

GIS CONTRIBUTION FOR THE EVALUATION AND PLANNING OF TOURISM: A SUSTAINABLE TOURISM PERSPECTIVE

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ABSTRACT

The need for a sustainable approach in tourism development is very often addressed among the academia, the authorities and the stakeholders, as well as the apparent need for tools which will guide the decision environment in evaluation and planning. It is argued that GIS could form the base for the development of such tools. An extensive literature review is performed on the topic of GIS applications in tourism. In this way the capabilities, the shortcomings and the areas of future research are highlighted.

Keywords: GIS applications, sustainable tourism

INTRODUCTION

Geographic Information Systems (GIS) applications in the field of tourism management and planning first appeared in the early 90's. However, the number of GIS applications for tourism planning has not mushroomed as in other fields. This is also reflected in the field of sustainable tourism, where the adoption of new technologies has been rather slow. Nonetheless, sustainable tourism decision-making has a lot to benefit from using such technologies. GIS can be used for managing the various informations needed, estimating indicators, and generally assisting decision making in the planning face, as well as, in the monitoring and evaluation phases.

The lack of applications of GIS tools in tourism is more evident on the subject of managing mass tourism in existing destinations. This may be the result of several factors. It can be attributed to the lack of proper planning when tourism development started growing in these destinations, on the fact that mass tourism is often perceived as contradictory to sustainable tourism and on the lack of research related to the topics of sustainable development for mass tourism and GIS contribution in this direction.

In this paper the potential contribution of GIS technology in sustainable tourism is discussed. An extensive literature review on the topic of GIS application in tourism is performed to identify current trends and areas of future research. The aim is to pinpoint the key features of GIS, which may be used for tourism development planning. To better illustrate these features, applications are categorized according to the generic questions a GIS is often used to answer.

SUSTAINABLE TOURISM DEVELOPMENT

The World Summit held in Rio de Janeiro in 1992, declared that there is a need for a more balanced approach in development planning and outlined a framework in which economic, sociocultural and environmental aspects are equally important for a sustainable future. Ever since, governmental and non-governmental organizations, international, national and regional authorities and the academic community have been trying to interpret the term of sustainable development and take action. One approach for doing this is to examine the concept of sustainability and ascertain how it applies in the different sectors of the economy. Tourism is an economic activity and can not be marginalized as its development and prosperity strongly depends on the environmental and sociocultural resources in each destination. It is not within the scope of the present research to argue on the concept of sustainable tourism. However, there are some issues, which should be highlighted.

Sustainable tourism is not a new form of tourism, or a synonymous to the new forms of tourism such as, ecotourism, or alternative tourism. Sustainable tourism is a new approach to tourism development that can be potentially applied to all forms of tourism in an effort to achieve sustainable development. It is often the case that focus is placed on the long-term viability of tourism industry. However, the holistic and dynamic nature of the concept implies that all, environmental quality, economic prosperity, social equity and viability of the industry are necessary for a balanced and long-term viable tourism development.

GIS APPLICATIONS IN TOURISM

Rhind (1990) categorized GIS applications in a structured approach according to the generic questions which GIS are frequently used to investigate. Bahaire and Elliott-White (1999) related these categories to the basic applications in tourism, as well as, to GIS basic functions as illustrated in Table 1.

Table 1. Capabilities of a GIS
(After Bahaire and Elliott-White, 1999)

Examples of functional capabilities of GIS	Examples of basic questions that can be investigated using a GIS (After Rhind, 1990)		Examples of tourism applications
Data entry, storage and manipulation	Location	What is at...?	Tourism Resource Inventories
Map production	Condition	Where is it...?	Identifying most suitable locations for development
Database integration and	Trend	What has changed...?	Measuring tourism impacts

management	Routing	Which is the best way...?	Visitor management / flows
Data queries and searches	Pattern	What is the pattern...?	Analysing relationships associated with resource use
Spatial analysis			
Spatial modeling	Modelling	What if...?	Assessing potential impacts of tourism development
Decision Support			

It becomes clear that tourism and recreation management and planning have a lot to benefit from using such a technology. Some of the key features of GIS that could benefit tourism planning include their ability to manipulate data and spatial attributes (Boyd and Butler, 1996) and provide necessary value added information (Bahaire and Elliott-White, 1999; McAdam, 1999), the ease in allocating resources between what are often conflicting demands (Townshend, 1991; Williams *et al* ,1996), their adaptability in requirements, needs and data changes over time (Beedasy and Whyatt, 1999), and their ability to identify patterns or relationships based on particular criteria and support in this way decision-making (McAdam, 1999).

