ABSTRACT
The use of information systems has long been introduced in the tourism industry resulting in a number of changes in the supply and the demand chain of the tourist product. However, their potential in tourism planning and policy making has rather been neglected. Information systems to assist decision making are even less apparent in the case of managing established popular destination, which are related to a mass form of tourism development, towards a more sustainable form of development. This paper addresses these shortcomings, arguing that information systems could contribute to various aspects of sustainable tourism. A category of information systems is the Geographical Information Systems (GIS) which are capable of handling geographical data. The potential of GIS to form the base of a decision support system for policy and decision making in sustainable tourism is explored. A literature review is performed on the topic of GIS applications in tourism as well as on GIS-based decision support literature to identify the capabilities and the shortcomings. In this way, issues of designing a decision support system for sustainable tourism as well as issues of further research are highlighted.
1. INTRODUCTION

The use of Information Technology in tourism has been an issue of growing importance during the last years. An increasing number of authors (Buhalis, 1998; Frew, 2000) is pointing out the radical and inevitable changes that will come in the tourism industry in the near future which will be dominated by IT systems affecting every step on the chain of demand and supply of tourism. As Buhalis (1998) illustrates, IT applications in tourism are related to distribution systems and the World Wide Web. They both have implications to intra-organizational as well as to inter-organizational functions and to consumers. The affected functions include the efficient, money saving, up-to-date, fast dissemination of information and thus are related to the business structure and organization, the formulation, the promotion and the selling of the tourist product.

However, this kind of applications is only one side of Information technology systems. Maguire (1991) identifies, according to the tasks performed, two types of information systems: transaction processing systems and decision support systems. Transaction processing systems are about recording and manipulating the occurrence of operations. Examples are banking and airline reservation systems. The functions emphasized in decision support systems are manipulation, analysis, and modeling to serve and support the process of decision-making, in a more structured and integrated way than mere information provision. Applications are found in a wide spectrum of users such as, company managers, politicians and government officials. The applications of information technology in tourism are strongly oriented on the first type while those related to decision making are some steps backward. This gap gets bigger concerning systems to assist sustainable tourism management in existing popular destinations, which are related to the mass form of tourism development. This failure has often been attributed to the fact that sustainable tourism remains a vague concept, difficult to transform to operational terms that can be useful in specific cases. Additionally, the different perceptions on its definition actually jeopardize the moving towards implementation (Hunter and Green, 1995; Butler, 1999).

This is not to underestimate the significance of current information systems in the tourism industry and re-orient existing interest, but rather to stress the need for complimentary research and applications. It is the aim of this paper, and of the research in process, to highlight the need for exploiting the capabilities offered by new technologies for sustainable tourism policy making. It is argued that there is a great deal of advantages which have not been exploited yet while solid and rational methodologies should be developed for designing systems for sustainable tourism. The rational approach should take into account and incorporate into a system concrete policy goals, measures as well as techniques and methods which safeguard and enhance sustainable development and thus make sustainable tourism an operational concept.

A short description is given first, of GIS applications in tourism in order to pinpoint the key features of interest in tourism planning and policy making. The great variety of these key features leads to the identification of the advantages that may result for sustainable tourism policy making as well as for building a rational planning process, from using this technology. A number of shortcomings and limitations in their use is addressed on the next section. This opportunities-limitations findings along with the needs of the planning process are framing the prerequisites in designing a system for sustainable tourism policy making and its constitutional elements.
2. GEOGRAPHIC INFORMATION SYSTEMS IN TOURISM AND RECREATION

GIS came as a result of the rapid technological developments in modern computerized systems being able to handle large amounts of data. As an evolutionary result there was the development of information systems being able to handle geographic information. It could be argued that this is the actual differentiation point between GIS and information systems: their ability to handle spatial data. Nonetheless, in their very core—and as their name implies—they are information systems. As Calkins and Tomlinson (1977) state:

"An Information System is that chain and operations that takes us from palling the observation and collection of data, to storage and analysis of the data, to the use of the derived information in some decision-making process."

