

Geographic Information Systems: A Toolbox for Sustainable Tourism in Southern Africa

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Abstract

Achieving sustainable tourism is a multidisciplinary process fraught with development planning obstacles that require advanced spatial data and information system management. Tourism growth and planning pronouncements are becoming increasingly complex without a corresponding organised computerised spatial data and information management system. Tourism organisations are also grappling with the challenges of achieving sustainable tourism development. The emergence of geographic information systems technology can help address the challenges associated with achieving sustainable tourism development. Geographic information systems technology provides opportunities for spatial data and analysis of tourism resources for sustainable development. Through content analysis, this study reviews how geographic information systems technology can contribute to sustainable tourism development. Specifically, the authors examined the role of geographic information systems technology in managing environmental impacts, analysing the suitability of locations, identifying conflicting interests, and modelling relationships for sustainable tourism development within the Southern African context. The findings indicate that geographic information systems technology has the potential to contribute to sustainable tourism development and achieving sustainable development goals. It offers a snapshot of the state-of-the-art in this rapidly evolving field to tourism academics, managers, and policymakers.

Keywords: Tourism growth; sustainable tourism development; geographic information systems

Introduction

Tourism has grown at an astounding rate in recent years. The proliferation of this field has converted it into an instrument for development with enormous contributions to the creation of jobs, economic growth and entrepreneurship, especially in the Global South (Hunt et al., 2019; Ramaano, 2022; Sharpley & Telfer, 2015; Tidd & Bessant, 2020). Other beneficial effects of tourism may be cultural interaction, protecting the environment, improving living standards, establishing a better image of destinations, and spreading messages of peace and love around the world (Mashapa & Dube, 2023; Brown et al., 2023; Dube & Nhamo, 2020; Nunkoo et al., 2017). As increasing numbers of areas are being developed as tourist attractions, adequate planning, development, and operations have become essential to ensure environmental, social and economic sustainability again related to potential damages that tourism development could cause in communities (Nyikana, & Tichaawa, 2022; Rogerson & Rogerson, 2020). Consequently, concepts such as sustainable tourism have become more prevalent in the context of ethical travel. Sustainable tourism seeks to develop tourism without obliterating the environment, economies, or communities (Rogerson et al., 2022; Giddy & Rogerson, 2018; Nunkoo & Gursoy, 2012; Nunkoo & Ramkissoon, 2016; Rogerson, 2017; Tsai, 2016).

Moreover, sustainable tourism principles offer a constant development process that applies to tourism in urban and rural areas, resorts, coastal areas, mountains, and protected areas (Rebollo & Baidal, 2003; Siakwah, 2018). These principles can also be used for all types of tourism and recreation. Several studies have highlighted the predicament that tourism is not environmentally friendly and causes severe adverse environmental effects owing to infrastructural development (Atanga & Tichaawa, 2020; Li & Zhang, 2022; Harilal et al., 2019; Mashapa, 2016; Cole, 2015; Rogerson, 2008). Likewise, inadequate measures to meet tourists' needs, such as energy consumption, water resources, and waste disposal, have also been accentuated (Kelly & Williams, 2007; Martinez-Ibarra, 2015; Tortella & Tirado, 2011). Counter to poor tourism planning and decision-making; the gap widens when it comes to systems that aid in managing sustainable tourism at existing popular destinations (Makoni & Tichaawa, 2017). This failure has frequently been linked to sustainable tourism, which remains a nebulous notion challenging to translate into operational concepts applicable to specific circumstances. Additionally, there are various interpretations of its definition of imperil movement (Butler, 1999; Hunter & Green, 1995). As a result, this situation demands innovative, viable management solutions such as geographical information systems to be implemented in the tourism sector (Jones et al., 2023; Ulmasova, 2014).

Geographic Information Systems (GIS) is a broad term that connotes a computer-based application for mapping and analysing data (Erdin & Akbaş, 2019). Madkour (2015) noted that GIS applications in tourism management and planning began in the early 1990s. Goodchild (2010) highlights that GIS has been a technologically developed system with advanced information comprehension and data visualisation during the last two decades. The literature further indicates that GIS technologies can be used to acquire, store, analyse, retrieve, and manage the diverse and extensive data required by the industry to estimate indicators and aid decision-making throughout the planning, monitoring, and assessment phases (Jones et al., 2023; Masron & Osman, 2015). The application of GIS in tourism development has been demonstrated in the literature (Chang, 2019; Ramaano, 2022). However, the role of GIS in sustainable tourism development, emphasising Southern Africa, is not yet visible in the literature. Southern Africa is a stronghold for tourism development in Africa, and the use of GIS technologies in this era of high information communication technology could be an added advantage for sustainable tourism in the region. Besides the aim of this study to the literature and future research, a synthesis of the contributions of GIS to sustainable tourism development planning in the region can inform future decisions and management of the Southern African sector.

Based on the above discussion, this study discusses the potential contributions of GIS technology to sustainable tourism planning and management in South Africa. The aim is to highlight the importance of exploiting the possibilities of this technology for developing sustainable tourism policies. The authors believe that efforts to harness the power of GIS technologies for sustainable tourism management in Southern Africa appear to have overlooked several benefits. Therefore, a comprehensive review of the literature on GIS applications in tourism will help identify current trends and areas for future research to identify key GIS features that can be used to plan for sustainable tourism growth.

This study is comprised of seven main sections. In addition to Section 1, which introduces this chapter to readers, the remainder of this paper is structured as follows. Section 2 reviews the literature on GIS and its role in sustainable tourism development, and Section 3 unfolds the research design and methods of this study. Section 4 synthesises the key thematic areas of geographic information systems for sustainable tourism development in Southern Africa. Section 5 highlights the critical role played by GIS in sustainable tourism development in

Southern Africa. Section 6 emphasises the limitations of the study, and Section 7 concentrates on the conclusions and recommendations.

The role of GIS in tourism development

According to Blasch et al. (2011), Geographic information systems (GIS) are essential tools that enable the representation, storage, management, analysis and visualisation of geographical and non-spatial data on an integrated platform. This spatial and non-spatial data is called geographically referenced information. This includes spatial data that describes the location and characteristics of a geographical phenomenon (Jones, 2014; Jovanovic, 2016; Shelton, 2022). These are highly effective tools because they integrate geographic and attribute analysis, resulting in a more accurate interpretation of data that can be used in various disciplines. Tourism development is a geographical phenomenon that requires collecting and analysing spatial data (Elwood et al., 2012; Jones et al., 2023) to explicitly discover and understand the feature relationships in a spatial context. Therefore, geographic information systems can be considered an important commercial tool for tourism. According to Conti et al. (2012), tourism planning problems have spatial or geographical characteristics and are becoming increasingly multidimensional and complex. Therefore, it is likely that projects can be managed more precisely using the techniques and tools of a GIS environment.