Although the number of GIS applications in tourism and recreation management and planning are increasing, there are still many more potential opportunities (Boyd and Butler, 1996; Porter and Tarrant, 2001). In the following section there is a description along with some examples of applications that have been proposed. Categorization is according to those in Table 1 in order to highlight the applicability of GIS in the tourism field. It should be stressed that, most of GIS applications in tourism involve more than one of the categories cited below and their limits are not always clear. Nonetheless, it was felt that categorization is necessary to place them in a context and facilitate understanding and identification of capabilities.

i. Tourism resources inventories

Tourism planning and management involves multiple agencies and different kind of information in order to assist a quite complex decision-making process. Therefore, GIS ability to integrate, store, and manipulate different data sets - both qualitative and quantitative, both spatial and nonspatial- may prove very useful (Bahaire & Elliott-White, 1999). Tourism resource inventories is one of the very first and basic applications. They may include information on natural resources, tourism and other infrastructure, demographics etc. as illustrated on the following examples. Such inventories may be further used for resource –both natural and man-made- management, resource allocation and land use planning decisions (Williams *et al.*, 1996).

Bahaire and Elliott-White (1999) cite the development of a Sites and Monuments Records Management System by the Royal Commission on Historic Monuments in the U.K., using GIS to link text and spatial data in order to facilitate planning and

other consultations. Resource inventories are usually developed to form the basis for other applications such as tourism planning, location suitability etc. In Lake District National Park Authority (LDNPA) GIS was used to integrate accommodation data from the Cumbria Tourist Board, Population Census and Ordnance Survey. This was in order to examine the ways in which different types of accommodation vary within the quieter areas and the busier central valleys of the Lake District (Bahaire & Elliott-White, 1999). Williams *et al.* (1996) explored the role of resource inventories in tourism planning. They presented a case study in Clayoquot in Canada, where different sector-specific stakeholders prepared maps identifying the areas of importance for them (i.e. aquaculture, forestry, mining, recreation etc). These maps became then visual tools for the *Landscape Management Plan*. In the case study of British Columbia the Tourism Resource Inventory Framework developed recorded three different types of data: tourism resources; tourism uses; and tourism capabilities highlighting the potential for different forms of tourism development in the area. Boyd and Butler (1996) used a resource inventory to identify potential ecotourism sites in Northern Ontario in Canada.

Another dimension of tourism resource inventories is to **provide information about tourist destinations over the Internet**. Map-based information for tourists that may be found on the web or at info-kiosks is a quite popular application of GIS. An ever-increasing number of destinations are promoted via the Internet and map-based information is used in many cases. Depending on the application, this information may be static or interactive allowing limited operations to be handled on line.

ii. Location suitability

Location suitability is perhaps the best known and most widely developed application of GIS. Tourism could not be excluded from this fact, and many of the cases are related directly or indirectly –such as the decision support examples- to identifying locations suitable for tourism development according to specified criteria in each case. Conflicting or complimentary land uses and activities, infrastructure availability, natural resources are considered to determine the possibility and the capacity of an area to be developed as a tourist destination (Butler, 1993; Bahaire & Elliott-White, 1999).

Berry (1991) used an area in the US Virgin Islands as a demonstration site to highlight the use of GIS in spatial analysis. Using three models he defined conservation areas, ecological research areas, and areas of residential and recreational development while, a fourth model was used for conflict resolution among competing uses. Boyd *et al.* (1994) and Boyd and Butler (1996) illustrate a methodology for identifying areas with potential for ecotourism in the context of Northern Ontario, Canada. At first, a resource inventory and a list of ecotourism criteria were developed. At a next stage GIS techniques were used to measure the ranking of different sites according to the set criteria and therefore identify those with the ‘best’ potential. Minagawa & Tanaka (1998) used GIS to locate areas suitable for tourism development at Lombok Island in Indonesia. The main objective was to propose a methodology for GIS based tourism planning. Using map overlay and multicriteria

evaluation a number of potential sites for tourism development was identified. Beedasy and Whyatt (1999) developed a GIS based decision support system for sound spatial planning for tourism in Mauritius. Given the space limitation of Mauritius, the increasing tourist demand and the need to consider alternative sites in order to avoid further deterioration of existing tourist zones, a spatial decision support system was developed to support tourism planning. GIS technology was considered as the appropriate platform for such a system because it can integrate both qualitative and quantitative information, it can provide a visual display of results thus permitting an easy and efficient appraisal of results, and can communicate information to all interested parties becoming thus a participatory and exploratory tool.

iii. Measuring / monitoring tourism impacts

This category of applications, as Rhind (1990) illustrated, involve tracing of trends and answering to the question '*what has changed...?*'. Therefore, it is related to the monitoring of desired parameters over time and across space rather than predicting potential impacts which is related to a next category. In the case of sustainable tourism development, where environmental, social and economic information is required, GIS technology permits the integration and management of the various data. Butler (1993) points out that such integration capabilities facilitate the identification and monitoring of indicators. Moreover, exploitation of the analytical capabilities that GIS offer may provide the complex measures and indicators that are often required for monitoring sustainable development.

