Due to its natural resources and tourism activities, this region plays a significant role for the national economy of Bangladesh. Also of its unplanned development in tourism activities, this forest has been facing some problems. The result of unplanned development is biodiversity losses, land use change, decreasing upstream flows and increasing deforestation. Thus, GIS is used as a decision supporting tool in this study for ecotourism planning and development [. The main objective of the study is to explore the potential of using GIS and Remote Sensing for planning resources relevant to ecotourism development in Sundarbans Bangladesh. The study was guided by the following specific objectives: describe the use of GIS & RS in ecotourism planning; Identify land use change over the last 33 years using satellite data, (Landsat Thematic Mapper (TM) & Enhanced Thematic Mapper (ETM) since (1977-2010); Plan Sundarbans by using GIS technique to protect biodiversity and ecotourism development.

5.1. Study area description

Sundarbans 21º30´N and 22º30´N latitudes, and 89º00´E and 89º55´E longitudes, located in the southern part of Bangladesh along the cost as shown in Figure 4. It has an area of about 139,500 .The main feature of this region that it was designated as a world heritage site in 1997 by the UNESCO. The biodiversity is obvious in this region such as the mangrove which is very famous due to its wide range of fauna including reptiles, birds, the Royal Bengal tiger and other threatened species, such as the crocodile [17]. However, due to climate change effects economic and tourism activities, it has been reducing day by day. Climate change is a big hazard to this forest because Sundarbans is only 3m above from the sea levels.
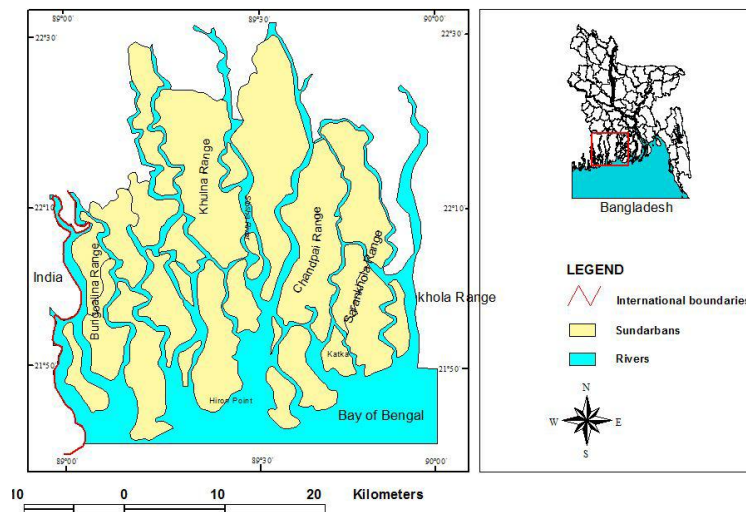

Figure 4. Location map of Sundarbans, Bangladesh

This mangrove forest consists of 200 islands, separated by some 400 interconnected tidal rivers, creeks and canals as it is shown in figure 4 [18].

5.2. Climate

The climate is characterized by a warm, wet and humid season in this region during the monsoon when 77-80% of annual rainfall occurs but in winter very little rainfall falls when this part of the year has the lowest temperature and humidity. it is temperature fluctuates from January to

December but January is the coldest time and March is summer. The mean annual maximum temperature recorded is 34°C and the average minimum temperature is 20°C. It rises from daily minimums of 2-4°C in the winter to over 32°C during the monsoon and a maximum around 43°C in March. The annual rainfall ranges from about 1,800 mm in Khulna near the north of the Sundarbans to 2,790 mm on the coast. About 80 % of the yearly rainfall occurs during the monsoon (wet season) [7].

5.3.   Local human population

The population is about 3 million people lived in small villages surrounding the Sundarbans according to the 1991 census. At certain periods of the year, it provides a livelihood for an estimated 300,000 people who work in various economic activities like, wood-cutting, fishing, and gathering of honey, and grass. More than 10000 people come from far away every year during the fishing, and honey collection season and they stay for only three months in winter. The region has a notorious background; approximately 300 people per year are killed by tigers and crocodiles [7].