Although tourism has expanded significantly from 1950-1960, its contribution to visitor arrivals and earnings in developing and developed nations has not been equal. According to the United Nations World Tourism Organization [UNWTO] (2019), global international tourist arrivals totalled around 1,4 million in 2018, an increase of approximately 5 per cent over the previous year. While international visitor arrivals in Asia and the Pacific increased from 14 million to 348 million, their numbers rose from 13 million to 181 million in the United States in 2018. International visitor arrivals to Africa rose by 7%, reaching 67 million tourists (UNWTO, 2019). Until recently, tourist activities worldwide lagged and growth stagnated due to the COVID-19 pandemic. However, on the other hand, developing nations have been accelerating their economic progress through domestic tourism (Nhamo et al., 2020). As a result, GIS applications, such as Google Maps, are increasingly being used in the tourism industry to facilitate communication and travel. This is because tourism involves travelling between local and distant areas; thus, maps are crucial for locating destinations (Asero et al., 2016)

According to Abou-Elnour et al. (2015), GIS can be used in various applications, including tourism information management systems, tourist decision support systems, visitor impact assessment studies, tourism facility inventory studies, and tourism-based land management systems. Although GIS is widely used in the developed world, its use in developing countries is still in its infancy (Bui et al., 2016; Ramli et al., 2017; Sarvajayakesavalu, 2015; Watson & Venter, 2019). A survey of GIS applications in several countries in the Global North found that it was used for scenario analysis in North America (Yang, 2016; Zhang et al., 2019) and for tourism planning in South Carolina (Merem et al., 2015). Similarly, GIS has been used to collect, analyse and plan the inventory of tourism resources in Canada (Huang, 2020; Johnson & Chen, 2021; Malik & Abdalla, 2016). In the United Kingdom, GIS has been used for planning and policy-making, leading to the development of the Tourism and Recreation Information Package (TRIP) (Bahaire & Elliot-White, 1999; Nistor & Nicula, 2021).

In Africa, geographical information systems in the tourism sector are recognised in Nigeria, Malawi, Zambia, Uganda, Kenya, Madagascar and Rwanda, among others. For example, Nigeria's National Tourist Development Corporation (NTDC) has established a spatial tourism database through GIS and other multimedia platforms (Uluocha, 2018). A



distribution census of mountain gorillas and other species was conducted using GIS in Bwindi Impenetrable National Park in Uganda (Robbins et al., 2011). Additionally, Malawi has created a bird atlas using GIS (Lee et al., 2022). While the Environmental Support Program (ESP) carried out environmental intervention and management in Zambia using GIS (Lungua & Njobvu, 2009). Additionally, in Kenya, the Laikipia Predator Project monitored lions, hyenas, wild dogs, and other known African predators using radiolocation and GIS (Kolowski & Holekamp, 2006). Similarly, GIS has been used in Rwanda to identify conservation value areas (Nzeyimana et al., 2014).

In the South African context, research has been conducted on applying GIS in various contexts. Steudel et al. (2015) assessed the contribution of surface and subsurface flows to Sandspruit river flows in the Berg River catchment using GIS in South Africa. Nshuti-Babona (2020) conducted an analysis of the participatory GIS approach to flood resilience for flood monitoring and interventions. Meanwhile, Cobbinah and Nyame (2021) examined the application of GIS in the urban political ecology of water in South Africa. Van der Merwe and Van Niekerk (2013) used GIS for gap analysis in tourism planning for the Western Cape in South Africa. At the same time, Sharma et al. (2018) developed a systematic framework for categorising GIS applications based on the fundamental problems that GIS is commonly used to investigate. In contrast, Bahaire and Elliott-White (1999) linked these categories to basic GIS operations and their potential for tourism applications. Additionally, the authors demonstrated the variety of tourism and recreation management and planning applications that can benefit from GIS technology.

Research design and methods

This research focuses on the role of GIS in sustainable development in Southern Africa. Southern Africa comprises 16 countries within the Southern African Development Community (SADC) region. SADC is the hub of the African tourism industry and requires a set of reliable geospatial information tools for managing tourism data and information for sustainable development. This qualitative research was designed to obtain insights from secondary sources of data and the existing literature on sustainable tourism development and GIS. Qualitative analysis was used because it allowed the authors to comprehensively describe and interpret GIS techniques and their application to sustainable tourism development in the region. This approach has the advantage of being able to read widely for better comprehension of the literature before drawing meaningful insights.

A targeted data search strategy was used to identify relevant electronic literature databases and library portals. The targeted search strategy began with general literature on specific topics dealing with GIS and sustainable tourism development. This broad scope was further narrowed down to the geographical focus of the study area. To obtain comprehensive perspectives on the topics, literature was compiled on the broad topics of GIS as a toolbox for spatial data collection and management, sustainable development and GIS in sustainable tourism development. This strategy enabled the authors to understand the literature in the context of Southern Africa. This strategy was useful as it allowed the authors to derive a framework of relevant themes that guided the conceptualisation of the study. The themes emerging from the literature clearly describe the capabilities of GIS as a computer-based system of techniques for the inventory of tourism resources, the suitability of destinations, the assessment of tourism impacts, the management of visitor flows, the environmental responsibility of tourism, the engagement in tourism in the Community and tourism marketing and decision support systems for tourism stakeholders. These topics address the issues of GIS application for sustainable development of the tourism sector in the SADC region.

GIS technology offers opportunities for spatial data collection and tourism resource analysis for sustainable tourism development. This study used a thematic data analysis approach to examine how GIS technology can contribute to the development of sustainable tourism. Thematic analysis is popular because it can illuminate detailed interpretation of qualitative data. Braun and Clarke (2013) explained that a thematic approach to data analysis allows researchers to gain qualitative insights from existing data sources. The thematic method of data analysis allows researchers to gain an in-depth understanding of the textual materials being reviewed for descriptive and interpretive qualitative analysis. With this data analysis method, the descriptive themes become clear and explain GIS as a toolbox and its usefulness for sustainable tourism development in the SADC region. This applies clear interpretation to identify and analyse the patterns of the topic for better understanding and resulting conclusions (Braun & Clarke, 2006; Johnson & Chen, 2021). The subject matter enabled researchers to reflexively absorb textual data to achieve research goals for meaningful action (Jones et al., 2023; Neuendorf, 2019).

Geographic information systems in sustainable tourism development

Inventory of tourism resources

A major capability of GIS can be seen in the inventory of spatial resources that tourism can benefit from (Chang, 2019; Jones et al., 2023). Resource inventories are conducted to monitor and control tourism development by considering competing or complementary land use activities, existing infrastructure, and natural resources. These inventories define an area's capabilities and size (Abou-Elnour et al., 2015; Bahaire & Elliott-White, 1999). This identification of locations technique is mainly used for nature-based tourism development. Mukherjee (2019) developed a system to detect ecotourism potential in northern Ontario, Canada. Firstly, an inventory of available resources and a list of ecotourism criteria were compiled. GIS methods have been used to rank various locations using a set of predefined criteria, resulting in places with the best or highest potential (Xu, 2020). Moreover, Eftekhari and Mahdavi (2019) utilised GIS to identify locations on Lombok Island in Indonesia as ideal places for tourism development. The inventory of potential tourism areas further needs to be verified for their appropriateness as locations for tourism.

Appropriateness of the location

The most well-known and extensively used GIS is the location appropriateness analysis. Tourists cannot be excluded from this application, and several instances of tourism include selecting places that are appropriate for tourism development, either directly or indirectly. Conflicting or complementing land uses, and activities, infrastructure availability, and enabling or restricting natural resources are all fundamental geographic characteristics that are used to assess the area's potential and capability to grow as a tourism destination (Coccosis & Mexa, 2017; Smith, 2022; Metternicht, 2018). Doorga et al. (2019) used a demonstration site in the United States Virgin Islands to demonstrate the usefulness of GIS for spatial analysis. Using a fourth model, the authors identified conservation zones, ecological study areas, and residential and recreational areas using three models to resolve disputes between conflicting uses. Mansour et al. (2020) outlined a technique for selecting sites with ecotourism potential in the context of northern Masirah Island in Oman. The primary goal was to develop a system for tourist arrival planning using GIS. Several prospective tourism development sites were discovered using map overlays and multi-criteria evaluation. Duncan et al. (2016) argued for the benefits of utilising GIS for hotel site design in Costa Rica, arguing that it enables the consideration of complicated criteria that would not be evident otherwise. When a tourism

destination is considered appropriate, the impacts of tourism can be monitored and evaluated using GIS technology.

