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## THE APPLICATION OF GIS IN SUSTAINABLE TOURISM MANAGEMENT

### Abstract

*The direction of future development of tourism destinations has been determined by market trends, including a need to preserve natural and anthropogenic resources. Considering previously mentioned, this research paper presents Geographic Information Systems (GIS) as an innovative approach of managing sustainable tourism. In this regard, the subject of the paper is to determine if GIS has positive impacts on sustainable tourism management. The paper is based on academic publications from different scientific disciplines: tourism, sustainable management and information technology (IT). Research outcome validated the primary hypothesis, which indicated that GIS application could be beneficial for decision-making process in sustainable tourism. The importance of the research results is reflected as a contribution to theoretical foundation for sustainable tourism, as well as a determination of its' innovative perspectives as a smart sustainable tourism.*

*Key words: geographic information systems (GIS), sustainable tourism, innovation, technology*

**JEL classification: Z32**

## ПРИМЕНА ГИС-А У МЕНАЏМЕНТУ ОДРЖИВОГ ТУРИЗМА

### Апстракт

*Правац будућег развоја туристичких дестинација обликован је прилагођавањем трендова на тржишту, уз потребу очувања природних и антропогенних атракција. Имајући у виду наведено, истраживачким радом је представљен иновативан приступ коришћења географских информационих система (ГИС) за управљање одрживим развојем туризма. Циљ овог рада је утврдити да ли употреба ГИС-а има позитиван утицај на менаџмент одрживим туризмом. У изради рада доминирају секундарни подаци из академских публикација у области туризма, менаџмента одрживог развоја и информационих технологија (ИТ). Резултати рада потврдили су почетне хипотезе, при чему је установљено да постоје користи од коришћења ГИС-а у процесу доношења одлука за потребе одрживог развоја туризма. Допринос овог рада огледа*

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*се у проширивању теоријског оквира одрживог туризма, као и утврђивању иновативних перспектива његовог развоја.*

**Кључне речи:** *географски информациони системи (ГИС), одрживи туризам, иновације, технологија*

## Introduction

Research on sustainable tourism has been done over the last 30 years extensively (Hunter, 1995; Hardy et al., 2002; Ritchie & Crouch, 2003; Liu, 2003; Pigram & Wahab, 2005; Lu & Nepal, 2009; Miller et al., 2010; Harris et al., 2012; Higgins-Desbiolles, 2018; Streimikien et al., 2021). Studies have also made a connection between sustainable tourism and information technologies (Hjalager, 1997; Yaw, 2005; Ali & Frew, 2010; Alie & Frew, 2014; Gossling, 2020; Fernell, 2021), although Liu (2003) points out that “sustainable tourism debate is patchy, disjointed and often flawed with false assumptions and arguments” (pp. 459). Nowadays, the emergence of the smart tourist destinations has given rise to new prospects for achieving the necessary tourism sustainability. This resulted in interchange of traditional concepts of tourism and sustainability, which now include long-term planning, innovation and cooperation (Ribe & Baidal, 2018).

Increased development of tourism destinations and growing number of tourists have caused numerous negative effects, which Jordan et al. (2019) ranged from increased traffic and crowding to increased cost of living or environmental degradation. Su et al. (2018) pointed out that negative environmental impacts might result in diminished sense of residents’ wellbeing and security. These concerns have led to development of numerous methods (Lu & Nepal, 2009; Molina-Azorin & Font, 2016) for their prevention, including technology use. If effectively implemented, IT could affect tourists’ attitudes and following intentions toward environmental preservation (Tan & Law, 2016).

In order to have a successful spatial modeling and analysis for sustainable tourism purposes, it is necessary to make use of location-based systems such as GIS, which are known as the most efficient technology for this tourism management approach (Longley et al. 2015; Omardadeh et al., 2021). Some destination management organisations have already used GIS, but primarily for charting tourist movements and routes during their stay in the tourism destination (Ali & Frew, 2013). Considering the facts above, developing GIS model for sustainable management could be beneficial for preservation of tourism resources and tourists’ loyalty, which will result in long-term sustainability and profitability.