5.4.   Biodiversity

The biodiversity of the mangrove forest as presented in Figure 5 is one of the richest and most extensive in the world. This forest has importance as a source of fishing, timber, shrimps and natural resources. Its green belt besides the cost makes a natural barrier to protect the land from frequent storms which is generally comes from Bay of Bengal and destroyed huge life [7].
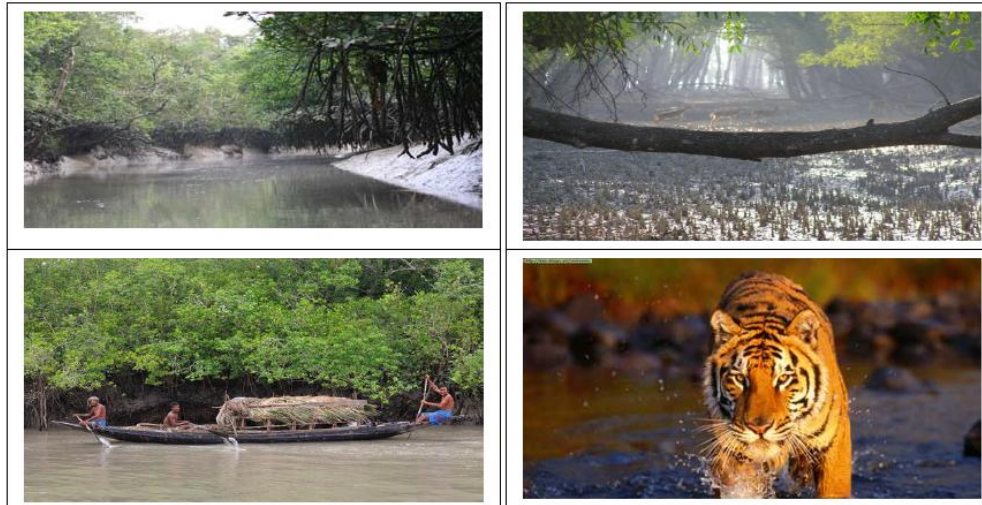
Figure 5. The biodiversity of Sundarbans

5.5.   Present situation of tourism

The total number of domestic and international visitors increased 100,000 in recent times [19]. The international visitors make up only around 2% of this total. The activities of tourists in the region mainly related to watching wildlife in forest, interaction with local people's and their activities as well as fishing, honey collection, timber production and enjoying various local cultural festivals. The visitors' flows have shown some variations over the last 5 years as shown in Figure 6. This figure present that the highest number of visitor receipts Sundarbans in 2008/2009 [7].
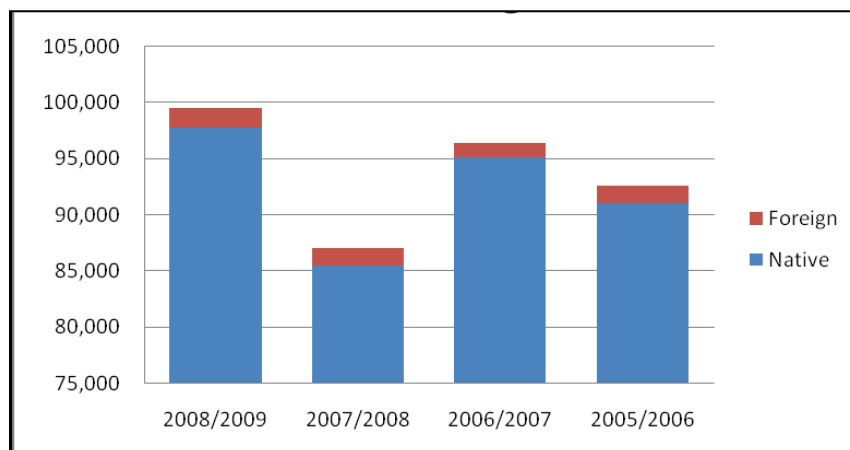

Figure 6. The number of visitors in Sundarbans, Bangladesh (USAID, 2009. p-6)

Thus, it is important for this region to make a guideline for ecotourism planning and visitor management. This is an essential issue to promote sustainable tourism development in this region [7].

5.6.   Methodology

The main topic of this section is to recognize land use change over the last 33 years using satellite data. This case study is designed to investigate causes and the extent of ecological and physical changes of land use patterns due to human activities, tourism development, and natural hazards over time. This section also describes different methods used for data collection, satellite image processing methods, accuracy assessments and ecotourism planning [7].

5.6.1.   Data collection

According to this study "satellite images of the study area have been downloaded from the United States Geological Survey (USGS) website (http://glovis.usgs.gov/). Landsat TM, ETM and Multispectral Scanner (MSS) satellite images from 1977 to 2010 have been used for land use classification and change detection" [7]. As well as local Government Engineering and Development (LGED) vector maps have been used as a reference map for digital image classification [7]. Ground observation information has been used to classify the image. Moreover, images have been adjusted using sun elevation. The other data have been collected from available literature in the form of books, journal and magazine articles, and annual reports [7].