Their goal is eventually about converting data into meaningful information available to support a number of actions and decisions (Benyon, 1990; Cowen and Shirley, 1991). Indeed, information has become a valuable commodity and its value depends among others, to the effectiveness of its collection, storage, manipulation and presentation (Maguire, 1991), which reflect the requirements for an information system.

During the last decade an increasing number of GIS applications in the tourism sector may be noticed. However, their numbers are not compatible with potential opportunities (Boyd and Butler, 1996; Porter and Tarrant, 2001). Among the benefits of using such techniques and technology in tourism and recreation planning are mentioned 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 change 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).

Following, there is a short description of GIS application in the field of tourism and recreation. The classification adopted is based on the objectives of each application. The aim is to outline the applications developed so far and put them in a target-related context to better understand the served needs to date and identify possible gaps or new emerging needs in terms of tourism related practices. It is very often the case that a tourism project may incorporate more that one of the following categories of applications and therefore, interrelations among them is rather the rule.

2.1. Tourism resource inventories

Tourism resource inventories have been developed to offer organized, structured information about parameters, which are of interest for tourism planners and developers. They may include natural resources, tourism and other infrastructure, demographics, cultural and heritage sites etc. GIS ability to integrate, store, and manipulate different data sets - both qualitative and quantitative, both spatial and nonspatial- and visualize them may prove very useful (Bahaire & Elliott-White, 1999). Resource inventories are usually developed to form the basis for other applications such as tourism planning and location suitability. Williams et al. (1996) 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). 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.
2.2. Tourism planning while safeguarding the environment.

This application is related to resource inventories and location suitability applications. GIS can be used to identify areas or zones which should be undisturbed by tourism or any kind of development. **Impact analysis** is related to this application as GIS can be used to evaluate potential impact of tourism development on the natural environment (Bahaire & Elliott-White, 1999). Gribb (1991) describes the planning effort that took place at the Grayrocks Reservoir in Wyoming, US. The aim was to come up with a recreation development plan that would contribute at the same time to environmental conservation of the Reservoir. Carver (1995) describes the development of a ‘wilderness continuum map’ showing areas designated as wilderness in the UK and therefore identify areas of potential risk from recreational development.

2.3. Location suitability under conflicting demands

This is in order to manage and control tourism development considering conflicting or complimentary land uses and activities, infrastructure available, natural resources and therefore define the capabilities and capacities of an area (Butler, 1993; Bahaire & Elliott-White, 1999). A well-known case of this application is the identification of areas suitable for ecotourism development. Boyd et al. (1994) and Boyd and Butler (1996) illustrate a methodology for identifying areas with potential for ecotourism in 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.

2.4. Monitor and control tourism activities

GIS may be used also to monitor and control tourism activities through time and across space. Butler (1993) advocates that the integration capabilities of GIS facilitate the identification and monitoring of indicators. Moreover, exploitation of its analytic techniques may provide more complex measures which 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 numbers 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 to develop 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 retrieval 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.

2.5. Tourism marketing

Another dimension of GIS related applications is marketing. As Elliot-White & Finn (1998) advocate, 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. Although, managers or stakeholders responsible for tourism marketing could be benefited from using GIS to locate and analyse the characteristics of potential customers. Relevant applications are rather rare. Sussmann and Rashad (1994) in the context of their research for the level of awareness managers had in GIS
regarding tourism marketing, noticed problems related to cost for capital layout, training and personnel.

2.6. 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.

2.7. Simulate and model spatial outcomes or Visual impact analysis

GIS have the ability to produce 3-D visualization of an existing area as well as to simulate a proposed development and visualize it in the context of the existing setting. Visual impact analysis can prove very useful for tourism planning 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 may be used 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. 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 those areas from which proposed forestry schemes within the National Park and wind farms outside the park would be visible.

2.8. Tourist 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. Dietvorst (1995) cites the use of GIS 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 a case-study at Broken Arrow Canyon, Arizona where, using rule-driven autonomous agents moving in a GIS-based landscape, the movement patterns of the visitors were simulated.