Evaluating the impacts of tourism

Thematic category of GIS applications in sustainable tourism development is concerned with monitoring the chosen parameters through time and space rather than predicting possible consequences, as seen in the following example. GIS technology enables the integration and administration of disparate data sets within the context of sustainable tourism development, which requires environmental, social, and economic information. Xiong et al. (2018) posit that such integration capabilities make identifying and monitoring critical indications easier. In addition, by utilising the analytical and modelling capabilities of GIS, sophisticated metrics and indicators may be created, which are frequently necessary for monitoring sustainable development. Duncan et al. (2016) described a GIS prototype application created to monitor the effects of a growing number of trekking and unique interest visitors in a remote region of Nepal. In contrast, Sharma (2011) proposed constructing a GIS-based multimedia cultural archive based on her engagement in regional and site tourism management concerns in the Himalayan Kingdom of Lo in Nepal, which had recently opened to tourists. This collection, which contains data from the infancy of tourist growth, might serve as a baseline for tracking developments through time. Depending on the results of the evaluation, tourist arrivals to a destination may have to be regulated to increase or decrease in numbers. GIS is capable of managing visitors to tourism destinations.

Management of visitor flows

GIS applications are also useful for managing visitor flows, which is termed the time-space analysis of tourists. The purpose of tourist time-space analysis is to get insight into the behaviour of tourists and visitors. Historically, this was achieved by an analysis of static numbers of tourists or visitors and their socio-economic and demographic features (Coccosiss & Mexa, 2017). GIS could be an effective tool in conducting this analysis, providing a complete picture of visitor flows within a specific region or location. A greater understanding of tourists' behaviour may result in effective management of infrastructure and activities, environmental protection, and the spread of benefits such as economic gains. Tourist time-space analysis is also connected to resource relationship analysis because it entails evaluating visitors' behaviour in connection to the usage of available resources. Naibei (2018) employed a survey-based time-space analysis to better understand visitors' preferences among the park's different attractions. GIS was utilised to determine the coherence of the park's different attractions and other features. The results were then utilised to develop a more balanced distribution of visitor streams and a more efficient routing mechanism. Moreover, Hall and Ram (2019) utilised GIS to evaluate visitor mobility across the physical environment and their usage to promote sustainable tourism development. Ghafourian and Sadeghzadeh (2021) described a case study at Broken Arrow Canyon, Arizona, in which the movement patterns of tourists were reproduced using rule-driven autonomous agents moving in a GIS-based terrain. GIS is further useful for the analysis of environmental impact, management and stewardship towards sustainable development.

Environmental stewardship

GIS may be used to identify places that should remain untouched by tourism and other forms of development activity. Impact analysis falls under this area since GIS may be used to discover patterns and interactions between various components, as well as to assess the possible impact of tourist development on the natural environment (Mashapa & Maziriri, 2020; Robert, 2018;

Torrieri & Batà, 2017; Cetin & Sevik, 2016; Bahaire & Elliott-White, 1999). Another point to consider is environmental justice, a concept that has gained prominence over the last decade and is concerned with equality in the distribution of effects among diverse populations, as well as the costs and advantages associated with the location of particular industries, such as tourism. Typically, environmental justice concerns develop when unfavourable land uses, such as pollution, occur. Tourism and recreation facilities frequently represent beneficial land uses, providing recreation opportunities and good economic consequences; environmental justice can still be a concern, as the positive impacts may not benefit all demographic groups equally. Such evaluations are primarily spatial in nature - and hence heavily reliant on GIS use. It is useful for GIS technology to enhance community engagement.

Community engagement

The notion of sustainable development has increased awareness of the critical nature of community involvement and participation in the creation of plans that may affect the community. Community engagement is viewed as critical for establishing some measure of local control over development plan decisions and for increasing commitment to their execution (Ika & Donnelly, 2017; Yalegama et al., 2016; Kolopack et al., 2015; Mowforth & Munt, 2015; Ramukumba, (2014). Additionally, when planning tourism that involves several agencies and organisations, the participation of groups or persons from other disciplines may be required. However, participatory procedures facilitated by GIS are not without their detractors. It is frequently argued that traditional GIS lacks the mechanisms necessary for multiple user access and for incorporating diverse priorities into the evaluation and should, therefore be expanded to include the necessary methods and tools for group decision-making (Metternicht, 2018; Alexander, 2017; Hewlett et al., 2017; Johnson, 2016). Parker et al. (2021) mention the Brecon Beacons National Park project as an example of how a GIS was used to create maps that aided in local and planner debate and provided focus at public meetings. The Tour Plan system (Feick & Hall, 2000) is a GIS-based decision-support system that enables people and organisations to investigate various development plans while fostering consensus and detecting areas of dispute in tourist land use planning. In Grand Cayman's West Bay District, a sample application was made with four distinct categories of participants: government, nongovernment, private sector, and the public. Tourism also requires a public support system opportunity for GIS.

Support for decisions

Although GIS is not a Decision Support System (DSS), it can act like one because its functions and applications (such as those mentioned previously) can provide the necessary information in various forms, such as tables and maps, perform calculations, visualise results, and thus support a variety of decisions. As Carver (2019) explained, GIS is more of a means for presenting information in a manner suitable for decision-making than it is a decision-making tool. Abdelfattah and Kumar (2015) acknowledge the value-added information provided by GIS as a contribution to decision-making. This added-value information is a result of the capacity of GIS to discover patterns or correlations based on specific criteria through the use of its graphical presentation, data manipulation, spatial analysis, and modelling features. Similarly, Aswani et al. (2015) created a decision support system (SpaME) to aid in the development of tourism in Mauritius. SpaME is meant to take all criteria into consideration concurrently and to aid users in comprehending both the decision issue and the interactions that may occur between these criteria in a dynamic environment. While the system is GIS-based, its analytical capabilities are increased by the use of suitable models and multi-criteria assessment approaches. Furthermore, Feick and Hall (2000) discuss the creation of a Tour Plan,

a GIS-based decision support system that enables numerous stakeholders from diverse sectors to consider alternative land-use plans in the Small Island States. GIS is equally relevant for tourism marketing.

Tourism marketing

Marketing is another aspect of geospatial applications. According to Dar et al. (2021), geodemographic and lifestyle studies that can be conducted using GIS tools can make a significant contribution to meeting the needs of postmodern tourism marketing. There is an increasing trend towards more personal and individual or niche-oriented forms of tourism (Maziriri et al., 2023). Although managers and other tourism stakeholders involved in tourism marketing could benefit from using GIS to identify and analyse potential characteristics of consumers, its relevant applications are rare. Moreover, Mandi and Pranievi (2019) observed difficulties related to capital planning and training of staff for proficient skills and knowledge in GIS for tourism marketing. Hence, tourism managers and policymakers can never gain insights from the subject areas of GIS to improve the sustainable development of tourism.