5.6.2. Digital Image classification

To identify changes in vegetation, first Normalized Differential Vegetation Index (NDVI) images have been generated using images from different years [20]. Then, the maximum likelihood technique has been used to classify the image. Finally, both interclass and within same class change have been detected through area calculation [21]. The whole classification and change detection process can be separated into the following major steps:

o Preprocessing
o Image Enhancement like spatial filtering enhances specific spatial patterns in an image
o Image Classification and Analysis. Figure 7. Shows the methodology for the case study as given below.
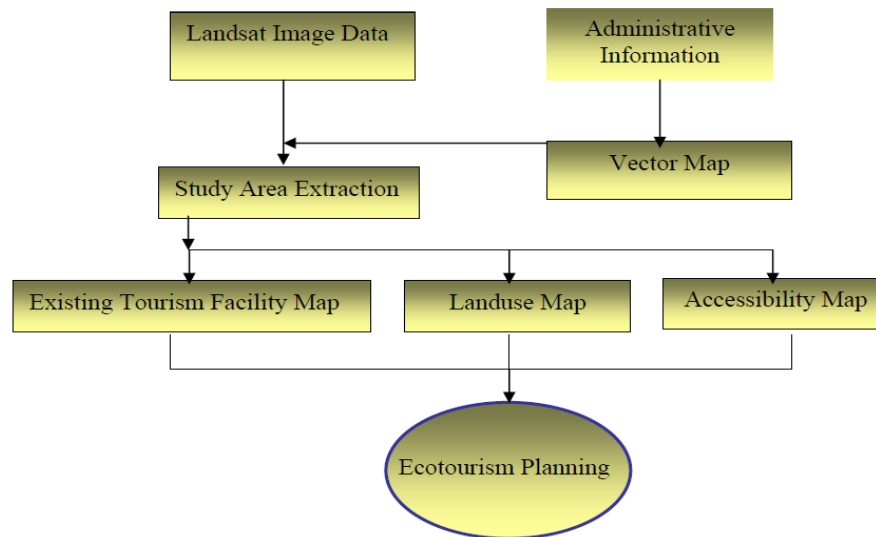
Figure 7. Methodology of Ecotourism planning in Sundarbans

In the planning process digital Image classification maps, administrative information existing tourism facilities maps and major water are overlay into the same map for preparing a ecotourism map and takes decision for sustainable planning in Sundarbans, Bangladesh. The next section will discuss satellite data analysis result, based on land cover change in Sundarbans and various planning issues related to ecotourism planning in this region [7].

5.7.   DATA ANALYSIS AND ECOTOURISM PLANNING

This section describes the results obtained through data processing following the methods of this research. In addition, causes of land use change, various ecotourism planning issues, and proposes an ecotourism plan for this region will be illustrated.

5.7.1. Land use changes in Sundarbans

Satellite data have been classified for the study area and analyzed to evaluate forest cover changes between the years 1977 and 2010. Two different methods were used in this research which is the maximum likelihood and Normalized Differential Vegetation Index (NDVI). The first method was used to quantify mangrove forest change whereas the second method was used for forest density measurements. Both techniques revealed different information about the spatial distribution

of forest cover change in the study area. The first section describes the results of maximum likelihood classification change detection then NDVI differencing results will sketch for forest density change [7].

5.7.2. Maximum likelihood classification result

The change describes the variation in areas occupied by each class between sensing periods and class-by-class reports illustrate changes by area. "The classification result has been divided into three parts. The first part represents a digital image classification map. Then, the second part shows classification results graphically and finally the last part leads to comparison and a discussion. The results of maximum likelihoods classification are as shown in Figure 8" [7].
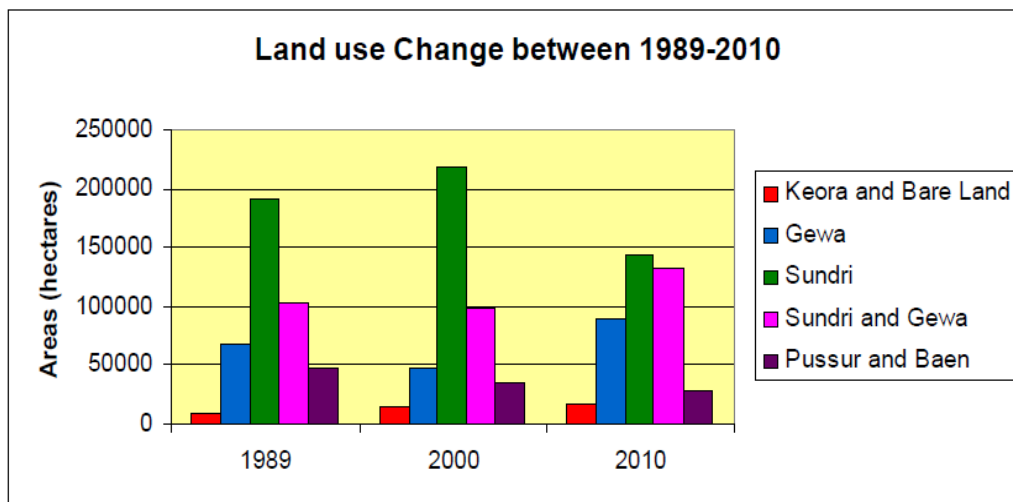