McAdam (1994) reported the case of a GIS prototype application developed for monitoring the impacts resulting from the increasing number of trekking and special interest tourists in a remote region in Nepal. Shackley (1997) within her involvement in regional and site tourism management issues of the, newly opened to visitors, Himalayan Kingdom of Lo (Mustang), Nepal, suggested the development of a GIS based spatially-referenced multimedia cultural archive. This archive, with data collected at an early stage of tourism development, would serve to monitor possible change through time.

Literature review reveals that the GIS potential in both identifying indicators and measuring them in a monitoring system which will aim at controlling development on the basis of pre-established targets has not been exploited yet.

What Butler (1993) has identified as '*analysis of trend*' for tourism development, may help decision-makers and stakeholders compensate with uncertainty over future, as well as, highlight the potential of areas to develop tourism activities.

Williams *et al.* (1996) within the context of a tourism resource inventory in British Columbia, Canada, developed a tourism capability map which indicates areas of high, moderate, and low capability for specific tourism activities. Ribiero de Costa (1996) used GIS to create a map of tourism potential in the Mediterranean area of Europe.

iv. Visitor management / flows

This category refers to what Rhind (1990) described as routing applications answering to the question *'which is the best way...?'*. The best way may be determined on the basis of diverse criteria such as the shortest path, or the way that combines passing through various points. In tourism applications this is mostly related to **tourism time-space analysis**. Tourist time-space analysis aims at understanding the behaviour of tourist or visitors. Traditionally this is being accomplished by analyzing static numbers of tourists/visitors and their socioeconomic and demographic characteristics (Dietvorst, 1995). GIS can be a powerful tool in such analysis offering a better understanding of tourists flows in a given region or area. Understanding of tourist behavior may further lead to better infrastructure and activities management, protection of the environment and spreading of benefits such as economic gains. Tourism time-space analysis is also related to the next category of *'analysing relationships associated with resources'* as it involves understanding visitors' behaviour with respects the use of available resources. **However, as it is the visitors flow management the outcome of such applications, it is examined here** (SVHSE TO IT DOES NOT MAKESENSE). **It should be stressed anyway that, most of GIS applications in tourism involve more than one of the categories cited in the present study and their limits are not always clear. Nonetheless, it was felt that categorization is necessary to place them in a context and facilitate understanding and identification of capabilities. SVHSE TO TO EVALA PARAPANO PRIN TO i.**

Dietvorst (1995) used a survey based time-space analysis at a theme park in the Netherlands, to better understand visitors' preferences for the various attractions of the park. A GIS was used for the analysis of the coherence between the various attractions and other elements of the park. Findings were then used for a more balanced diffusion of visitor streams and a better routing system. Van der Knaap (1999) used GIS to understand the use of the physical environment by tourists in order to promote sustainable tourism development. Bishop and Gimblett (2000) presented the use of spatial information systems, spatial modeling and virtual reality in recreation planning. Using rule-driven autonomous agents moving in a GIS-based landscape, the movement patterns of the visitors can be simulated. In this way it is argued that better management of the recreational area is achieved through the effective management of recreationists' behavior. A case –study was conducted at Broken Arrow Canyon, Arizona.

v. Analysing relationships associated with resource use

Analysing relationships associated with resource use refers to answering the question *'What is the pattern...?'*. Scientists, planners and decision-makers may undertake pattern detection to identify phenomena, their occurrence and their distribution. GIS can be used to delineate areas that should be undisturbed by tourism or any type of development activity. **Impact analysis** is related to this category as GIS can be used to identify patterns and the interaction between different components and evaluate potential impact of tourism development on the natural environment (Bahaire & Elliott-White, 1999). Another issue here is **environmental justice**, an issue that has been growing in importance the last few years and which is related to the equity of the distribution among various population groups of the costs and benefits resulting from the location of certain activities. Usually, the issue of environmental justice

arises when analyzing the impact of undesirable land uses, such as pollution sources. Although, tourism and recreation facilities represent desirable land uses with recreation opportunities and positive economic impacts as the main benefits, environmental justice can still be an issue since the positive impacts may not influence in a similar way all the population. [The spatial character –and thus GIS use- is strongly present in such evaluations.](#)

