GIS Applications in Optimum Site Selection for Tourist Sites: Texas State as a Case Study

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Abstract

The optimal allocation of land-based resources and optimum location of facilities involve processing different environmental and socioeconomic data. GIS which is a powerful tool in spatial analysis can be useful and effective in such applications. This paper uses different site location criteria such as accessibility, crime rate, proximity to historic sites and water bodies to demonstrate the potential application of GIS in locating optimum tourist resorts in Texas, USA. The paper applied vector-based binary model in analyzing transportation, crime, urban area and historic site data for determining potential tourist resorts. The result of the analysis indicated that the potential tourist's sites are located in two clusters of counties and none of the major existing tourist resorts counties is selected. This shows that the factors determining tourism attractiveness of a place might be more complex than the criteria considered in this study. Based on the finding, the paper made some recommendations on the use of GIS in optimum site selection.

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Keywords: optimum site selection; GIS; spatial analysis; multi-criteria analysis.

Introduction

Public facility planning involves the optimization of resources and the allocation of facilities at the optimal location guided by different planning criteria. The identification of potential tourist places is within the ambit of facility planning. Tourism activities mean a complex interplay of different factors. The planning and development of tourism implies the management of a lot of information related to the cultural, social and economic context of each reality, and potential relations due to proximity or another location factor (Mejia, et al., 2000). The volume and complexity of the data that are used in site selection require a powerful tool for spatial data analysis.

The tourism industry is growing and there is need for further development of facilities. Most importantly, the public are now more than ever conscious of the impacts of development activities on the environment. The public usually demand assurance that all factors have been considered before location decisions are made. Thus, the need for tools that could help decision-makers in not only making the optimum decisions but also showing to the public that the decision is reached through an objective and transparent process.

The capability of GIS technology to process both spatial and attribute data offers the opportunity of using GIS in locating public facilities such as potential tourist resorts. GIS facilitates effective decision-making by planners in planning and developing infrastructure and tourism activities. GIS goes beyond the limits of paper maps in manipulating and analyzing spatial data. The advantages of GIS in data documentation and processing include:

- quick updating of information,
- automated cartography,
- integration of information by linking spatial and attribute data,
- spatial analysis,
- production of maps at different scales and
- visualization.

Aim and Objectives

The main aim of this study is to demonstrate the effective capability of GIS in public facility planning by using GIS to locate potential tourist resort(s). Texas State in USA is taken as a case study in this paper. The specific objectives of this study include:

- identifying criteria necessary for siting suitable tourist sites,
- applying the set of criteria in GIS analysis to locate such suitable sites,
- identifying the potential tourist sites and their respective regions,

- making recommendations on the use of GIS in facility planning.

Study Area

Texas which is the study area of this study is one of the coastal states in the United States of America. It is the largest state in conterminous United States (Infoplease, 2002). It is located in the South Central part of the country and it is bounded by Oklahoma in the North, Arkansas in the North East, Louisiana in the East, the Gulf of Mexico in the South East, New Mexico in the West and Mexico in the South West. Texas covers an area of about 692,405 sq. km. Austin is the capital city of Texas and the largest city is Houston. Other cities and counties include Dallas, Galveston, Fort Worth, San Antonio, Wichita and Lubbock. Texas has a population of about 20 million and population density of about 64 per square mile (Census Bureau, 2002). The main economic activities in Texas are mineral resources activities, agriculture and industry. The state is the leading U. S producer of oil, natural gas, natural-gas liquids and some agricultural products (cattle, cotton and cottonseed). Due to its fairly long coastline (about 700 km), Texas has a potential for tourist attraction. The study is particularly carried out on the Gulf Coast Region of Texas (Fig. 1) because of its proximity to the coast. The task is to identify suitable site for harnessing and developing the potential tourist attraction.