Figure 8. Land use changes of Sundarbans 'between' 1989-2010

5.7.3. Normalized Differential Vegetation Index (NDVI)

"The NDVI difference map reveals that, the density of the forest has decreased over the study period 'between' 1977-2010 as presented in Figure 9. In 1977 the NDVI map represents the highest value of density which is 1.13 it means very dense forest but by 2010 it was only 0.90 because of deforestation over the time. Most of the deforestation occurred in the southeastern corner and western edge of the study area. However, NDVI values increased in the north-central part and southwestern part of the study areas. Density of forest decreased along the cost regular basis,

because of tidal waves, floods, cyclones and human and tourism activities. The accessibility of this forest in only water channels, therefore, human disturbance influenced the change besides rivers and canals channels. Vegetation density decreased consequently over the study period. In 1989, the south central and south eastern parts of the NDVI map looks dark due to cloud cover. The comparative result from NDVI 'between' 1977-2010 has been illustrated in figure .9" [7].
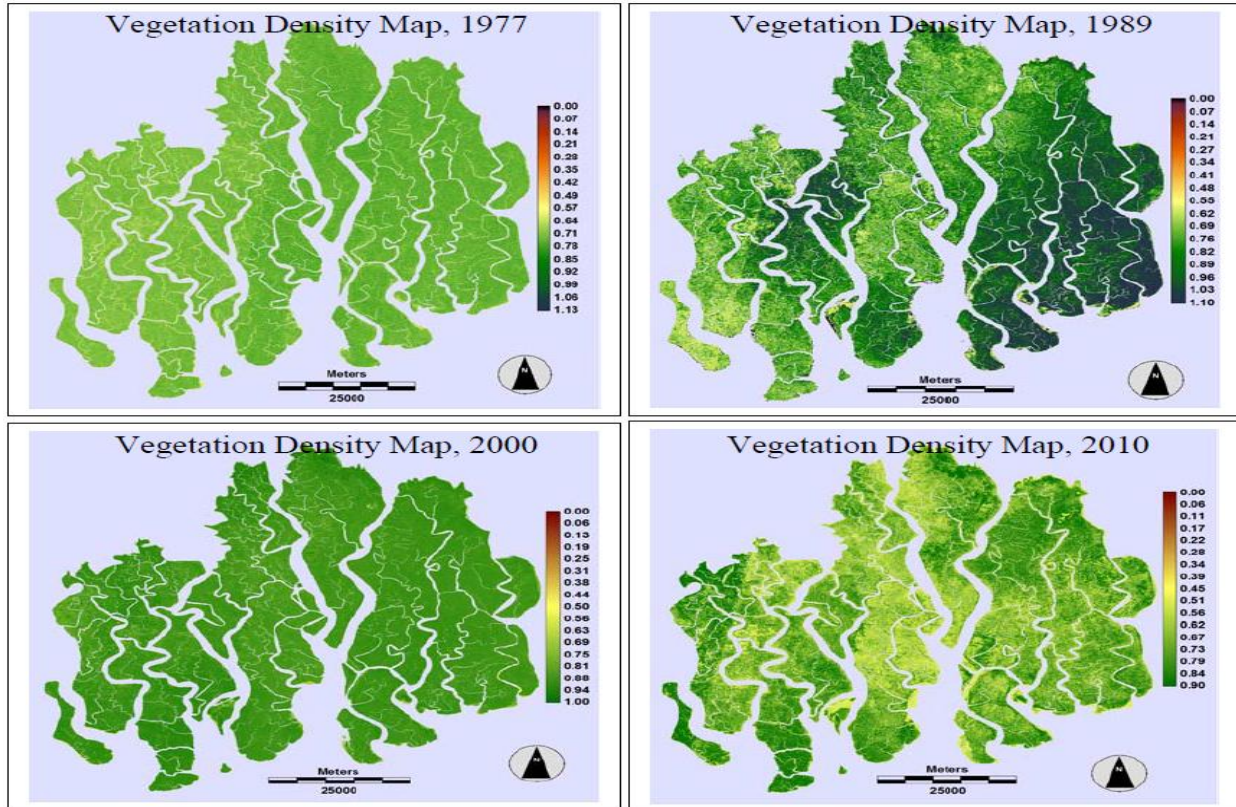