Gribb (1991) describes the planning effort that took place at the Grayrocks Reservoir in Wyoming, US, integrating visitor surveys, environmental factors in a GIS. The aim was to combine recreationists' needs for activities and services with environmental limitations and constraints to the development of the reservoir in order to prepare a recreation development [plan which would contribute at the same time to environmental conservation.](#) Nepal and Weber (1994) described the identification and delineation of buffer areas for biodiversity conservation in Nepal. Fishwick and Clayson (1995) used GIS in Lake District National Park, UK, to exclude certain areas from tourism development as detrimental to the qualities of those areas, as well as, to identify the areas adjacent to the lake which suffered noise disturbance because of power boats. Carver (1995) describes the development of a 'wilderness continuum map' showing areas designated as wilderness in the UK and its use to identify areas of potential risk from recreational development. Porter and Tarrant (2001) used GIS within the framework of environmental justice to determine whether certain socioeconomic and racial groups are discriminated regarding the distribution of federal tourism sites. Although this is an environmental justice GIS application, rather than tourism related one, it addresses the issue of social equity on the allocation of both benefits and costs which, is essential in sustainable development. It could actually be used as a framework for tourism impact analysis. Related to the later, is the application illustrated by Nicholls (2001) in which, the accessibility and distributional equity in the park system of Bryan, Texas, is examined. The author illustrates how GIS can assist leisure service professionals to visualize and measure levels of accessibility and equity. Using GIS, the author was able to measure accessibility in other, than the straight-line measure way achieving a much better accuracy and eliminating errors.

Tourism marketing is another dimension of applications related to this category. As Elliot-White & Finn (1998) advocate, that geodemographics and lifestyle analysis which can be performed by a GIS, could have a significant contribution in the needs of 'post-modern tourism marketing'. There is a growing trend, which indicates smaller, and more personalized –or specific- types of tourism. Therefore, managers or stakeholders responsible for tourism marketing could be benefited from GIS in order to locate and analyse the characteristics of potential customers. Despite the potential benefits, GIS applications in tourism marketing seem rather rare. As Sussmann and Rashad (1994) point out in their study on the level of GIS awareness among managers of tourist areas, this may be the result of lack of capital, training and qualified personnel.

vi. Assessing potential impacts of tourism development

This category includes applications which may integrate all the previously mentioned features of GIS and which employ the more complex analytical capabilities of GIS. The 'what if...?' question refers to the development and evaluation of different scenarios. **Visual impact analysis** may be undertaken in a number of tourism planning projects especially in the case of scenic or of high aesthetic value environments (Miller *et al.* 1993). Tourism relies strongly on the attractiveness of the landscape and therefore, GIS can be a valuable tool for evaluating proposals and alternatives (Butler, 1993; Bahaire & Elliott-White, 1999).

Selman *et al.* (1991) produced a Digital Terrain Model (DTM) for the Aonach Mor in Scotland. This was used to provide a visibility analysis of the skiing development. The impacts of the development on vegetation and on competing land uses were also considered. Miller *et al.* (1994) developed an application, which among others provided scenery and visual impact assessment in the Cairngorm Mountains in Scotland. Lake District National Park Authority (LDNPA, 1995) used GIS to identify the areas from which proposed forestry schemes within the National Park and wind farms outside the park would be visible. SpaMe (Beedasy and Whyatt, 1999), a spatial decision support system for tourism planning on developing islands, is further enhanced by adding a visibility analysis component. As the authors argue, it is important to explore the visual qualities and examine the visual impacts of developments as tourism sites competitiveness depends on scenic landscapes and natural attractions provided.

Community involvement and participation applications are also related to this category. Participatory processes in planning for sustainable tourism are considered to enhance the evaluation of developmental alternatives in which different groups or individuals may have conflicting interests or perceptions. Community involvement in decision making is seen as important for asserting some degree of local control over decisions on development plans (Mowforth and Munt, 1998), incorporating locals' knowledge and distributing equally potential benefits and costs. GIS have been used in a number of cases as the facilitator of participatory processes as illustrated in the examples that follow. However, as Carver (1991); Armstrong (1994); and Feick and Hall (2000) argue, the capabilities of traditional GIS in group decision making should not be overemphasized as it lacks those mechanisms for multiple users access and for incorporating the diverse priorities on the evaluation and therefore should be expanded to encompass the necessary methods and tools for group decision-making.