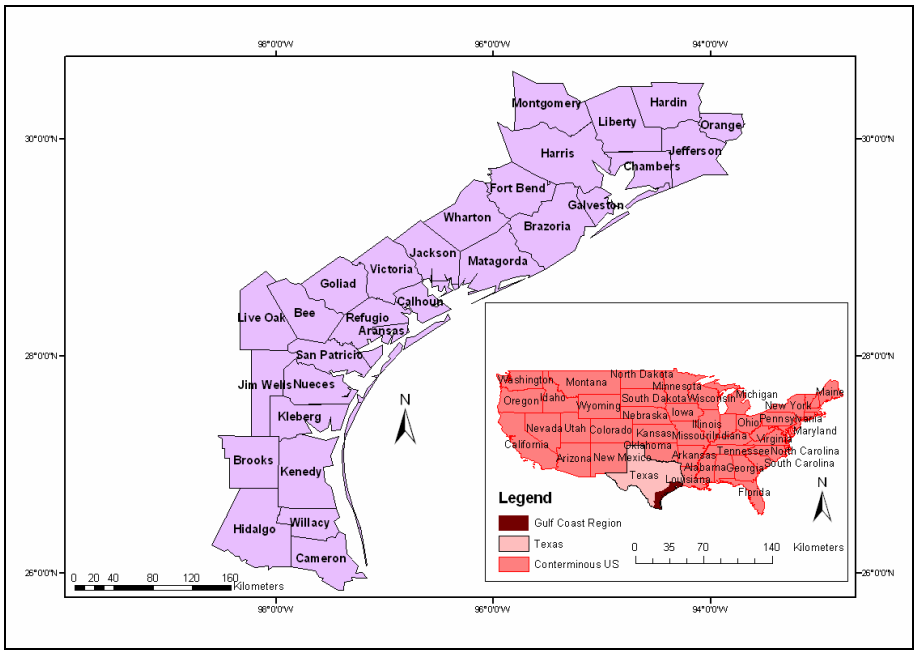

Fig. 1 Map showing the Gulf Coast Region of Texas.

Review of Literature

Different studies have been carried out to investigate and demonstrate the application of GIS in site selection especially tourist selection. Mejia et al. (2000) used GIS, with the application of accessibility analysis, areas of influence, and 3D studies through network analysis, to develop a decision making support system for tourism planning in Zulia State, Venezuela. As regard the location criteria, Macdonald (2000) highlighted the physical elements of tourism as cultural facilities, sports facilities, leisure settings (ancient monuments, historical buildings, parks and green areas and water sides), amusement facilities and accessibility. Although the study did not elaborate on GIS techniques, it pointed out tourist site selection criteria. Quiambao (2001) elaborated on the criteria

for selecting and evaluating tourist sites. The study stated proximity to urban area (not within 2km radius of built-up area), size of the site (0.5 to 2 sq. km), and accessibility and proximity to the airport. Alonso and Cabrera (2002) in their study of the impact of tourist resorts on beach erosion highlighted the importance and influence of proximity to the coast on tourism development. Also, studies by Surendran et al. (2003) and Banerjee et al. (2002) highlighted the different criteria necessary for selecting potential sites for tourism development. This paper identifies the different criteria in literature and applied them in determining the potential sites in the study area.

Methodology, Data Collection and Analysis

The paper used a vector-based binary modeling approach, within the GIS environment, to locate potential tourist resort sites based on factors such as supporting facilities, accessibility, crime rate and proximity to historical, recreation sites and airports. The analytical framework for vector-based approach is highlighted in Figure 2. Data relevant to the study were extracted from ESRI data CD-ROM and US Census Bureau website. The tool of the study was ArcGIS version 8.3. Data layers such as state polygon, interstate road (major roads); urbanized areas, parks, airports, elevation, water bodies and crime rates were extracted. GIS analysis tools of ArcGIS such as “identify”, “selection by attribute”, "selection by location" and “reselect” were used to get the needed data on Texas from the US data. Other tools such as “buffer” and “proximity” analysis were also applied in the study (Fig. 3). Some specific

criteria which had been applied in different studies (Ouiambao, 2001; Surendran et al., 2003; Macdonald, 2000; Mejia et al., 2000) were adapted for each analysis. Table 1 shows the specific criteria that were applied in the study and the justifications for applying the criteria. The selection of the sites is based on Boolean logic (true or false). That is, only sites that meet the criteria are selected.

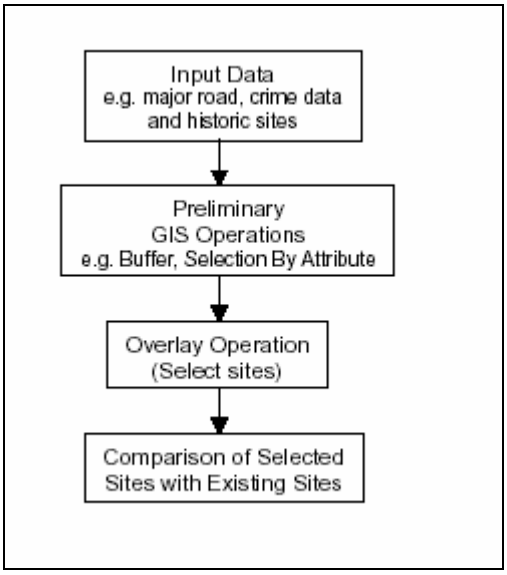

Fig. 2 Analytical framework of the study

Factors	**Site Selection Criteria**	**Justifications for the criteria**
Accessibility	Within 5km from a major road	The tourist resort need to be accessible to people. If it is not fairly accessible, there will be low patronage (Ouiambao, 2001).
Crime rate	Less than 4000crime/100000people	The tourist resort should be located in an area with low