Figure 9. Vegetation density map of Sundarbans between 1977-2010

5.7.4. Causes of land use change in Sundarbans

The land use has been changing for a long period because of many reasons. These are human &tourism activities, climate change effects, Poor management, and decreasing freshwater flows from the upstream catchments [16].

5.7.5. Ecotourism planning in Sundarbans

The current study considered some key issues for planning Sundarbans for ecotourism development according to United Nations World Tourism Organization (UNWTO) destinations guideline. The result is obtained from sixty researchers working in twenty countries covering a wide variety of case circumstances for tourism development in both developed and developing countries [7].

Indeed, the effect of tourism increased rapidly due to environmental harm but there is no steady analysis of tourism effects on the ecosystem or adjacent communities. Furthermore, in the study area there is no accessible tourism plan in effect to help measure how tourism administration is performance at current state, nor is there any management authority within the reserve that has tourism administration as part of its authorization. Thus, ecotourism planning is essential for sustainable tourism development and forest management in this region [7].

A set of GIS databases and the current study have been organized for ecotourism planning. The main goal of the GIS database was set to create an ecotourism map for the study area. The specific information, administrative information, present land use, accessibility, and existing tourism facilities were used to prepare the GIS database. All created maps are as follows in Figures 10-14. Finally, Figure 14 shows that all individual maps ware overlapped to produce an ecotourism map of Sundarbans [7].
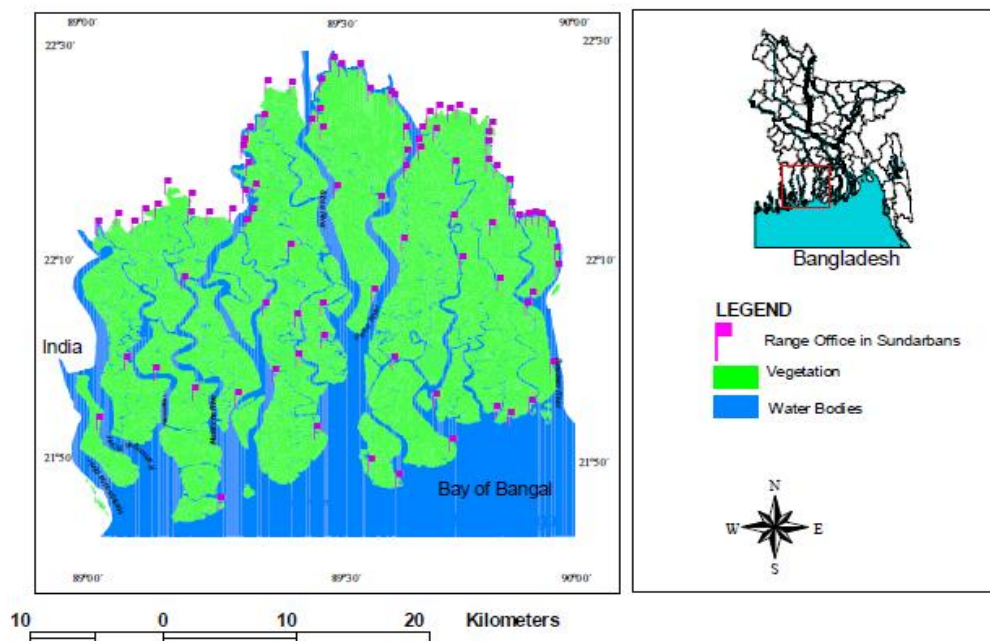