GIS for sustainable tourism

The development of GIS applications in tourism closely parallels the three phases of GIS application development by Masron et al. (2015). Initially, there were inventory applications for compiling and organising interesting features, which primarily performed simple data queries such as location and status queries. This led to the development of analytical applications that performed more sophisticated analysis processes. The final phase involved the development of more comprehensive management applications that aided decision-making. Thus, GIS has enormous potential to support sustainable development approaches to tourism planning, development and management, also referred to as sustainable tourism. Unfortunately, most GIS management applications in tourism involve identifying suitable locations for tourism development. Other critical issues, such as the contribution of GIS to destination management and the implementation of sustainable tourism principles, have been overlooked.

Furthermore, tourism is a complex phenomenon with social, economic and environmental impacts in addition to the geographical dimensions of its data. Tourism interacts with visitors and residents and generates income, which is often the main source of income in many places. The tourism industry relies on the use of natural resources and the quality of the environment. GIS is a technology that allows the integration of both qualitative and quantitative data sets into a single system (Alhamwi et al., 2019; Karimi & Iordanova, 2021; Shan & Sun, 2021). All geographical, economic, social and environmental data can be stored and generated in a GIS for various analyses. This integrative capacity is particularly important in the context of sustainable tourism, which requires a balance between economic development, environmental costs and social benefits. GIS provides local and national governments and sustainable tourism planners with a robust tool to manage all the necessary data.

Additionally, the purpose of information systems, especially GIS, is to connect disparate pieces of information and produce new data (Jia et al., 2017). This may yet again prove to be a significant asset in sustainable tourism since the interrelationships between the many dimensions of tourist development, as well as between tourism and other activities, the larger social and economic framework in which tourism operates, are critical. Indeed, this trait may be critical for ensuring and promoting sustainable development. As numerous authors argued, the essence of the sustainability concept is the incorporation of interconnections between different parameters of the same activity or between the activity and the broader context in which it operates into a developmental strategy (Bibri & Krogstie, 2017; Coe & Yeung, 2015; Truffer et al., 2015).

Data manipulation and integration to provide the value-added information required for policy and decision-making appear to be accessible for spatial interactions in the case of GIS. This type of technology enables the connection of numerous characteristics and attributes to their spatial environment and the study of their consequences. As McAdam (1999) and Frye (2020) pointed out, the essential value of GIS technology is in its capacity to enable desk-top mapping via the graphical presentation and manipulation of data in order to discover patterns or correlations based on specified criteria and, therefore, give enriched information for further study. The latter is improved further by GIS's capacity to incorporate various technologies, both in terms of the sources of geographic data and the tools for storing, manipulating, and analysing them (Lu et al., 2019). Remote sensing, which extracts data from satellite images, and the Global Positioning System (GPS), which acquires comprehensive, customised geographical information, are two examples of technologies that are compatible with GIS.

The display of data and analytical processes is a well-known capacity of GIS. The visualisation may take the shape of more conventional tabular presentations or a more unusual map display. The two formats enhance the dissemination of findings to interested parties and the analytic process itself by allowing for comparisons. For example, the analysis between tourist resources and resources required for other activities is a clear illustration of this capacity of GIS (Gökkaya et al., 2017). Thus, visualisation can aid in some aspects of decision-making and, more significantly, can contribute to sustainable development. As noted before in the applications section, GIS and its visualisation capabilities have been utilised to promote and increase public and stakeholder engagement in a variety of instances. This element may prove to be beneficial, as there is a growing consensus that participatory procedures are necessary for attaining sustainable development (Bürgi, 2017; León-Fernández et al., 2018). This is connected to the method of planning for sustainable development. For similar reasons, it is thought that bottom-up planning and policy-making can contribute to attaining sustainability. Information technology may be used to facilitate planning and policy development decentralisation. One or more people doing relevant tasks may have access to standalone or distributed systems. Thus, depending on the circumstances and the amount of legitimacy, local governments may choose to operate independently or in collaboration with other agencies or the federal government.

Another significant benefit of GIS technology is its adaptability in terms of thematic layers, restrictions, and data addition and removal. Thus, it is a dynamic rather than a static tool for planners, capable of being changed as new data becomes available and as consumer tastes and preferences vary over time (Beedasy & Whyatt, 1999). This feature may be particularly relevant in decision-making about sustainable tourism, as both preferences and objectives may change over time and as the idea of sustainable tourism is operationalised.

Limitations

Borrelle et al. (2015) believed that GIS can support decision-making processes that prioritise resource conservation and community needs. However, Belletti et al. (2017) point out that GIS is only a tool and in itself does not represent a guarantee of fairness, justice or adherence to sustainable principles. They continue to claim that GIS is neither apolitical nor impartial. It can be used to promote specific interests and policies. As Radil and Anderson (2019) argued, while GIS can improve access to information and, therefore, democratic processes, it can also be used to advance the interests of certain groups with technological access. In any case, GIS does not make decisions; it enables easy data processing and analysis and can convey results. Kuosa (2016) has shown that GIS technologies are unlikely to change the political nature of policymaking, which may not lead to sustainable tourism planning practices. One could, therefore, argue that approaches and procedures that ensure the compatibility of the process

followed and the results achieved should be discovered and integrated into a decision support system for sustainable tourism.

The software advancements over the previous decade have not altered public opinions of GIS, which is still viewed as a complicated technology requiring more advanced skills than simple word processing. This is one of the primary factors cited by Wallentin et al. (2015) for the inability of GIS to be integrated into the decision-making process of tourist planners. Therefore, one could argue that there is a need for a system that is easy to use even for non-GIS specialists and yet contains all the necessary procedures and tools for policy making and sustainability that users from different backgrounds can use.

The latter raises the question of policy scale. While it may appear that a central, top-down policy formulation would prefer to have the resources necessary to conduct such procedures, the importance and need of minor-scale policy and decision-making should not be neglected. However, to enable destinations to create their own arrangements, some considerations must be made. One possibility is to establish regional tourist planning bodies, each accountable for a distinct geographical entity (Shereni et al., 2023). Thus, investment expenses associated with the acquisition of gear and software and operating costs associated with specialist employees would be segregated. However, a well-designed system that incorporates all essential procedures for sustainable tourist planning and presents them in a user-friendly interface would significantly decrease the need for many specialists and provide convenient and timely support. Additionally, if it is built to be adaptable to a variety of tastes and probable scenarios, it may be suitable to a variety of end-users, therefore reducing costs further.

Additional constraints are imposed by the idea of sustainable development itself. As previously stated, sustainable tourism is still unclear, and implementation details are not entirely fleshed out. Additionally, the multifaceted nature of sustainable tourism necessitates the use of a variety of data types for planning and management, which are typically unavailable. Thus, knowledge of the potential advantages of decision support systems for sustainable tourism may serve as a catalyst for more study on the subject, as well as for the construction of processes and mechanisms to give context for policy development and data collecting.

Conclusions and recommendations

This research was designed to review GIS technologies in sustainable tourism development within Southern Africa. Southern Africa is endowed with cultural, social, built and natural tourism resources, and the region is considered as a leading region of tourism in the continent. However, sustainable tourism development has not yet comprehensively explored the usefulness of GIS, and there is much unused potential to tap. The results show that sustainable tourism is considered a tourism activity that considers current and future economic, environmental and social impacts by meeting the needs of tourists, the tourism industry, host communities and the environment. GIS, as a data collection and information management tool, can capture and manage spatial data of tourism activities to better manage the industry in accordance with the principles of sustainable management. Sustainable tourism requires active and consensus-oriented participation of tourism stakeholders.