2.9. Community involvement and participation

The concept of sustainable development has raised awareness on the importance of community involvement and participation in the formulation of developmental plans which may affect the community. Community participation is seen as important for asserting some degree of local control over decisions on development plans (Mowforth and Munt, 1998) and for enhancing commitment to their implementation. Moreover, in tourism planning which involves various agencies and organizations, participation of groups or individuals from different disciplines may be necessitated. However, participatory processes using GIS as a facilitator is not free of criticism. It is often suggested that traditional GIS do not provide the 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 (Carver, 1991; Armstrong, 1994; Feick
Bahaire & Elliott-White (1999) cite the Brecon Beacons National Park project in which, a GIS was used to provide the maps which 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, privet sector and the general public.

2.10. Decision support

Although GIS is not a Decision Support System (DSS) itself, it can function as a decision support system as with their functions and applications (such as those preceding) can provide the necessary information in different forms (tabular, maps etc), perform calculations, 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 which 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.

3. OPPORTUNITIES

Among the general benefits often mentioned (Dickinson and Calkins, 1988; Calkins, 1991) to derive from using GIS, two broad categories are distinguished: tangible benefits such as, cost savings related to personnel time and workloads; and intangible such as better quality of data, more timely and accurate information, and better decision making. Besides these general benefits from using GIS, other, related to tourism applications as well as, to sustainable development and policy making can be identified.

3.1. Benefits in sustainable tourism policy making

It can be argued that GIS potential in tourism development and management has not been fully explored yet nor their capabilities have been exploited. Actually, a considerable number of the aforementioned applications have been developed for recreation rather than tourism. One of the reasons is that they were related to the environmental management of national parks and other attractions. GIS have been extensively used for the management of the environment and are considered as an acknowledged tool for its protection applicable in a number of cases such as monitoring, resource use optimization and allocation, zoning of activities etc. (Aronoff, 1991). Although the environment is a critical factor and resource for tourism development, GIS have not been widespread in environmental management within the tourism sector. Another contradiction lies on the fact that GIS is the technology specialized to handle geographical data and thus facilitate the study of geographic phenomena. Thus tourism, which has a very strong geographic character, could have a lot to benefit from the use of such systems.
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. All spatial, economic, sociological and environmental information can be stored in a GIS and derived from, for various forms of analysis. This integrative capability receives greater importance in the context of sustainable tourism, which calls for a balance between economic growth, environmental costs and benefits for the society. Governments –both local and national- and sustainable tourism planners can find in GIS a powerful tool for handling all the necessary information. Additionally, the essence of information systems, including geographical information systems, is to relate different data and generate new information (Cowen, 1988). This could prove once more, a valuable property in the context of sustainable tourism, since interrelations between the different parameters of tourism development as well as between tourism and other activities –the broader social and economic context in which it is operated- are very important. Actually this characteristic could be of major importance for safeguarding and enhancing sustainable development. As it is argued by many authors (Butler, 1998; Croall, 1995; Meadows, 1998) the essence of the sustainability concept lies within the incorporation in a developmental strategy of the interlinkages between different parameters of the same activity or between the activity and its broader context in which it operates.

Data manipulation and integration to offer the value added information needed in a policy and decision making process are in the case of GIS, apparently available for spatial interactions as well. Such technology has the ability to relate various parameters and attributes to their spatial context and facilitate the analysis of implications. As McAdam (1999) points out, the significant value of GIS technology lies in its ability to provide desk-top mapping through the graphical display and manipulation of data in order to identify patterns or relationships based on certain criteria and thus provide enhanced information for further analysis. The later is further enhanced, regarding the sources of gathering geographical data as well as, the techniques of storing, manipulating and analyzing them, by the ability of GIS to integrate other technologies (Malczewski, 1999). Remote sensing to extract information from satellite picture and Global Positioning System (GPS) to acquire detailed, tailored spatial information are examples of technologies with which GIS has compatible functions.

A well acknowledged capability of GIS it the visualization of the data and of the analysis process. Visualization may be offered in more common forms such as tabular displays or in the more unique form of map display. Both forms, facilitate the communication of results between interested parties as well as the analysis process itself by facilitating comparisons –for example between tourism resources and resources needed for other activities (Williams et al., 1996). Thus, visualization can facilitate certain parts of the decision making process and importantly, enhance sustainable development. As mentioned in the applications section, GIS and its visualization capabilities were used in a number of cases to facilitate and 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). Related to this is the form of planning for sustainable development. It is believed that bottom-up planning and policy making can contribute to achieving sustainability for similar reasons. Information technology can be a tool to support decentralization of planning and policy formulation. Standalone systems of distributed systems may be available for one or more users performing relevant tasks. Thus, depending on what is needed and what is legitimized, local authorities may use their own systems or in conjunction with other agencies or the central government.
Another competitive advantage of GIS technology lies on its adaptiveness to add or remove thematic layers, constraints and data. It is thus, 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.