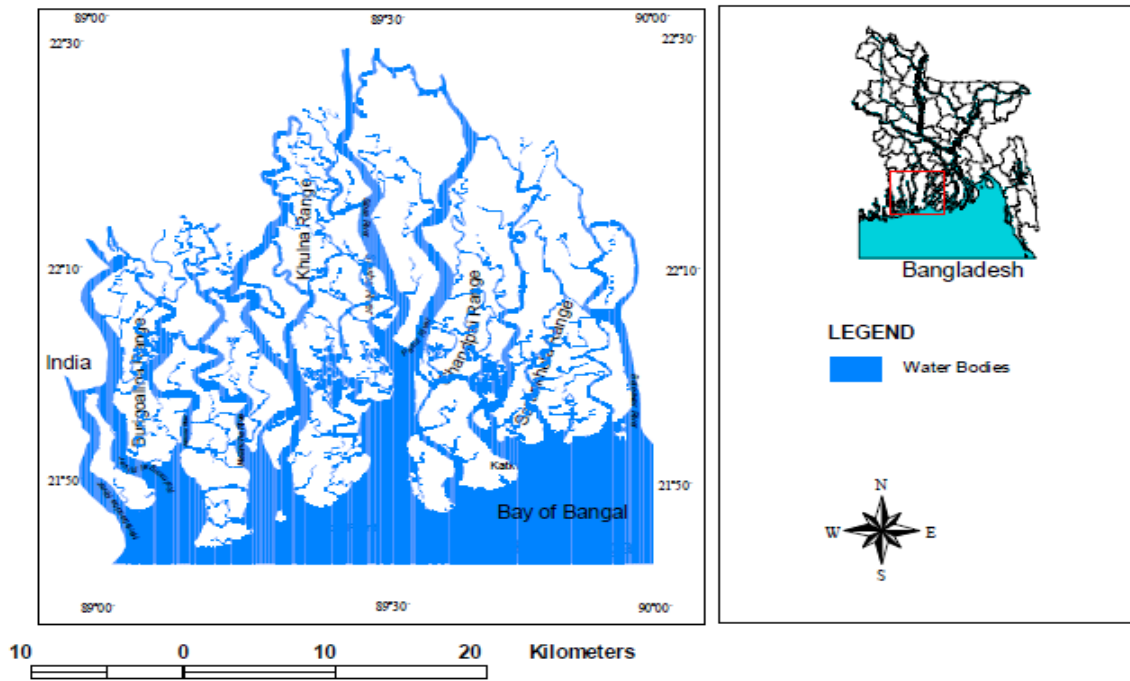Figure 10. Administrative information map of Sundarbans