Bahaire & Elliott-White (1999) cite the Brecon Beacons National Park project in which, maps generated from the GIS were used to facilitate locals and planners discussion and provide focus at public meetings. The TourPlan system (Feick and Hall, 2000) is a GIS-based decision-support system designed to assist individuals and groups to explore alternative development strategies while building consensus and identifying conflict in land use planning for tourism. A sample application was conducted in West Bay District of Grand Cayman involving four basic types of participants: government, nongovernment, private sector and the general public. PAGIS (Hasse 2001) is another GIS-based system aiming not only to facilitate the planning process for tourism involving all the basic functions of a GIS system (data

storage, manipulation and display) but also to facilitate participation processes as a mean to broaden understanding and communication between various stakeholders. Emphasis is placed on integrating into the GIS systems complex forms of qualitative local knowledge such as values, emotions and perceptions. Locals' knowledge is represented as one of the thematic map layers while experts' knowledge is represented in other layers.

Ultimately, the '*what if...?*' question and the modeling and analytical capabilities of GIS refer to **supporting decision-making**. Although GIS is not a Decision Support System (DSS) itself, it can function as a decision support system as with its functions and applications (such as those preceding) can provide the necessary information in different forms (tabular, maps etc), perform calculation, and visualize results and therefore support a number of decisions. As Boyd *et al.* (1994) state GIS is rather a method for providing information in a form on which decisions can be based than a decision making tool. Mc Adam (1999) recognizes GIS's contribution to decision-making in providing value-added information. This value-added information is a product of GIS ability to identify patterns or relationships based on particular criteria thanks to its graphical display, data manipulation and spatial analysis and modeling functions.

Beedasy and Whyatt (1999) developed a decision support system (SpaME) to assist tourism planning in Mauritius. SpaME is designed to take into account all criteria simultaneously and to facilitate user's understanding of the decision problem, as well as, of the interactions that may take place between these criteria on a dynamic environment. Although GIS based, the system's analytical capabilities are further enhanced using appropriate models and multicriteria evaluation techniques. Feick and Hall (2000) describe the development of TourPlan, a GIS-based decision support system designed to allow multiple participants from various sectors to explore alternative land-related development strategies in Small Island States. The system has a tourism-based land management orientation meaning that it assists the designation of appropriate land for tourism-related development or for a competing land use.

GIS AS A DECISION SUPPORT SYSTEM FOR SUSTAINABLE TOURISM DEVELOPMENT

It can be noticed that the evolution of GIS applications in tourism is very close to the three phases of GIS applications as described by Crain and MacDonald (1984). First there were the '*inventory applications*' for assembling and organizing features of interest and which performed mainly simple data queries such as the location and condition questions identified by Rhind (1990). At a second stage there were '*analysis applications*' in which more complex analytical operations were undertaken. The third stage is related to '*management applications*'. It actually reflects the evolution of an information system from a transaction processing system to a decision support system (Crain and MacDonald, 1984). Tourism planning and management has still a lot to benefit from GIS. So far most of the '*management applications*' are related to identifying most suitable locations for developing tourism activities while other

important issues such GIS contribution to the management of existing destinations and to the implementation of sustainable tourism principles is neglected.

Although GIS is not widely considered as a decision support system in itself its contribution in supporting decision making has been acknowledged (Boyd *et al.*, 1994; Mc Adam, 1999; Nicholls, 2001). It is not the aim of the present research to argue on whether GIS is a decision support system or not. The arguments are strongly related to the point of view, whether this is the GIS application or the decision support systems literature. What is examined here is the potential of GIS to contribute to sustainable tourism decision-making.

Malczewski (1999) identifies GIS contribution in all the three phases of a decision-making process. GIS can ideally perform the data acquisition, storage, processing and management that the *intelligence* phase implies for identifying opportunities or problems. The *design* phase is related to the development and the analysis of possible alternatives to the problem identified in the intelligence phase. In a spatial context, GIS, spatial decision alternatives are derived by manipulation and analysis of the data stored in a GIS, using its overlay function. The third and last phase is the *choice* phase and is about the evaluation of the alternatives. GIS contribution here is not as strong as in the previous two. All three phases necessitate the identification and use of sustainable tourism indicators for assessing present situation, identifying weaknesses, monitoring, and evaluating alternatives. GIS could be the technology to use for identifying and monitoring the indicators.