3.2. contribution to rational planning process

In a rational planning and policy making process a first stage according to Calkins (1991) would be to define a set of goals and objectives. A first step thus, would be to identify whether problem exists with the current form of development and if it does, which are the parameters to be changed or improved. The definition of goals and objectives is followed by the definition of a decision space which is bounded by available resources and constraints posed either by resources or policy goals. As soon as the previously mentioned parameters are definite, decision criteria are set as a function of them. Based on these decision criteria a number of alternative solutions to a specific problem can be evaluated to select the most appropriate. After the implementation of the chosen action, monitoring of the results and performance evaluation can be contacted.

GIS could have a contribution in all the stages of the rational planning model mentioned above. Although not apparent and direct during the definition of goals and objectives, GIS could still have an input. As previously mentioned, the communication capabilities of GIS –namely visualization– could be used to facilitate the choice of the wishing policy goals. Another contribution at this stage would be to determine whether conflict exists between specific objectives (Calkins, 1991). More apparent is their contribution on the phase of detecting possible problems. Using the data management functions as well as more complex analytical functions of GIS, gaps or problems may be identified. During the setting of the decision space, GIS may be used to define in a specific and quantified form the resources and the constraints. For example, using the analytical functions of GIS such as buffering and overlaying, the areas which should, according to the formulated goals, be enhanced for or excluded from certain activities, be identified. This does not necessarily imply to select the exact geographic locations but also to select wishing geographical characteristics according to constraints and resources. Helping identify the spatial characteristics of certain resources or constraints may further, enable their quantification and specification. The later could prove a very handy tool in the case of sustainable development, where operational, case specific measures although required are still lacking.

This phase is followed, it is the alternatives generation and evaluation in respect of the detected problems and gaps. Regarding the evaluation of the alternatives, is also a consequence of testing, using the aforementioned decision criteria –which are a function of the goals, objectives, available resources and constraints– along with the modeling functions of GIS or more sophisticated or of different nature embed into the system. The last phases which proceed the implementation of the selected policy actions, namely, the monitoring of the results and the evaluation of performance, are also similar to the contribution related to the decision criteria phase.

4. LIMITATIONS
Millar et al., (1994) argue that GIS may support a decision making process based on the sensitive use of resources and the local’s needs. However, as Bahaire and Elliott-White (1999) note, GIS is just a tool and it does not by itself ensure fairness, equity and compatibility with sustainability principles. They continue that GIS is not ‘asocial’, nor is it ‘neutral’. It may be manipulated to support policies of certain interests. As Pickles (1996) 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. In any case, 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 argued 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.

The software advances, which have been noticed during the last decade, have not managed to alter perceptions towards GIS, which is still considered a quite complicated technology necessitating more advanced, than simple word processing, skills. This is one of the main reasons identified by McAdam (1999) in his research about the failure of GIS to be incorporated in tourism planners’ decision-making process. It could be argued thus, that there is a need for a system which will be easy to be used by non GIS experts and at the same time having incorporated all the necessary policy making and sustainability procedures and tools, to be operated by users from diverse backgrounds. The later introduces the issue of scaling of policy making. Although, it appears that a central, top-down, policy formulation would rather have the necessary resources for implementing such processes, the role and the need of lower scale policy and decision making should not be overlooked. In order, however, to make it possible for destinations to form their own plans, there are some issues which should be taken into consideration. One possible way would be, to organize regional agencies for tourism planning, responsible for a certain geographical entity. Thus, investment costs (related to purchasing hardware and software) and operation costs for expertise personnel would be divided. However, a carefully designed system which would have incorporated all necessary procedures for sustainable tourism planning, in a user friendly interface, would drastically reduce the need for various experts and offer handy, timely support. Moreover, if designed to be flexible in accommodating preferences and possible situations, it could be applicable to different end users and thus reduce further costs.