With regards to the facts mentioned above, this research paper is based on two hypotheses:

Hypothesis 1: GIS application by Destination Management Organizations has positive impacts on sustainable tourism development.

Hypothesis 2: GIS application by Destination Management Organizations has positive impacts decision-making process in sustainable tourism.

## Methods

Relating to the subject and the main goal of the research, the paper is based on secondary data research of academic publications in subsequent scientific disciplines: tourism, sustainability management and ICT.

Based on the information collected, the results of the research were presented in detail in two steps:

1. GIS usage for development of sustainable tourism: Literature review
2. GIS based sustainable tourism development: Case studies

### **Gis usage for development of sustainable tourism: literature review**

Emerging tourist market trends are conditioning destinations to change and adapt, accepting sustainability as one of the main developmental focuses. According to Amerta et al. (2018) sustainable tourism development can be achieved if the usage degree of different resources does not exceed beyond their regeneration capacity. Besides, the quality of decision regarding sustainable tourism depends on the accessibility and the reliability of the information about the resources being managed. The flow of information between stakeholders is essential if the primary goal is to manage resources in a sustainable manner (Latu, 2009). Thus, sustainable tourism development must be based on combining GIS and spatial decision-making tools that can serve as decision support systems (Jokar et al. 2020). In other words, sustainable tourism has to be developed in a organized approach where GIS is thought about as a suitable framework for land suitability (Jokar et al., 2021) and decision-making for future land-use planning (Malczewski and Rinner, 2015).

Bahaire & Elliot-White (1999) were one of the first researchers to point out a role of GIS in investigation of environmental conditions, assessment of site suitability for planned development and identification of conflicting interests. Besides them, few authors have studied GIS and its application in sustainable planning process. Aminu et al. (2013) have proposed an integrated use of GIS, ANP and Water Quality Index (WQI) for sustainable tourism planning. Patwal (2013) have suggested GIS-supported sustainable tourism infrastructure planning approach (STIP), which is focused on creating a sustainability dimensions' package (i.e., corresponding to development goals, favorable tourists' experiences etc.) in GIS based tourism planning.

Considering these different approaches of GIS usage in sustainable tourism development, it could be concluded that the role of GIS is crucial in this process. GIS can be used for analysis, planning and monitoring of indicators, conflicts leading to the identification of optimum locations for tourism development (Kyriakou et al., 2017). Further, many authors have presented capabilities of GIS related to tourism sector, namely tourism resources inventories, identifying optimal locations for development, measuring tourism effects on natural resources, analysing relationships associated with resources use, and evaluating potential positive or negative results of tourism development (Bahaire & Elliott-White, 1999; Farsari & Prastacos, 2004; Miller, 2008; Albuquerque, 2018). In addition, Cvetković & Jovanović (2016) pointed out the significance of GIS usage

for the analysis for master planning in sustainable tourism, which is used worldwide to prepare regions for development and growth. GIS-driven master plans can track the environmental impacts of tourism and will most likely be increasingly crucial for destinations experiencing rapidly growing tourism demands.

Besides the fact that sustainable tourism includes environmental protection, it also incorporates social and economic aspects of the surrounding living conditions and tourist areas (Janusz & Bajdor, 2013), which means that GIS could be used for improved waste management, energy monitoring, information comparison and integration and fostering better decision-making (Ali & Frew, 2014). This complex process of making decisions in order to solve key issues for sustainable tourism could be facilitated by enabling easily available and concise information. With this information attainable to them, destination managers could focus on practising sustainable tourism management. Using technology for sustainable tourism will enhance communication between tourists and tourism organizations by building platforms where every stakeholder could exchange information on sustainable tourism questions (Ali & Frew, 2013).