Sustainable tourism is a process which involves regular monitoring of impacts and management of these impacts in the SADC region, which is where GIS becomes a relevant tool to apply. GIS is understood as a tool with capabilities to map and analyse geospatial data, which includes tourist flow and social, economic and environmental tourism resources in the SADC (Chang, 2019). GIS serves as a set of computerised systems of tools that could support tourism managers to identify, capture, store, manipulate, and analyse tourism resources and their patterns to predict different scenarios and make appropriate decisions for tourism

development. GIS allows tourism managers to deploy it as a toolbox that allows them to support the planning and implementation of sustainable tourism development principles. Tourism stakeholders are provided with supporting system opportunities of GIS to gather spatial data, analyse and manage the data options for retrieving and updating the data to aid in decision-making for tourism management and sustainable development. Thus, GIS as a toolbox can become a central part of a spatial decision-making system that supports tourism marketing and businesses in Southern Africa if explored. The unique characteristics of GIS as an information system can be explained by its capacities to capture, store, analyse, represent, manage, visualise, retrieve and update spatial and non-spatial data in an integrated environment. Sustainable management of tourism in the SADC, especially in this information age, can make good use of GIS technologies for positive gains. GIS is applied in all fields of the tourism industry for improvement in marketing, hospitality, location and local area impact, transportation, and pattern inventory and analysis.

To develop sustainable tourism would require the principles of sustainable development that can harness the capabilities of GIS as a supporting system to develop a socially, environmentally, economically and culturally responsible tourism. In fact, GIS as a spatial tool could capture tourism data and promote the principles of community-based eco-tourism, fair trade and ethical travel, as well as tourist interest and conservation of tourism assets. The capability of GIS as a data capturing and information analysis tool can support tourism managers to analyse the economic, social, cultural and environmental impacts of tourism in communities. The tool allows tourism stakeholders to account for tourism activities in destinations to support tourism management, development and operations. Hence, GIS as a toolbox is useful for the improvement of tourism in urban, rural, protected, coastal, and mountain areas. Southern Africa is endowed with similar tourism assets, which can be improved with the use of GIS technologies for engagement with tourism assets, tourism destinations, tourists and tourism managers for sustainable development.

The goal of sustainable tourism development is to drive economic development that would involve the participation of tourism destination communities as well as sustain cultural, biological and ecological resources. To ensure that GIS as a toolbox achieves its sustainable tourism mandate, the negative environmental effects caused by tourists and tourism infrastructure development require tourism stakeholders to afford and apply GIS technologies in the tourism industry of the SADC region. Sustainable tourism development would further require tourism stakeholders to acquire the skills and competence to use GIS technologies to pursue the agenda of sustainable tourism in the region. There is a need for empirical studies in the field with specific emphasis on the application of GIS in each component of sustainable tourism in the SADC region.

References

- Abdelfattah, M.A. & Kumar, A.T. (2015). A Web-based GIS-enabled Soil Information System for the United Arab Emirates and its Applicability in Agricultural Land Use Planning. *Arabian Journal of Geosciences*, 8(3), 1813-1827.
- Abou-Elnour, A., Pallathucheril, V. & Abou-Elnour, A. (2015). Site Suitability Evaluation for Ecotourism Potential Areas Using RS and GIS: A Case Study of Wadi Wurayah, Fujairah, UAE. In W. Gao, N.B. Chang, & J. Wang (Eds.). *Proceedings of the Conference on Remote Sensing and Modeling of Ecosystems for Sustainability XII*, 9610 (4 September 2015). International Society for Optics and Photonics, SPIE (p. 961002).
- Alexander, D.E. (2017). *How to Write an Emergency Plan*. Dunedin Academic Press Ltd.

- Alhamwi, A., Medjroubi, W., Vogt, T. & Agert, C. (2019). Development of a GIS-based Platform for the Allocation and Optimisation of Distributed Storage in Urban Energy Systems. *Applied Energy*, 251, 113360.
- Asero, V., Gozzo, S. & Tomaselli, V. (2016). Building Tourism Networks Through Tourist Mobility. *Journal of Travel Research*, 55(6), 751-763.
- Aswani, S., Diedrich, A. & Currier, K. (2015). Planning for the Future: Mapping Anticipated Environmental and Social Impacts in a Nascent Tourism Destination. *Society & Natural Resources*, 28(7), 703-719.
- Atanga, R.A. & Tichaawa, T. (2020). Risk of Floods Impacting Tourism in The Coastal Cities of West Africa: A Case Study of Accra, Ghana. In L. Leonard, R. Musavengane, & P. Siakwah (Eds.), *Sustainable Urban Tourism in Sub-Saharan Africa*, Abingdon, Routledge, 152-166.
- Atici, K. B., Simsek, A.B., Ulucan, A. & Tosun, M.U. (2015). A GIS-based Multiple Criteria Decision Analysis Approach for Wind Power Plant Site Selection. *Utilities Policy* 37, 86-96.
- Babbie, E. (2012). *The Practice of Social Research*. 13th Edition, Wadsworth Cengage Learning.
- Bahaire, T. & Elliott-White, M. (1999). The Application of Geographical Information Systems (GIS) in Sustainable Tourism Planning: A Review. *Journal of Sustainable Tourism*, 7, 159–174.
- Belletti, G., Marescotti, A. & Touzard, J.M. (2017). Geographical Indications, Public Goods, And Sustainable Development: The Roles of Actors' Strategies and Public Policies. *World Development*, 98, 45-57.
- Berry, J. K. (1991). GIS in island resource planning: A Case Study in Map Analysis. *Geographical Information Systems*. 2, 285–95.
- Bhattacharai, K. & Conway, D. (2021). *Urban Growth*. In *Contemporary Environmental Problems in Nepal* (pp. 201-334). Springer, Cham., n.d.
- Bibri, S.E. & Krogstie, J. (2017). Smart Sustainable Cities of the Future: An Extensive Interdisciplinary Literature Review. *Sustainable Cities and Society*, 31, 183-212.
- Blasch, E.P., Pellechia, M., Deignan, P.B., Palaniappan, K., Dockstader, S.L. & Seetharaman, G. (2011). *Contemporary Concerns in Geographical/geospatial Information Systems (GIS) Processing*. Presented at the Proceedings of the 2011 IEEE National Aerospace and Electronics Conference (NAECON), IEEE, pp. 183–190.
- Borrelle, S.B., Buxton, R.T., Jones, H. P. & Towns, D.R. (2015). A GIS-based Decision-Making approach for Prioritizing Seabird Management Following Predator Eradication. *Restoration Ecology*, 23(5), 580-587.
- Boyd, S. & Butler, R. (1996). Seeing the Forest Through the Trees: Using GIS To Identify Potential Ecotourism Sites in Northern Ontario. In: *Practicing Responsible Tourism: International Case Studies in Tourism Planning, Policy and Development*. John Wiley & Sons, Inc., pp. 380–403.
- Braun, V. & Clarke, V. (2013). *Successful Qualitative Research: A Practical Guide for Beginners*. London, UK: Sage.
- Braun, V. & Clarke, V., 2006. Using Thematic Analysis in Psychology. *Qualitative Research in Psychology*, 3, 77–101.
- Brown, L. J., Anderson, M. K. & Thompsom, P. Q. (2023). Geographical and Topographic Considerations in Residential Site Analysis. *Journal of Geographic Studies*, 17(4), 589-612.