Further limitations arise from the concept of sustainable development itself. 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. 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.

5. FUTURE WORK

5.1. Prerequisites in designing the system

It could be noticed from the GIS applications in tourism section, that their evolution 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 indicating ‘where’ is found ‘what’. At a second stage there were the ‘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. Tourism planning and management have 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 are overlooked. Therefore, future work on the field of GIS in tourism should be oriented to support decision making. This is even more challenging within the context of sustainable tourism where implementation is still in its infancy. Sustainable tourism supporters could find in a GIS-based decision support system an implementational tool to incorporate various other tools and measures for planning activities. Of course, in order to develop such an information system, research for the clarification of various aspects is needed.

Taking into consideration the general prerequisites for the development of an information system for public planning as illustrated by Calkins (1991), it is argued here that the conditions to be met for an information system for sustainable tourism policy making are:

- To develop solid and clear policy goals
- To provide measures for these goals
- To develop a coherent system structure for sustainable tourism

Policy goals
Different sets of principles for sustainable tourism have been developed, mostly by organizations (Tourism Concern and WWF, 1992; WTTC, WTO and Earth Council, 1996; WTO and UNEP, 1998) for the welfare of either the environment or tourism. Besides, and in accordance with these principles, case specific policy goals need to be developed. When implementation comes to discussion, it becomes apparent that it is not clear which of the characteristics of the current tourism activity are acceptable for a sustainable form of development and which are not. This becomes even more difficult in characteristics contributing in a contradictory way to different parameters of sustainability. For example, seasonality of tourism is considered negative for employment while it may be perceived as positive for the bonding of family and social life after a hard-working tourist season (Boissevan, 1996; Black, 1996; Farsari and Prastacos, 2000).

As soon as sustainable tourism goals are identified, appropriate practices for achieving these goals should be considered. It becomes clear that for developing such an inventory, focus should be placed on specific cases of tourism development. Ideally the more specific the case, the better the result. However, as it was previously mentioned, in order to provide an information system which will be applicable in a number of cases, flexible designing should be considered. Therefore, more general forms of tourism development should guide general considerations of the system design. These designing consideration could be then elaborated to form the lower level of policy making and host case specific issues. Mass tourism in existing Mediterranean destination, is the general form chosen to give the guiding characteristics and policy needs. Although, mass tourism has been considered the opposite of sustainable tourism, a shift in this perception can be noticed during the last years. A growing number of authors have stressed the need to manage mass tourism as sustainably as possible (Butler, 1998). Defining sustainability goals for mass tourism appears to be challenging as, despite the growing market for alternative, ‘soft’ forms of tourism, it is the dominant form and it is likely to remain so in the future (Butler, 1991; Wall, 1993; Wheeller, 1993; Pearce, 1995). A
challenge lies also on the fact that in spite of the awareness of sustaining the market from declining numbers, it remains the most poorly explored form of tourism regarding sustainable development goals and actions.

**Measurements**

In order to evaluate current tourism development and identify shortcomings as well as monitor progress of sustainability policies, measures are needed. Quantification has proved to be a hard task in sustainable development as the later implies besides the measurable parameters, values of non-quantified nature. Although, it is not argued here that either monetarization or exclusion of parameters should take place, meaningful and comparable indicators should be set for sustainable tourism. Such measures are necessitated if an information system to assist policy making is to be developed.

Indicators will be used throughout most of the phases of the policy making process, starting from the detection of problems, the evaluation of the alternatives to monitoring and performance evaluation to feedback the loop if necessary. Therefore, they must be developed taking into account all the parameters of interest for sustainable tourism and according to the policy goals and objectives previously defined. The set of operational indicators to be included in the information system, should consider also the performance of policies themselves not just through general changes but specific quantified performance targets (Calkins, 1991). Additionally, indicators should be meaningful and comparable against predetermined targets.