ADVANTAGES OF THE USE OF GIS IN DECISION-MAKING FOR SUSTAINABLE TOURISM

GIS have a number of advantages for supporting decision-making and planning for sustainable tourism. Tourism is an activity which strongly implies the geographical dimension for all, the users (the tourists), the providers and the planners. GIS is the technology specifically developed for the management and study of spatial phenomena. Moreover, tourism is a complex phenomenon involving besides its spatial dimension, social, economic and environmental implications. It involves tourists and locals in an interactive way; it generates income, which in many destinations is the major source; and it 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 and quantitative in a single system. This is even more important within the context of sustainable development the implementation of which regards the evaluation of economic, social and environmental parameters against pre-established targets. Additionally, focusing on the environmental parameter of tourism, GIS has proved to be able to handle a number of different cases related to environmental management.

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 –such as remote sensing, GPS, CAD etc.- (Malczewski, 1999) which

could further facilitate and offer more tools to sustainable tourism planning and decision-making. Another competitive advantage of GIS technology is that, because of its adaptiveness to add or remove 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 and as tastes and preferences in demand change over time (Beedasy & Whyatt, 1999). This characteristic could be of particular importance in sustainable tourism decision making as both preferences and targets may change in the course of development and in the course of operationalizing the concept of sustainable tourism.

The concept of sustainable tourism development is a subject of an on-going debate while its implementational aspects are still fuzzy. This is even more apparent in sustainable tourism management of mass tourism. The development of a GIS based decision support system for sustainable tourism planning and management could have a significant contribution in highlighting implementational aspects and offer the framework and the tools for evaluating, monitoring and planning sustainable tourism. Such a system would need to include indicators, criteria for their evaluation based on established policy goals and possibly weights to reflect relative importance of the parameters examined. Therefore a coherent framework should be developed contributing in this way to the sustainability debate and the operationalization of the term. With particular reference to indicators, GIS can contribute not only to their measurement but also to their definition. GIS distinctive ability, to generate new information (Cowen, 1988) from the existing datasets and thus offering added value information, can lead to the identification of sustainability indicators which otherwise would not be possible to be defined and measured. This is even more important since talking about sustainable development indicators for which combined information from different disciplines is necessitated while applicable data are not often available.

Because of GIS' efficiency in producing maps and other tabular displays, comparisons are facilitated for example, between tourism resource features and resources needed for other activities (Williams, 1996; Paul and Hainsworth, 1996) and thus decision-making is facilitated. The information communication capabilities of GIS are another feature which assists decision making. As mentioned in the applications section, GIS was used in a number of cases to enhance citizens and stakeholders participation. This aspect can turn out to be a valuable contribution as there is a growing belief that such participatory processes are essential in achieving sustainable development (Harris *et al.*, 1996; Nicholls, 2001)

LIMITATIONS

Bahaire and Elliott-White (1999) conclude that GIS is a very useful tool which can support decision-making in sustainable tourism planning and management based on the sensitive use of resources and locals' needs (Millar *et al.*, 1994: 120). However, they note that GIS is just a tool and it does not by itself ensure fairness, equity and compatibility with sustainability principles. Bahaire and Elliott-Whyat argue that GIS is not 'asocial', nor is it 'neutral'. It may be manipulated to support policies of certain

interests. As Pickles (1996: 234) argues although GIS can enhance access to information and therefore enhance democratic practices they can also be used to promote the interests of particular groups having access to the technology. Anyway, GIS do not make the decision themselves; they may facilitate data processing and analysis as well as communicate results but according to Bahaire and Elliott-White they are “unlikely to alter the political character of policy making and thereby produce a more sustainable tourism planning practice”.

It could be thus suggested that those techniques and methods, which would safeguard the compatibility of both, the process followed and the results, should be identified and integrated into a system for decision support for sustainable tourism.

Further limitations arise from the concept of sustainable development itself and the policy making context for tourism in Greece. The concept of sustainable tourism as already mentioned is still vague and implementational aspects are not fully elaborated yet. Moreover, the multidimensional character of sustainable tourism would necessitate diverse kind of data for planning and management, which are not available in most cases. The fuzziness on tourism policy making is another constraint. It is not clear in Greece who performs the tourism planning –national government, local authorities, stakeholders- not to mention if there is actually any coherent planning. This rises concerns over the user of a system for decision support for sustainable tourism with apparent implications on its design.

However, as mentioned in the previous section, awareness on the potential benefits of systems for supporting decision making in sustainable tourism could act as a stimulus for further research on the field as well as for the establishment of the procedures and the mechanisms to provide the context for policy making and data collection.