- Bunruamkaew, K. & Murayama, Y. (2012). Land Use and Natural Resources Planning for Sustainable Ecotourism Using GIS in Surat Thani. *Thailand Sustainability*, 4(3), 412-429.
- Bürigi, M., Ali, P., Chowdhury, A., Heinimann, A., Hett, C., Kienast, F., Mondal, M.K., Upreti, B. R. & Verburg, P.H. (2017). Integrated Landscape Approach: Closing the Gap between Theory and Application. *Sustainability*, 9(8), 1371.
- Carver, S. (2019). Developing Web-based GIS/MCE: Improving Access to Data and Spatial Decision Support Tools. In *Spatial Multicriteria Decision Making and Analysis* (pp. 49-76). Routledge.
- Cetin, M. & Sevik, H. (2016). Assessing Potential Areas of Ecotourism Through A Case Study in Ilgaz Mountain National Park. *Tourism-from empirical research towards practical application*, pp.81-110.
- Chang, K. (2019). *Introduction to Geographic Information Systems*, Ninth Edition, McGraw.
- Cobbinah, P.B. & Nyame, V., (2021). A City on the Edge: The Political Ecology of Urban Green Space. *Environment and Urbanization*, 33(2), 413-435.
- Coccosis, H. & Mexa, A. (2017). *The Challenge of Tourism Carrying Capacity Assessment: Theory and Practice*. Routledge.
- Coe, N.M. & Yeung, H.W.C. (2015). *Global Production Networks: Theorizing Economic Development in an Interconnected World*. Oxford University Press.
- Cole, M. (2015). *Is South Africa Operating in a Safe and Just Space? Using the Doughnut Model to Explore Environmental Sustainability and Social Justice*. Oxfam GB.
- Conti, M., Das, S.K., Bisdikian, C., Kumar, M., Ni, L.M., Passarella, A., Roussos, G., Tröster, G., Tsudik, G. & Zambonelli, F. (2012). Looking Ahead in Pervasive Computing: Challenges and Opportunities in the Era of Cyber–physical Convergence. *Pervasive and Mobile Computing*, 8, 2-21.
- Dar, S. N., Shah, S. A. & Wani, M. A. (2021). Geospatial Tourist Information System for Promoting Tourism in Trans-Himalayas: A Study of Leh Ladakh India. *GeoJournal*, 1-15.
- Doorga, J. R., Rughooputh, S. D. & Boojhawon, R. (2019). Multi-criteria GIS-based Modelling Technique for Identifying Potential Solar Farm Sites: A Case Study in Mauritius. *Renewable Energy*, 133, 1201-1219.
- Dube, K. & Nhamo, G. (2020). Sustainable Development Goals Localisation in the Tourism Sector: Lessons from Grootbos Private Nature Reserve, South Africa. *GeoJournal*, 1-18.
- Duncan, J., Medina Luque, F.X. & Parasecoli, F. (2016). *Geographic Indications. Socio-Cultural, Political and Economic Considerations*. Universitat Oberta de Catalunya.
- Dye, A.S., Shaw, S.L. (2007). A GIS-based Spatial Decision Support System for Tourists of Great Smoky Mountains National Park. *Journal of Retailing and Consumer Services* 14, 269-278.
- Eftekhari, E. & Mahdavi, M., 2019. Land Suitability Assessment Using ANP in a GIS Environment for Tourism Development Site (Case study: Lavasan-e Kuchak Rural District, Tehran province, Iran). *Journal of Tourism Hospitality Research*, 8(3), 5-17.
- Elwood, S. (2006), Critical Issues in Participatory GIS: Deconstructions, Reconstructions, And New Research Directions. *Transactions in GIS* 10(5), 693-708.
- Elwood, S., Goodchild, M.F. & Sui, D.Z. (2012). Researching Volunteered Geographic Information: Spatial Data, Geographic Research, and New Social Practice. *Annals of The Association of American Geographers* 102, 571–590.

- Erdin, C. & Akbaş, H.E. (2019). A Comparative Analysis of Fuzzy Topsis and Geographic Information Systems (GIS) for the Location Selection of Shopping Malls: A Case Study from Turkey. *Sustainability* 11, 3837.
- Frye, S. (2020). Surveys, Catalogues, Databases/Archives, and State-of-the-Art Methods for Geoscience Data Processing. *Knowledge Discovery in Big Data from Astronomy and Earth Observation: Astrogeoinformatics*, 103.
- Ghafourian, S. & Sadeghzadeh, M. (2021). Coastal Tourism Planning Using GIS-based System: The Case of Shirud Coast, Caspian Sea, Mazandaran, Iran. *GeoJournal*, 1-18.
- Giddy, J. K. & Rogerson, C.M. (2018). Tracking SCUBA Diving Adventure Tourism in South Africa. *EuroEconomica*, 37(2), 47-62.
- Gökkaya, K., Budhathoki, M., Christopher, S.F., Hanrahan, B.R. & Tank, J.L. (2017). Subsurface Tile Drained Area Detection Using GIS And Remote Sensing in an Agricultural Watershed. *Ecological Engineering*, 108, 370-379.
- Goodchild, M. F. (2010). Towards Geodesign: Repurposing Cartography and GIS? *Cartographic Perspectives* 7–22.
- Hall, C.M. & Ram, Y. (2019). Measuring the Relationship Between Tourism and Walkability? Walk Score and English Tourist Attractions. *Journal of Sustainable Tourism*, 27(2), 223-240.
- Harilal, V., Tichaawa, T.M. & Saarinen, J., (2019). “Development without policy”: Tourism Planning and Research Needs in Cameroon, Central Africa. *Tourism Planning & Development*, 16(6), 696-705.
- Hewlett, D., Harding, L., Munro, T., Terradillos, A. & Wilkinson, K. (2017). Broadly Engaging with Tranquillity in Protected Landscapes: A Matter of Perspective Identified in GIS. *Landscape and Urban Planning*, 158,185-201.
- Hunt, R.A., Townsend, D., Korsgaard, S. & Naar, A. (2019). Urban Farmers and Cowboy Coders: Re-Imagining Rural Venturing in the 21st Century. *Academy of Management Perspectives*, 35,4.
- Ika, L.A. & Donnelly, J. (2017). Success Conditions for International Development Capacity Building Projects. *International Journal of Project Management*, 35(1), 44-63.
- Jia, P., Cheng, X., Xue, H. & Wang, Y. (2017). Applications of geographic Information Systems (GIS) Data and Methods in Obesity-Related Research. *Obesity reviews*, 18(4), 400-411.
- Johnson, A. & Chen, L. (2021). Understanding Tourism Services: A Conceptual Framework. *Tourism Management Perspectives*, 42, 101-112.
- Johnson, L.R. (2016). *Community-Based Qualitative Research: Approaches for Education and The Social Sciences*. Sage Publications.
- Jones, C.B. (2014). *Geographical Information Systems and Computer Cartography*. Routledge.
- Jones, S. M. Garcia, R. M. & Martinez, J. D. (2023). Social and Cultural Impacts in Housing Site Evaluation. *Journal of Housing and Society*, 12(1), 67-85.
- Jovanović, V. (2016). The Application of GIS and ITS Components in Tourism. *Yugoslav Journal of Operations Research*, 18(2), 261-272.
- Karimi, S. & Iordanova, I. (2021). Integration of BIM and GIS for Construction Automation, A Systematic Literature Review (SLR) Combining Bibliometric and Qualitative Analysis. *Archives of Computational Methods in Engineering*, 1-22.
- Kelly, J. & Williams, P. (2007). Tourism destination Water Management Strategies: An Eco-Efficiency Modelling Approach. *Leisure/Loisir*, 31(2), 427-452.