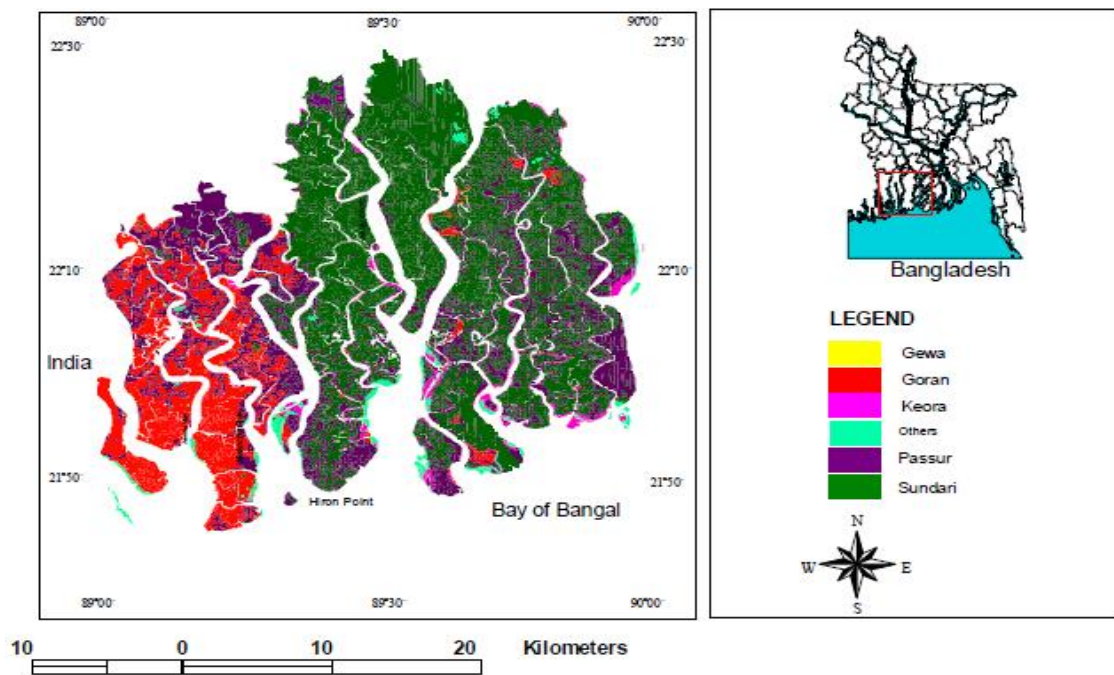Figure 11. Accessibility information map of Sundarbans
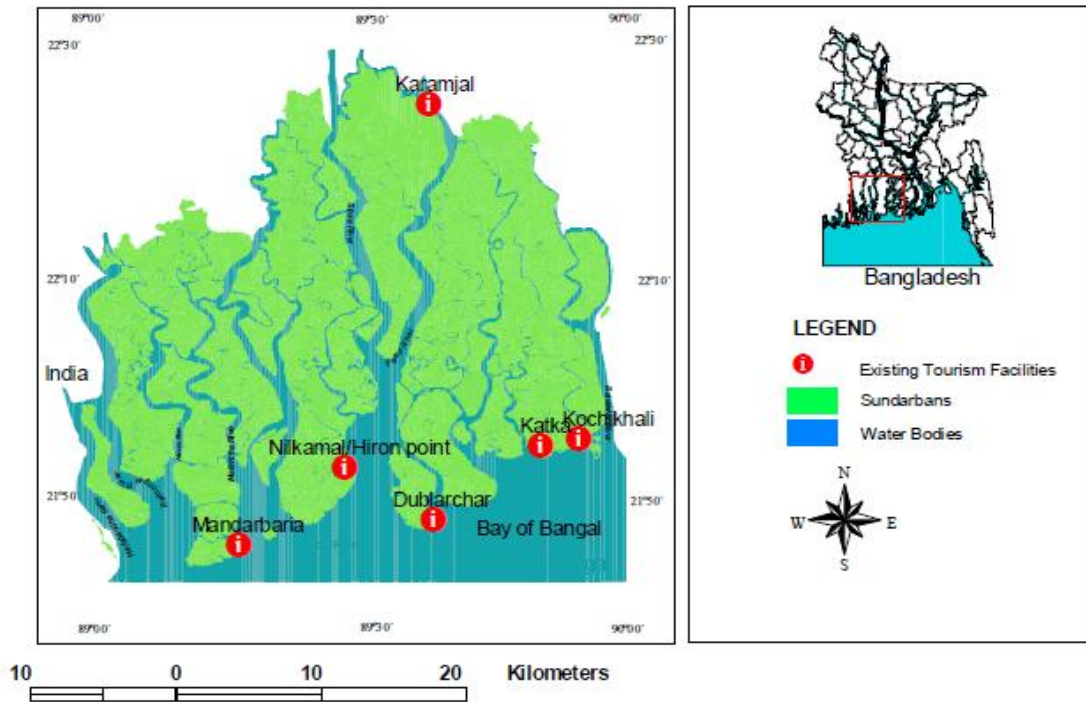

Figure 12. Land use map of Sundarbans

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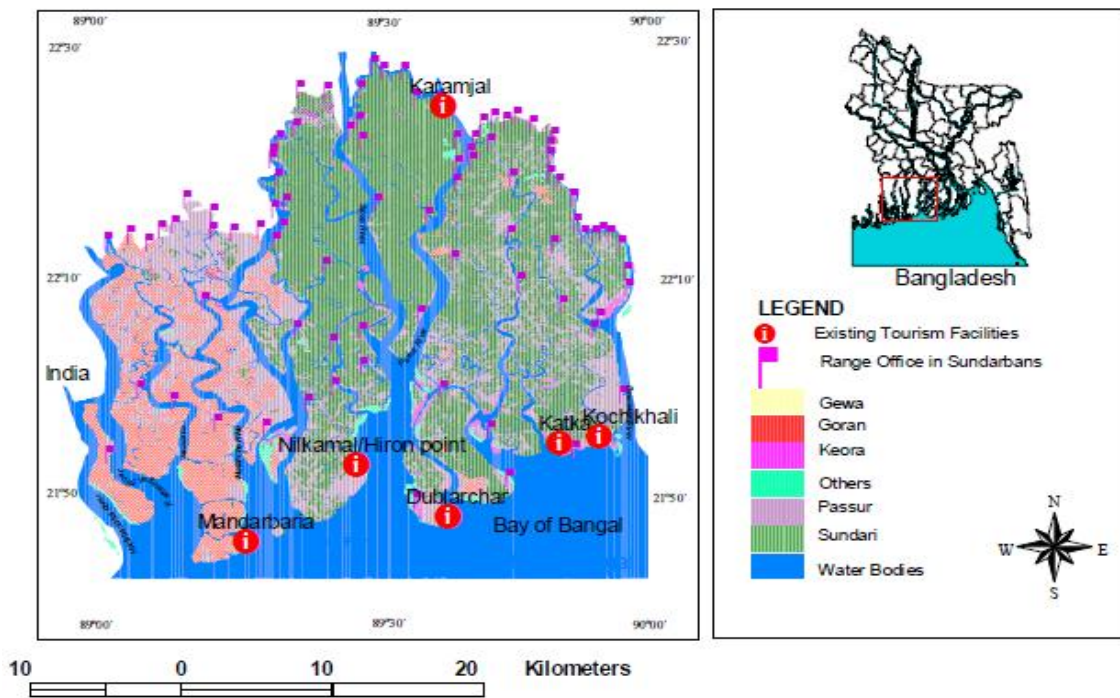Figure 12. Existing tourism facilities map of Sundarbans