CONCLUSIONS

The literature review, which was performed on the topic of GIS applications in tourism, revealed that most applications are related in one way or the other, in identifying areas suitable for tourism development. Regarding sustainable tourism this is also the case while there is also consideration for the participation of the public in the decision-making and the planning process. The evolution of GIS applications in tourism planning implies that systems which will support decision-making effectively and in integrated way need to be developed. This is even more challenging respecting the vision of implementing sustainable tourism and particularly in existing popular destinations. GIS technology may provide the basis for the development of systems to support decision-making for sustainable tourism. Such systems should be integrated and capable of identifying weakness in the form of development followed, evaluate alternatives and monitor change.

For developing such systems there is an apparent need to identify methods and techniques which will safeguard that evaluations made, in all the detection, scenario and monitoring phases, are consistent with sustainable tourism principles. In

operational terms, this would include at a first stage, the identification of proper indicators, criteria and policy goals for sustainable tourism development. Modeling for sustainable tourism should also be a consideration in case that simulation is needed.

REFERENCES

Armstrong, M. (1994) "Requirements for the Development of GIS-Based Group Decision-Support Systems", in *Journal of the American Society for Information Science*, 45 (9): 669-677

Bahaire, T., M., Elliott-White (1999) "The Application of Geographical Information Systems (GIS) in Sustainable Tourism Planning: A Review. In: *Journal of Sustainable Tourism*, Vol. 7, No. 2.

Beedasy, J. and Whyatt, D (1999) "Diverting the tourists: A spatial decision-support system for tourism planning on a developing island", in *ITC-Journal*, (3-4): 163-174

Berry, J.K. (1991) "GIS in Island Resource Planning: A Case Study in Map Analysis". In: Maguire, D. et al. (eds) *Geographical Information Systems: Volume 2 Applications* (pp. 285-95), Harlow, Longman.

Bishop, I.D. and Gimblett, H.R. (2000) "Management of recreational areas: GIS, autonomous agents, and virtual reality", in *Environment and Planning B: Planning and Design*, 27(3): 423-435

Boyd, S., Butler, R., Haider, W. and Perera, A. (1994) "Identifying Areas for Ecotourism in Northern Ontario: Application of a Geographical Information System Methodology". *Journal of Applied Recreation Research*, 19 (1): 41-46.

Boyd, S.W. and Butler, R.W. (1996) "Seeing the Forest Through The Trees: Using GIS to Identify Potential Ecotourism Sites in Northern Ontario". In: Harrison, L.C. and Husbands, W. (eds) *Practicing Responsible Tourism: International Case Studies in Tourism Planning, Policy & Development* (pp. 380-403), New York, J. Wiley & Sons.

Butler, R. (1993) *Alternative Tourism: The Thin Edge of the Wedge*. In V. Smith and W. Eadington (eds) *Tourism Alternatives* (pp. 31-46). Chichester: Wiley.

Carver, S.J. (1991) "Integrating Multi-Criteria Evaluation with Geographical Information Systems", in *International Journal of Geographical Information Systems*, 5 (3): 321-339

Carver, S.J. (1995) *Mapping the Wilderness Continuum*. *Proceedings of the GIS Research UK 1995* (p. 15). University of Newcastle.

- Cowen, D.J. (1988) GIS Versus CAD Versus DBMS: What Are the Differences? *Photogrammetric Engineering and Remote Sensing*, 54: 1551 – 4.
- Crain, I.K. and MacDonald, C.L. (1984) “From Land Inventory to Land Management”, in *Cartographica*, 21: 40-60
- Dietvorst, A.G.J. (1995) Tourist Behaviour and the Importance of Time-Space Analysis. In G.J. Ashworth and A.G.I. Dietvorst (eds) *Tourism and Spatial Transformations: Implications for Policy & Planning*. Oxon, UK: CAB International
- Elliott-White, M.P. and Finn, M. (1998) “Growing in Sophistication: The Application of GIS in Post-Modern Marketing”. In: *Journal of Travel and Tourism Marketing* 7 (1), 65-84.
- Feick, R.D. and Hall, B. (2000) “The Application of a Spatial Decision Support System to Tourism-Based Land Management in Small Island States”, in *Journal of Travel Research*, 39:163-171
- Fishwick, A. and Clayson, J. (1995) *GIS Development Project: Final Report to the Countryside Commission*. Kendal: Lake District National Park Authority.
- Gribb, W. (1991) “Integrating Visitor Surveys, Environmental factors, and GIS into Recreation Planning: Site Development at Grayrocks Reservoir, Wyoming”, in *GIS/LIS '91 Proceedings*, Vol. 1, American Congress on Surveying and mapping, US.
- Harris, T.M., Weiner, D., Warner, T. and Levin, R. (1996) “Pursuing Social Goals Through Participatory GIS: Redressing South Africa’s Historical Political Ecology”. In J. Pickles (ed) *Ground truth: the social implications of geographic information systems*. New York, Guilford Press.
- Lake District National Park Authority (1995) *Tourism in the Lake District*. Kendal: LDNP.
- Malczewski, J. (1999) *GIS and Multicriteria Decision Analysis*, John Wiley & Sons Ltd, US.
- McAdam, D. (1994) Mustang 2: The Silk Road Project. *Association for Geographical Information Systems Conference Proceedings 1994*, paper 4.1.
- McAdam, D. (1999) “The value and Scope of Geographical Information Systems in Tourism Management”. *Journal of Sustainable Tourism*, Vol. 7, No. 1, pp. 77-92.
- Millar, D.R., Morrice, J.G., Horne, P.L. and Aspinall, R.J. (1994) The use of geographic information systems for analysis of scenery in the Cairngorm mountains, Scotland. In M.F. Price and D.I. Heywood (eds) *Mountain Environments and GIS* (pp. 119-132). London: Taylor & Francis.