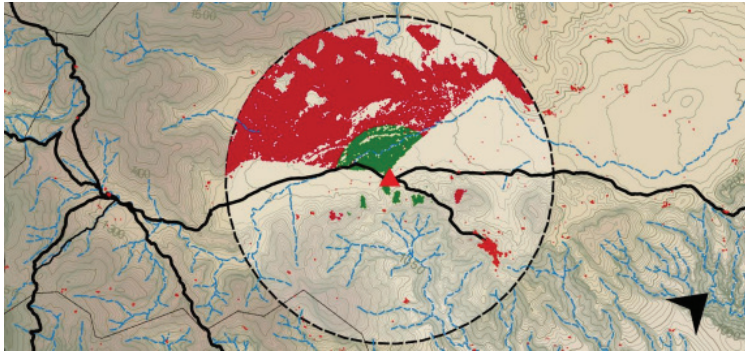
Having this in mind, it is essential to respond to the requirements of those interested groups in order to successfully plan and implement tourism strategies (Hall, 2008; Rasoolimanesh et al., 2020). Sustainable tourism needs to address several issues, including: environmental protection and financial health, guest satisfaction and promotion of community well-being (Hardy & Pearson, 2018; Amerta et al., 2018; He et al., 2018; Chan et al., 2020). Thus, it is of great importance for these stakeholder groups to accept and implement GIS, as a tool for accomplishing sustainable tourism goals.

### **Gis based sustainable tourism development: case studies**

The research of GIS application in sustainable tourism development, although not detailed enough, has been done during the last decade. Several examples of GIS usage in sustainable tourism are given in this chapter of the review paper. In addition, the examples emphasise the need of further research in this area, as it could be valuable for sustainable development of tourism in the future.

García-Esparza and Altaba used GIS to analyze Vistabella del Maestrazgo, Spain and identified landscape areas of tourism value (presented in green) and surroundings (presented in red). In addition, they fragmented these areas considering their historical, cultural, ethnographic and intangible values. The fragmented areas are located in the green area, as shown in the Picture 1.

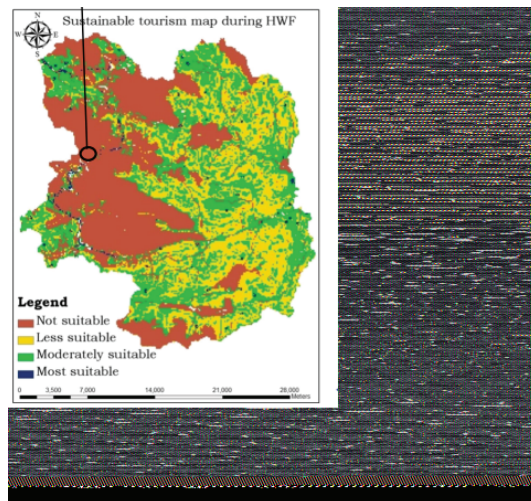
**Picture 1:** GIS presentation of tourism valuable areas in Vistabella del Maestrazgo, Spain



**Resource:** García-Esparza & Altaba (2018)

Ghorbanzadeh et al. (2019) used fifteen geographical factors grouped in four clusters: water attractions, forest attractions, mountain attractions and scenic spots in Iran. These four layers, presented in GIS, were used for identification of the most visited tourism sites (presented in red) and areas with no tourism value (presented with dark blue). This research could be used for further identification of sustainable tourism sites and their categorization by the level of sustainable significance (economic, social and environmental).

**Picture 2:** Mapping potential nature-based tourism areas by applying GIS-decision making systems in East Azerbaijan Province

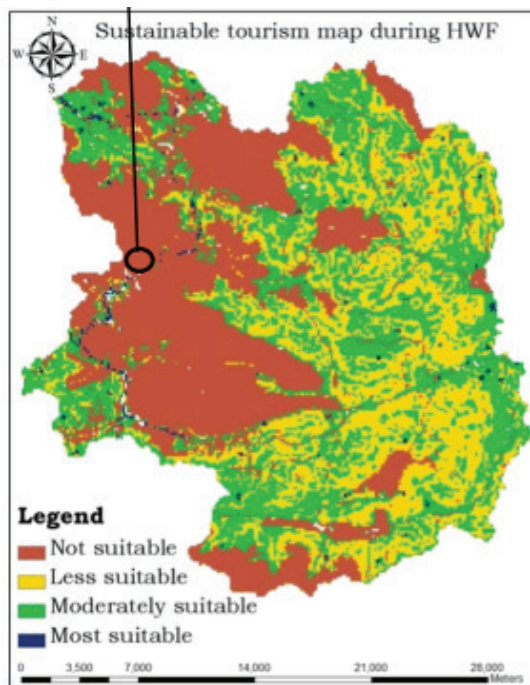


**Resource:** Ghorbanzadeh et al., (2019)

Aminu et al. (2017) identified areas in Cameron Highlands (Malaysia) for sustainable tourism development, which are mostly areas that are less sensitive to human