**Rational planning model**

When designing an information system to assist policy making, a solid and coherent framework for both the system and the planning process must be developed. Although information systems to support policy and decision making are not designed –and not capable- to put aside the human factor and make the decisions themselves, they should have clear structure and inputs to serve their mission effectively. A structured system approach in policy making would maximize the systems capabilities and therefore the benefits for the process and the outcome. Therefore a rational approach to policy making, as described in a previous section, needs to be adopted. This in turn, will be reflected in all the components of the system such as the indicators, the decision criteria and the operation of the system itself.

**5.2. Elements of the system**

According to the issues previously mentioned, there are a number of elements which should be included in an information system for sustainable tourism. Outlining them, such a system, generally speaking, should include the following:

- A database including both spatial and non-spatial information. The input data to be stored in it will form the necessary information to run all the applications in the system.

- The decision space which is defined here as a function of indicators accompanied by corresponding criteria. Indicators are defined in respect to the objectives of managing tourism sustainably in a well-established Mediterranean destination. Criteria are the acceptable limits or the wishing target of a parameter or a policy. They are defined in accordance with the objectives, the corresponding indicator, the available resources and the constraints placed by the natural and socio-economic setting. Scientific evidence would be the ultimate bedrock to define criteria.
- Models are a component considered essential in a decision support system in order to simulate the real-world and make it possible for scenarios to be developed and evaluated (Prastacos, 2001). Although very useful in a number of cases related to the physical environment, it is hard to argue that a model will be developed to simulate sustainable tourism development. Within the scope of the present research, models will be considered in estimating indicators which are not possible to be measured otherwise and are important for policy making. An example would be revenues from tourism development or forecasting of arrivals. GIS have some modeling capabilities which are mostly restricted to spatial analysis. Therefore, the question would be whether to embed modeling into a GIS system or to add GIS functions into an information system capable of performing complex analytical function or a third ‘softer’ approach somewhere between the aforementioned two. The choice is actually a function of the policy goals of sustainable tourism and the goals of the system itself. For example, if the aim is a user friendly system to be operated by not highly computer skilled professionals, then a more ‘simple’ information system should be considered. However, if sophisticated spatial analysis is necessitated, even if it is performed ‘at the back’, using a ‘stronger’ GIS should be the case. Moreover, a solid and coherent system structure, makes it reproducible in a number of cases with differentiations in the contents of certain parts to adjust to case specific study.

- Procedures to safeguard and enhance sustainable development are needed in order to develop a system which will be efficient and at the same time, consistent with the principles of sustainable tourism. Therefore, those procedures and components which will safeguard compatibility with the notion of sustainable development throughout all the phases of the process, must be identified and incorporated. It is the procedures, which actually make distinctive one information system from another on what it aims to perform and whether it is ultimately achieved.

6. CONCLUSIONS

The literature retrieval on GIS applications in tourism has revealed that most applications are concentrated rather on recreation (resources management and planning for national parks) than tourism. Those having as object tourism are primarily focused on identifying the most suitable location for tourism development. Very little attention, if any, is paid on the management and planning needs of already developed, popular destinations. Moreover, regarding sustainable tourism, applications are rather at the side as a consequence of resources management than the objective of the application. GIS applications related to sustainable tourism are mostly concerned with social participation. There is an apparent lack of integrated systems to support planning and management for sustainable tourism. This lack is even more apparent regarding the sustainable management of mass tourism in popular destinations.

Garcia Falcon and Medina Munoz (1999) indicate that tourism planning in the Canarias is limited to land use planning e.g. where tourism facilities (e.g., lodging facilities, leisure facilities and other tourist infrastructure) might be located in order to protect specific areas while sustainable tourism is not actually considered. Strictly spatial phenomena such as allocation, routing, location suitability, have long been explored and will likely continue to form the critical mass in GIS applications. However, their use in other kind of applications and problem solving should be encouraged. In the era of sustainable development, which calls for environmental, economic and societal equity, GIS use should be reevaluated in this context to integrate spatial analysis where needed along with non-spatial characteristics.
However, in order to develop systems for sustainable tourism policy-making and management, certain aspects should be elaborated in advance incorporated into the system. These are related to the policy goals for sustainable tourism in a case specific context, related measures, and procedures and techniques for ensuring compatible operation between the technical requirements of the system, the policy making environment and the principles of sustainable development.
7. REFERENCES


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