Miller, D., Morrice, J.G., Horne, P.L. and Aspinall, R.J. (1993) Analysis of landscape Views for Visual Impact. *Association for Geographical Information Systems Conference Proceedings 1993*, paper 2.27

Miller, D., Morrice, J.G., Horne, P.L. and Aspinall, R.J. (1994) The Use of Geographic Information Systems for Analysis of Scenery in the Cairngorm Mountains, Scotland. In M.F. Price and D.I. Heywood (eds) *Mountain Environments and Geographical Information Systems*. London: Taylor & Francis.

Minagawa, M. and Tanaka, N. (eds.) (1998) *Application of Geographic Information Systems to Tourism Development Planning: A Case Study of Lombok, Indonesia*. Nagoya, Japan: UNCRD Research report Series No. 27.

Mowforth, M. and Munt, I. (1998) *Tourism and sustainability: New tourism in the Third world*, Routledge, London.

Nepal, S.K. and Weber, K.E. (1994) "A Buffer Zone for Biodiversity Conservation: Viability of the Concept in Nepal's Royal Chitwan National Park, in *Environmental Conservation*, 21 (4): 332-341.

Nicholls, S. (2001) "Measuring the Accessibility and Equity of Public Parks: A Case Study Using GIS", in *Managing Leisure*, 6 (4): 201-219

Pickles, J. (ed) (1996) *Ground truth: the social implications of geographic information systems*. New York, Guilford Press.

Porter, R. and Tarrant, M. (2001) "A Case Study of Environmental Justice and Federal Tourism Sites in Southern Appalachia: A GIS Application", in *Journal of Travel Research*, 40: 27-40.

Rhind, D.W. (1990) "Global Databases and GIS". In M.F. Foster and P.J. Shands (eds.) *The Association for Geographic Information Yearbook 1990*. Taylor & Francis, London

Ribiero de Costa, J. (1996) "Assessing Tourism Potential: From Words to Numbers". In: S. Morain and S.L. Baros (eds.) *Raster Imagery in Geographic Information Systems*, Santa Fe, NM: On World.

Selman, P., Davidson, D., Watson, A. and Winterbottom, S. (1991) GIS in Rural Environmental Planning: Visual and Land-Use Analysis of Major Development Proposals. *Town Planning Review* 62 (2), 215-223.

Shackley, M. (1997) "Saving Cultural Information: The Potential Role of Digital Databases in Developing Cultural Tourism", in *Journal of Sustainable Tourism*, 5 (3): 244-249.

Sussmann, S. and Rashad, T. (1994) "Geographic Information Systems in Tourism Marketing". In C. Cooper and A. Lockwood (eds.) *Progress in Tourism, Recreation and Hospitality Management*, Vol. 6, London: Belhaven Press, pp. 250-258.

Townshend, J.R.G. (1991) "Environmental Data Bases and GIS". In: Maguire, D. et al. (eds) *Geographical Information Systems: Volume 2 Applications* (pp. 201-216), Harlow, Longman.

Van der Knaap, W. (1999) Research Reports: GIS-Oriented Analysis of Tourist-Space patterns to Support Sustainable Development. *Tourism Geographies*, 1 (1), 59-69.

Williams, P.W., Paul, J. and Hainsworth, D. (1996) Keeping track of what really counts: Tourism resource inventory systems in British Columbia, Canada. In L.C. Harrison and W. Husbands (eds) *Practising Responsible Tourism: International Case Studies in Tourism Planning, Policy & Development* (pp. 404-421). New York: J. Wiley & Sons.