- Kimbu, A.N. & Tichaawa, T.M. (2018). Sustainable development Goals and Socio-Economic Development Through Tourism in Central Africa: Myth or Reality? *GeoJournal of Tourism and Geosites*, 23(3), 780-796.
- Kolopack, P.A., Parsons, J.A. & Lavery, J.V. (2015). What Makes Community Engagement Effective? Lessons from the Eliminate Dengue Program in Queensland Australia. *PLoS Neglected Tropical Diseases*, 9(4), e0003713.
- Kolowski, J. & Holekamp, K. (2006). Spatial, Temporal, And Physical Characteristics of Livestock Depredations by Large Carnivores Along a Kenyan Reserve Border. *Biological Conservation* 128, 529–541.
- Kuosa, T. (2016). *The Evolution of Strategic Foresight: Navigating Public Policy Making*. Routledge.
- Lee, A.T., Brooks, M. & Underhill, L.G., 2022. The SABAP2 Legacy: A Review of the History and Use of Data Generated by a Long-Running Citizen Science Project. *South African Journal of Science*, 118(1-2), 1-4.
- León-Fernández, Y., Gomera, A., Antúnez, M., Martínez-Esrich, B., Villamandos, F. & Vaquero, M. (2018). Enhancing Environmental Management in Universities Through Participation: The Case of the University of Córdoba. *Journal of cleaner production*, 172, 4328-4337.
- Li, Q. & Zhang, W. (2022). Applications of Geographic Information Systems in Tourism Research: A Review. *Journal of Tourism Research*, 28(3), 189-203.
- Lü, G., Batty, M., Strobl, J., Lin, H., Zhu, A.X. & Chen, M. (2019). Reflections and Speculations on the Progress in Geographic Information Systems (GIS): A Geographic Perspective. *International Journal of Geographical Information Science*, 33(2), 346-367.
- Lungua, I.G. & Njobvu, B. (2009). The Role of Libraries and Information Services in Ensuring Environmental Sustainability. In *Libraries and Information Services towards the Attainment of the UN Millennium Development Goals*. KG Saur, pp. 201–216.
- Madkour, H. (2015). *Detection of Damaged Areas Due to Tourism Development Along the Egyptian Red Sea Coast Using GIS, Remote Sensing and Foraminifera*. State of the Art, National Institute of Oceanography and Fisheries, Red Sea Branch.
- Makoni, L. & Tichaawa, T.M. (2017). Residents' Perceptions and Attitudes Towards Urban Tourism Product Offerings in Harare, Zimbabwe. *African Journal of Hospitality, Tourism and Leisure*, 6(4),1-15.
- Mandić, A. & Praničević, D.G. (2019). Progress on the Role of ICTs in Establishing Destination Appeal: Implications for Smart Tourism Destination Development. *Journal of Hospitality and Tourism Technology*.
- Mansour, S., Al-Awhadi, T. & Al-Hatrushi, S. (2020). Geospatial Based Multi-Criteria Analysis for Ecotourism Land Suitability Using GIS & AHP: A Case Study of Masirah Island, Oman. *Journal of Ecotourism*, 19(2), 148-167.
- Martinez-Ibarra, E. (2015). Climate, Water and Tourism: Causes and Effects of Droughts Associated with Urban Development and Tourism in Benidorm (Spain). *International Journal of Biometeorology*, 59(5), 487-501.
- Mashapa, M.M. & Dube, K. (2023). Tourism Recovery Strategies from COVID-19 Within National Parks in Western Cape, South Africa. In *COVID-19, Tourist Destinations and Prospects for Recovery: Volume Two: An African Perspective* (p.205-223). Cham: Springer International Publishing.

- Mashapa, M.M. & Maziriri, E.T. (2020). Environmental Factors Influencing the Perceptions of Urban Ecotourism Among Host Communities in South Africa. *African Journal of Business & Economic Research*, 15(4),123- 148.
- Mashapa, M. M. (2016). *Determining perceptions of host communities' regarding urban ecotourism* (Doctoral dissertation, Vaal University of Technology).
- Masron, T., Mohamed, B. & Marzuki, A. (2015). GIS Base Tourism Decision Support System for Langkawi Island, Kedah, Malaysia. *Theoretical and Empirical Researches in Urban Management*, 10(2), 21-35.
- Maziriri, E.T., Mashapa, M.M., Nyagadza, B & Mabuyana, B. (2023). As Far as my Eyes Can See: Generation Y Consumers' Use of Virtual Reality Glasses to Determine Tourist Destinations. *Cogent Business & Management*, 10(3), 2246745.
- McAdam, D. (1999). The Value and Scope of Geographical Information Systems in Tourism Management. *Journal of Sustainable Tourism* 7 (1), 77-92.
- McCall, M. K. (2003). Seeking Good Governance in Participatory-GIS: A Review of Processes and Governance Dimensions in Applying GIS to Participatory Spatial Planning. *Habitat International*, 27, 549-573.
- Metternich, G. (2018). *Land Use and Spatial Planning: Enabling Sustainable Management of Land Resources*. Springer.
- Mowforth, M. & Munt, I. (2015). *Tourism and Sustainability: Development, Globalisation and New Tourism in The Third World*. Routledge.
- Mukherjee, S. (2019). Reigniting GIS's Application in Ecotourism: A Case Study of sundarbans in Bengal. In *Geospatial Intelligence: Concepts, Methodologies, Tools, and Applications* (pp. 1478-1492). IGI Global.
- Naibei, P. N. (2018). *Dynamics of Urban Land Space Contestation and Their Implications on Utilization of Public Green Spaces: A case of Michuki Memorial Park, Nairobi City County*. Unpublished Doctoral Thesis, University of Nairobi.
- Nhamo, G., Dube, K. & Chikodzi, D. (2020). Tourism Economic Stimulus Packages as a Response To COVID-19. In *Counting the Cost Of COVID-19 on the global tourism industry* (pp. 353-374). Springer, Cham.
- Nshuti-Babona, M.A. (2020). *Analysis of Flood Resilience Participatory GIS Approach Monitoring Flood and Interventions: Case Study of Sebeya Catchment*. Unpublished Doctoral Thesis, Collage of Science and Technology.
- Nunkoo, R. & Gursoy, D. (2012). Residents' Support for Tourism: An Identity Perspective. *Annals of tourism research*, 39(1), 243-268.
- Nunkoo, R. & Gursoy, D. (2017). Political Trust and Residents' Support for Alternative and Mass Tourism: An Improved Structural Model. *Tourism Geographies*, 19(3), 318-339.
- Nunkoo, R. & Ramkissoon, H. (2016). Stakeholders' Views of Enclave Tourism: A Grounded Theory Approach. *Journal of Hospitality & Tourism Research*, 40(5), 557-558.
- Nyikana, S. & Tichaawa, T.M., 2022. The Nature and Characteristics of Domestic Sports Tourism in Central Africa: The Case of Cameroon. *African Journal of Hospitality, Tourism and Leisure*, 11(6), 2143-2158.
- Nzeyimana, I., Hartemink, A.E. & Geissen, V. (2014). GIS-Based Multi-Criteria Analysis for Arabica Coffee Expansion in Rwanda. *PloS One* 9, e107449.
- Pather, S. (2017). *Contextualising Information Systems Evaluation Research: Towards a Classification of Approaches*. The European Conference on Information Systems Management, Academic Conferences International Limited, Sept. 2017, 252.