Figure 13. Ecotourism map of Sundarbans

6. ADVANTAGES OF USEING GIS IN TOURISM

Many studies have been reported that GIS is a very useful tool because it supports decision making in sustainable tourism planning, and management based on the sensitive use of resources and local requirements. It helps the tourists and locals in an interactive way; it generates income, which in many destinations is the major source; also depends on the use of the natural resources and the quality of the environment. GIS is a technology capable of integrating various data sets both qualitative quantitative in a single system. Besides the integration of environmental, social and economic parameters in a single system, GIS is an integrating technology capable of working along with other technologies (remote sensing, GPS, CAD, etc) which could further facilitate and offer more tools to sustainable tourism planning and decision making.

Another competitive advantage is that, because of its added remote thematic layers, constraints and data, it is a dynamic tool for planners rather than a static one, capable of being adjusted as new data become available as preferences in demand change over time. These characteristics could be of particular importance in sustainable tourism decision making [2].

7. LIMITATIONS OF USEING GIS IN TOURISM

On the other hand, Elliot- White and Bahaire (1999) mentioned that GIS is just a tool and does not by itself ensure fairness and compatibility with sustainability principles. As Pearce (2000) argues, although GIS can enhance access to information and there enhance democratic practices they can also be used to encourage the benefits of particular groups having access to the technology. In any case, GIS is do not make decision themselves; they make easy data processing and analysis as well as communicate results but according Bahaire and Elliot –White they are "unlikely to alter the political character of policy making and thereby produce a more sustainable tourism planning practice" [7].

8.   FUTURE GIS USES AND CHALLENGES

With GIS technology many complex spatial relationships are evaluated easily because it provides a comprehensive access to the query features, database, and create layouts, themes and reports. The critical thing for the managers of tourism businesses is the relationship between marketing places, geographic factors and visitors' behaviors associated with a visit to the region, visitor perceptions of various attractions, and the trip characteristics. In contrast, the important factor of tourists' travel trips is the maps. The travels agencies focus in develop informative, well-designed and ready-to print maps to enhance visitors' travel plans in the future. GIS makes the trips of the tourists easier because it guides them to their destinations easily. The Internet also gives prospective for the visitors to select various destinations like Google map website. The mapping technology combines images, audios and video clips to plan the trips of visitors in advance. Furthermore, several issues can be examined including visitors position, attractive places, market stores, and so on by using the GIS business analysis functions. In addition, several travel problems could be solved, such as the best, set up locations to visit, the closest facility, evaluating accessibility across destinations by using the network analysis tool [7].

CONCLUSION

In conclusion tourism is a highly complex activity and, thus, requires tools like GIS which can be used as aid in effective decision making for environmental demands of sustainable development. The discussion and case study in this term paper shows that applications of GIS in tourism are strong and effective. GIS technology can play an important character in assessing environmental conditions, investigative the suitability of locations for proposed developments sites, effect calculation for tourism activities, visitor, and flow controlling. The case study that is presented in this term paper found that, the land use and density of forest of Sundarbans changed over the study period because of numerous climate change effects and human activities. The case study evaluates the capabilities of GIS for ecotourism planning in Sundarbans which has been used for ecotourism planning as a decision supporting tools. I found that GIS technology is a set of effective tools for ecotourism planning in Sundarbans. Furthermore, using these tools it is possible to identify land use change over time.

RECOMMENDATION

According to this term paper and the case study that is presented, I found that the GIS technology is a very important and useful tool for sustainable ecotourism planning. I recommend to use GIS technology for tourism planning in Saudi Arabia because there are many interesting and nice places such as Abha in south, Al-Baha and Hafr-Albatin. Furthermore, there are also many interesting tourism places in Yemen like Ibb, Aden, Hajjah and Al-Mahwit so I am planning to conduct a case study in the green province named Ibb city in my country in the future in order to benefit from GIS tool to aid in the development of tourism in an effective and sustainable way.

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