		crime rate as high crime rate may result in low patronage. The rate is fixed at 4000crime/100000people because that is the average crime rate in Texas.
Proximity to recreation/historic sites	Within 1km from a park	Closeness to recreation and historic sites enhances the patronage of the tourist resort. 1km (walking distance) is recommended so that other activities at the recreation sites may attract tourists (Mejia, et al. 2000).
Proximity to airport	Within 10km from airport	Closeness to airport is very important if the tourist resort is to attract tourist from other regions and even other countries. 10 km (15 min driving-distance) is recommended for easy accessibility (Ouiambao, 2001).
Proximity to water body	Within 2km from a water body	Water bodies such as lakes are very important tourist attractions. So it is recommended that the tourist site should be at a walking/trekking distance (2km) to a water body (Macdonald, 2000; Surendran et al., 2003).
Proximity to urbanized area	Not within 3km from urbanized area	It is recommended that the tourist site is not within 3km from urbanized area to avoid

		urban noise and congestion and create a serene environment (Banerjee et al.; Surendran et al., 2003).
Size	Area not less than 1 sq. km	Due to the activities expected at the tourist site, it is recommended that the size should be about 1 sq. km (Ouiambao, 2001).

Table 1 Criteria for locating the optimum tourist resort.

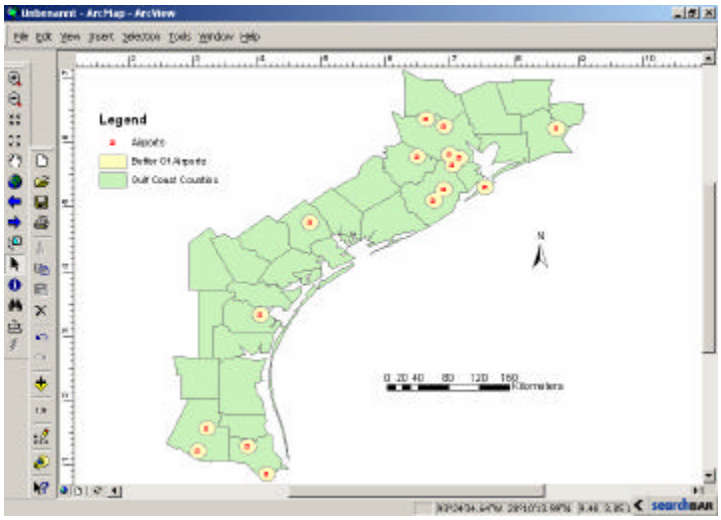

Fig. 3 The result of 10km buffer of the airports in the Gulf Coast

Findings and Discussion

The result of the overlay and select by theme analysis shows the possible area of locating tourist sites in the Gulf Coast region of Texas based on the selection criteria (Fig. 4). The number of sites (new potential sites) that are finally selected is about 32. The sites are selected in two clusters of seven different counties in the

Region. The counties are Bee, Chambers, Hardin, Jackson, Liberty, Montgomery and San Patricio. Bee County has the highest number of selected sites with about fourteen sites. The result shows the potential sites for tourism development based on the criteria. However, it is essential to note that when the counties with major existing tourist resorts (Fig. 5) are compared with the selected sites, the result indicated that none of these counties is selected through the selection criteria. The counties like Aransas, Galveston and Nueces (Corpus Christi) are noted for tourism and they have a number of tourist resorts. The non-selection of existing tourist resorts shows that the factors determining tourism attractiveness of a place might be more complex than the criteria considered in this study and there is need for more study on identifying the factors that determine potential for tourism in a place.

Generally, the selection criteria do dictate the result generated by GIS analysis. If fewer factors were considered more sites would be selected. Apart from the number of factors considered, the conditions applied to each factor such as the distance of the buffer will also dictate the sites that will be generated. In essence, one must make sure that the criteria applied for the analysis are valid criteria and the criteria must not contradict one another. For example, one cannot specify that the location should be within 5km of urbanized area and also specify that the location should be within forest region. This is an example of contradictory criteria. The criteria will cancel out one another and no site will be selected.

Nonetheless, the study still shows that the potential of a place to generate tourist attraction might not always be deterministic, other factors than the criteria found in literature might play important role in attracting tourist to certain places. Thus, there is the need to further look into the factors and probably ascertain the weight of each factor in determining attractiveness to tourist. Probably if the criteria were weighted the result might include existing sites. The challenge is in determining the valid weights for each factor so that an applicable result could be achieved.