interference - that occupy only 0.57% (presented in blue). They have also distinguished constraint areas, which are areas that would be conserved from tourism and related sustainable development (presented in red).

**Picture 3:** Analytic network process (ANP)-based spatial decision support system (SDSS) for sustainable tourism planning in Cameron Highlands

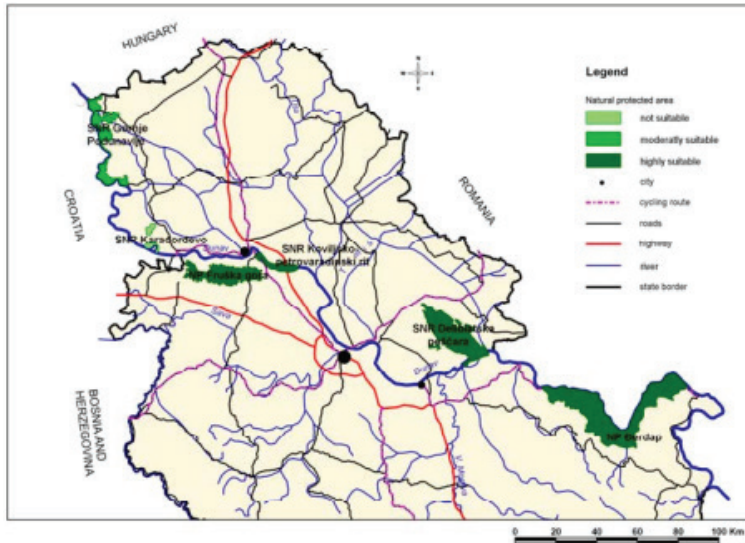


**Resource:** Aminu et al., (2017)

GIS analysis of sustainable tourism locations in Serbian Danube region has been done by Stojković et al. (2015). The research showed the most suitable protected natural areas for sustainable development: Fruška Gora National Park and Đerdap National Park, as well as the Koviljsko-Petrovaradinski Rit Special Nature Reserve and Deliblatska Peščara Special Nature Reserve, moderately suitable location - Gornje Podunavlje Special Nature Reserve, and the only unsuitable location - Karađorđevo Special Nature Reserve.



**Picture 4:** Application of multi-criteria analysis and GIS in ecotourism development



*Resource:* Stojković et al., (2015)

## Conclusion

With increasing tourist arrivals and their negative impacts on tourism resources (both natural and anthropogenic), it has become crucial to sustainably develop tourism. Although the area of sustainable tourism has been researched, there are still unexplored areas and approaches. In order to broaden strategic knowledge of tourism sustainability, it is necessary that the stakeholders implement GIS in sustainable tourism management.

Four case studies (García-Esparza & Altaba Tena, 2018; Ghorbanzadeh et al., 2019; Aminu et al., 2017; Stojković et al., 2015) have been presented in the research in order to determine different solutions of GIS usage in sustainable tourism. These approaches are based on analyzing developed or undeveloped tourism destinations in order to determine suitable and unsuitable areas for tourism development.

The research showed that GIS could be used for identifying the most suitable locations for sustainable tourism development and those locations that are unsuitable for this type of tourism. GIS could be also used for measuring tourism impacts on natural and anthropogenic resources and analysing relationships associated with resources use. Authors have also suggested using GIS for master planning of sustainable tourism and, improving waste management and energy monitoring. These facts confirmed primary hypotheses that GIS application has positive impacts on decision-making process in sustainable tourism and overall – on its' development.

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