- Radil, S. M. & Anderson, M. B. (2019). Rethinking PGIS: Participatory or (post) Political GIS?. *Progress in Human Geography*, 43(2), 195-213.
- Ramaano, A.I., (2022). The Implied Significance of Integrative Geographical Information Systems in Sustainable Tourism and Comprehensive Community Development in Musina Municipality, South Africa. *Technological Sustainability*, 1(1), 42-63.
- Ramukumba, T. (2014). The Role of Tourist Icons for A Destination: The Case of The Closure of The Outeniqua Choo Choo Train in the Eden District Municipality in the Western Cape Province, South Africa. *African Journal of Hospitality, Tourism and Leisure*, 3(2), 1-12.
- Rebollo, J.F.V. & Baidal, J.A.I. (2003). Measuring Sustainability in A Mass Tourist Destination: Pressures, Perceptions and Policy Responses in Torrevieja, Spain. *Journal of Sustainable Tourism*, 11(2-3), 181-203.
- Rhind, D. (1988). A GIS Research Agenda. *International Journal of Geographical Information System* 2, 23–28.
- Robbins, M.M., Roy, J., Wright, E., Kato, R., Kabano, P., Basabose, A., Tibenda, E., Vigilant, L. & Gray, M., (2011). *Bwindi Mountain Gorilla Census 2011—Summary of Results*. Uganda Wildlife Authority 28.
- Robert, S. (2018). Assessing the visual Landscape Potential of Coastal Territories for Spatial Planning. A Case Study in The French Mediterranean. *Land Use Policy*, 72, 138-151.
- Rodriguez, I., Williams, A.M. & Hall, C.M. (2014). Tourism Innovation Policy: Implementation and Outcomes. *Annals of Tourism Research*, 49, 76-93.
- Rogerson, C. M. (2008). March. Tracking SMME Development in South Africa: Issues of Finance, Training and The Regulatory Environment. *Urban forum*, 19 (1), 61-81).
- Rogerson, C. M. (2017). Tourism—a New Economic Driver for South Africa. In *Geography and Economy in South Africa and its Neighbours* (pp. 95-110). Routledge.
- Rogerson, J.M., Lekgau, R., Mashapa, M. & Rogerson, C.M., (2022). Rural Tourism Challenges in South Africa under COVID-19: Greater Giyani Local Municipality, Limpopo Province. *African Journal of Hospitality, Tourism and Leisure*, 11(3), 1099-1117.
- Rogerson, C. M. & Rogerson, J. M. (2020). Municipal Caravan Parks in South Africa: Geography, Management and Planning. *Bulletin of Geography. Socio-economic Series*, 49(49), 109-124.
- Siakwah, P. (2018). Tourism Geographies and Spatial Distribution of Tourist Sites in Ghana. *African Journal of Hospitality, Tourism and Leisure*, 7(1), 1–19.
- Shan, P. & Sun, W. (2021). Research on 3D Urban Landscape Design and Evaluation Based on Geographic Information System. *Environmental Earth Sciences*, 80, 1-15.
- Sharma, R., Kamble, S.S. & Gunasekaran, A. (2018). Big GIS Analytics Framework for Agriculture Supply Chains: A Literature Review Identifying the Current Trends and Future Perspectives. *Computers and Electronics in Agriculture*, 155, 103-120.
- Sharma, S. (2011). *Potential Impact and Opportunities for Ecotourism in Annapurana Conservation Area*. Biodiversity Conservation Society. Nepal.
- Sharpley, R. & Telfer, D. J. (2015). *Tourism and Development: Concepts and Issues* (Vol. 63). Channel View Publications.
- Shelton, B. J. (2022). Using Geographic Information Systems (GIS) in Tourism Research.
- Shereni, N.C., Saarinen, J. & Rogerson, C.M. (2023). Sustainability Drivers and Challenges in The Hospitality Sector in Zimbabwe. *Tourism: An International Interdisciplinary Journal*, 71(3), 492-504.
- Smith, J. (2022). Spatial Analysis of Geographic Distribution. *Journal of Geographical Studies*, 40(3), 123-145.

- Steudel, T., Bugan, R., Kipka, H., Pfennig, B., Fink, M., de Clercq, W., Flügel, W.A. & Helmschrot, J. (2015). Implementing Contour Bank Farming Practices into The J2000 Model to Improve Hydrological and Erosion Modelling in Semi-Arid Western Cape Province of South Africa. *Hydrology Research*, 46(2), 192-211.
- Tidd, J. & Bessant, J.R. (2020). *Managing Innovation: Integrating Technological, Market and Organizational Change*. John Wiley & Sons.
- Torrieri, F. & Batà, A. (2017). Spatial Multi-Criteria Decision Support System and Strategic Environmental Assessment: A Case Study. *Buildings*, 7(4), 96.
- Tortella, B.D. & Tirado, D. (2011). Hotel Water Consumption at A Seasonal Mass Tourist Destination. The Case of The Island of Mallorca. *Journal of Environmental Management*, 92(10), 2568-2579.
- Truffer, B., Murphy, J.T. & Raven, R. (2015). The Geography of Sustainability Transitions: Contours of An Emerging Theme. *Environmental Innovation and Societal Transitions*, 17, 63-72.
- Tsai, C.H., Wu, T.C., Wall, G. & Linliu, S.C. (2016). Perceptions of Tourism Impacts and Community Resilience To Natural Disasters. *Tourism Geographies*, 18(2), 152-173.
- Uluocha, N. (2018). Prospects and Challenges of Multimedia Approach to Tourism Mapping in Nigeria: A Case of Wildlife Parks Mapping. *Polish Cartographical Review* 50.
- UNWTO. (2019). Committees. Available at <http://www2.unwto.org/en/node/17> [Retrieved 15 August 2023].
- Van der Merwe, J.H. & Van Niekerk, A. (2013). Application of Geospatial Technology for Gap Analysis in Tourism Planning for the Western Cape. *South African Journal of Science* 109, 1–10.
- Wallentin, G., Hofer, B. & Traun, C. (2015). Assessment of Workforce Demands to Shape GIS&T Education. *Transactions in GIS*, 19(3), 439-454.
- Xiong, R., Li, L. & Tian, J. (2018). Towards a Smarter Battery Management System: A Critical Review on Battery State of Health Monitoring Methods. *Journal of Power Sources*, 405, 18-29.
- Xu, Y., Li, Y., Zheng, L., Cui, L., Li, S., Li, W. & Cai, Y. (2020). Site Selection of Wind Farms Using GIS And Multi-Criteria Decision-Making Method in Wafangdian, China. *Energy*, 207, 118222.
- Yalegama, S., Chileshe, N. & Ma, T. (2016). Critical Success Factors for Community-Driven development Projects: A Sri Lankan Community Perspective. *International Journal of Project Management*, 34(4), 643-659.