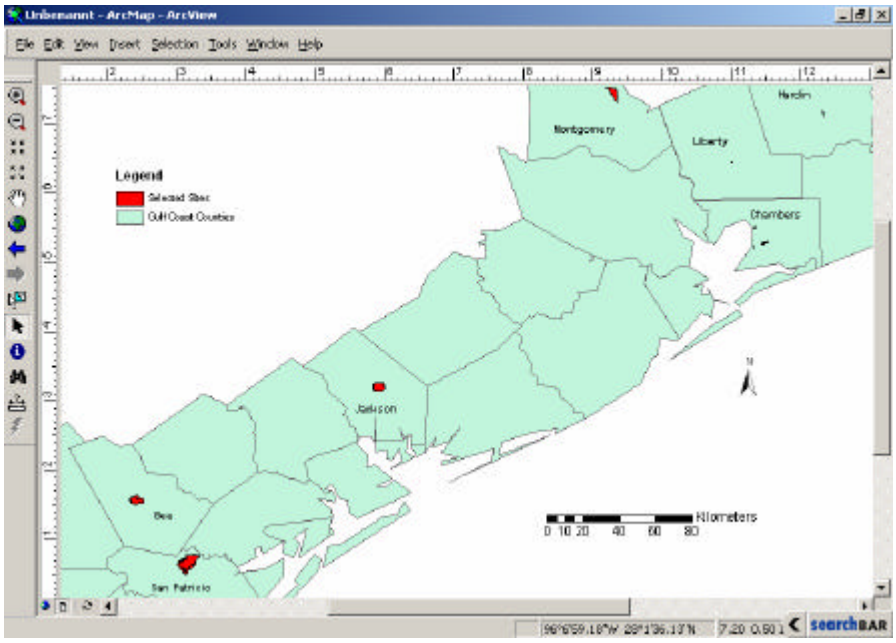

Fig. 4 Selected tourist sites and their County names

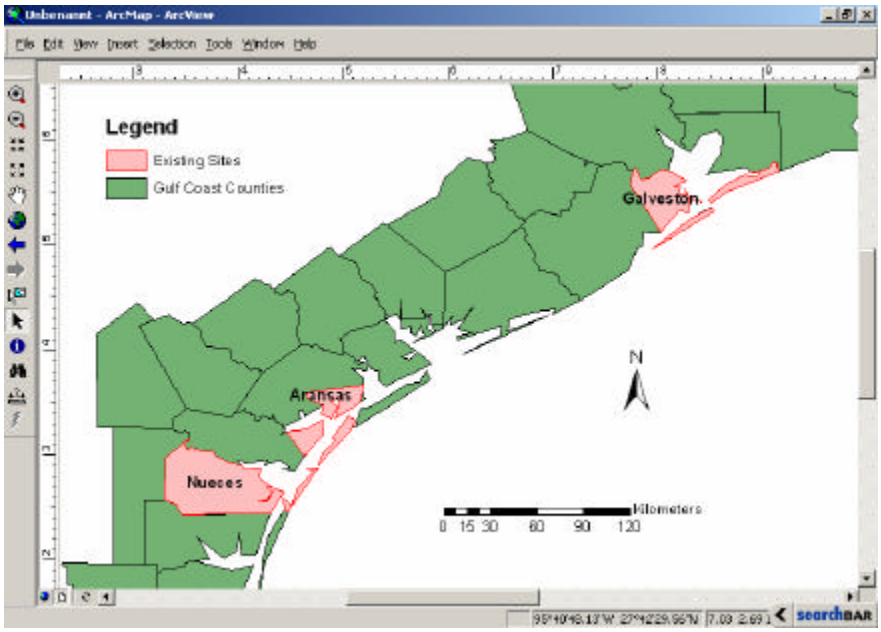

Fig. 5 The counties of major existing tourist resorts

As indicated above, more selection criteria can be applied to streamline the selected sites. For instance, population density (number of potential users) and proximity to national and local recreation sites can be applied for further analysis and selection in the case of locating tourist sites.

Conclusions

The study has shown that a GIS is a good tool to help aid in finding of suitable sites for tourist activities. About 32 tourist sites are selected by applying criteria such as proximity to urbanized areas, proximity to airport, proximity to road network and proximity to and distance from water body. GIS made the process of making

preliminary decision in siting more efficient as it was very easy to find suitable sites quickly and then recommend them for further study. The biggest strength of using a GIS program for primary site selection is that it is very quick and outputs good results that can be viewed and understood. Many criteria can be factored into the creation of a map which allows for detailed study if necessary data are available. It is recognized that availability of data really dictates the level of detail of a GIS analysis. Further analysis can be carried out if necessary data are available and in the right format and standard. Another advantageous capability of GIS is that more criteria can be added easily as more information becomes available.

Recommendations

The study makes the following recommendations:

- that the user should ensure that valid criteria (which are not contradictory) are applied in selecting potential sites.
- that the user should ensure the availability of adequate data which are in compatible standard and format.
- that adequate knowledge of the link between the criteria and the subject of selection is very essential for a meaningful and valid site location analysis. Therefore, there is need for further investigation on the factors that make places attractive to tourists.
- GIS visualization capability could be explored for citizen participation

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