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Exploring the Potential and Benefits of AHP and GIS Integration for Informed Decision-Making: A Literature Review

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ABSTRACT

In the realm of informed decision-making, especially where spatial dynamics are pivotal, the integration of Analytic Hierarchy Process (AHP) and Geographic Information Systems (GIS) has been increasingly recognized as a potent tool. This comprehensive review critically examines the interplay between AHP and GIS in augmenting decision-making efficacy. Initially, the review delineates the contributions of AHP in managing criteria and sub-criteria, highlighting its structured methodology for assigning weights to decision-making factors. Subsequently, the focus shifts to GIS's role in the assimilation of spatial and non-spatial data, pivotal in geographical decision contexts. The synergy between AHP and GIS is elucidated through its capabilities in data management, visualization, and analysis, culminating in enhanced decision-making quality. Methodological scrutiny of diverse scholarly works, encompassing site selection, natural resource management, and infrastructure development, forms the backbone of this analysis. The strengths of AHP-GIS integration, such as superior data organization, integration of expert insights, time and cost efficiency in surveys, identification of critical decision-influencing factors, and advanced visualization leading to robust decision support, are comprehensively discussed. However, the review does not shy away from addressing challenges, including analytical complexity, stringent data quality demands, intricacies in modeling complex scenarios, and constraints in criteria definition. The fusion of AHP and GIS is underscored as a significant leap forward in geographical decision-making. It empowers decision-makers to evaluate and prioritize multifaceted options effectively, thereby fostering well-grounded choices across various contexts. The practicality and potential of this integration are demonstrated through cases such as land suitability analysis and natural resource management, underscoring its versatility and applicability in diverse decision-making scenarios.

1. INTRODUCTION

In the contemporary landscape of information technology and geospatial development, the realm of decision-making has been thrust into prominence [1]. This evolution has spurred the exploration of various methodologies to navigate the complexities inherent in diverse research domains [2]. Notably, the integration of AHP and GIS has garnered significant attention [3, 4]. This fusion has been identified as a pivotal tool in addressing multifaceted challenges that encompass a spectrum of criteria and spatial variables. Research endeavors have been dedicated to elucidating the synergistic potential of AHP and GIS in practical applications [5].

The utility of AHP, in conjunction with GIS, has been explored in various contexts. For instance, Aburas et al. [6] employed this integration for the assessment of land suitability, incorporating multiple criteria. Similarly, Vijith and Dodge-Wan [7] investigated the vulnerability and regeneration of forests post-logging utilizing AHP and GIS methodologies. Groundwater potential in India's Vamanapuram watershed was delineated by Arulbalaji et al. [8] through the combination of GIS with hierarchical analysis techniques, specifically AHP.

Further, Sulaiman et al. [9] discussed groundwater analysis and forecasting methods. The assessment of agricultural land suitability in the Darjeeling district was conducted by Pramanik [10] through the application of AHP and GIS. The integration of Fuzzy AHP (FAHP) and GIS was leveraged by Mahdi and Esztergár-Kiss [11] to aid tourists in making informed accommodation choices.

In an investigation into the suitability of areas in Iran's Marvdasht plain for maize cultivation, Tashayo et al. [12] mapped limestone and saline soils, integrating AHP with GIS and geostatistics to assign weights to soil characteristics, weather, and terrain. An integrated approach for analyzing agricultural land suitability using AHP and GIS was presented by Bozdağ et al. [13]. The development of a land suitability index (WSI) for wheat cultivation, combining expert and scientific knowledge through AHP integrated into GIS based on the Linear Combination Technique, was undertaken by Kittipongvises et al. [14].

Additionally, Dedeoğlu and Dengiz [15] analyzed flood hazards and community preparedness in Ayutthaya Island, Thailand, focusing on the influence of past experiences. These studies collectively offer a rich tapestry of insights into the potential and advantages of integrating AHP and GIS across various application contexts. The aim is to deepen understanding of the synergistic capabilities of AHP and GIS in supporting decision-making across diverse scenarios.

Therefore, the objective of this journal article is to synthesize knowledge regarding the application of AHP and GIS in decision-making contexts. The research question, arising from the desire to address and solve the discussed problem, is: What are the potentials and benefits of integrating AHP and GIS? It is anticipated that this research will significantly contribute to the comprehension of the potential inherent in this integration.

2. METHOD

2.1 Research design

A systematic literature review methodology was adopted to examine the theoretical underpinnings and synthesize knowledge on the utilization of AHP and GIS in decision-making processes.

2.2 Literature search and identification

A comprehensive search was conducted across several digital scholarly databases, including Scopus, PubMed, Google Scholar, Proquest, and Ebsco. The search, focusing on the integration of AHP and GIS in decision-making, initially identified over 30 articles. The search terms 'AHP, GIS' were used, with an exclusive focus on publications from 2015 to 2023. Publications prior to 2015 were excluded to ensure the inclusion of recent and relevant literature. A two-step process was applied: first, keywords were used to identify articles, followed by a detailed assessment of abstracts to ascertain their relevance.

2.3 Criteria for inclusion

The selection criteria for articles included studies employing qualitative, quantitative, or mixed-methods research approaches, as well as primary and secondary literature studies. From the initial set of 30 articles, ten articles published between 2015 and 2023 were meticulously selected for detailed analysis, based on their alignment with the study's criteria. The exclusion of 20 articles from the preliminary set was due to factors such as relevance, data precision, and substantiated evidence. The review process was guided by several parameters: nature of the research, focus on 'AHP, GIS', publication period (2015-2023), use of English language, and availability of comprehensive articles.

2.4 Addressing bias

The researchers remained vigilant against potential biases by maintaining an objective stance. The review adhered to stringent quality standards, ensuring a thorough evaluation of scientific writing, reliance on results, and meticulous analysis of article contents. This cautious approach is especially vital due to the diverse spectrum of research methodologies adopted, which assess various aspects of writing from a transformative standpoint.

2.5 Extraction of data

Within this literature review, the research team executed and assessed standardized data extractions by relevant guidelines. Key details extracted from the database encompassed conceptual frameworks pertinent to reflective journal discussions, writing practices, and transformative writing in a global context. Other extracted information included publication year, study type, and authorship. Moreover, the research team evaluated whether the literature in question had undergone rigorous peer review and involved an extensive research timeline.

3. RESULTS AND DISCUSSION

3.1 Results

This review examined various literature sources, including journal articles, books, industry reports, and case studies related to decision-making and marketing integration. Here are ten journals that were used to study the integration of AHP and GIS.

The studies conducted by [6-15] offer profound insights into the enrichment of land suitability analysis through the integration of AHP and GIS. This body of work collectively enhances our comprehension of AHP and GIS integration in several key aspects.

Primarily, the utility of AHP in assigning weights to diverse criteria within the scope of land suitability analysis is elucidated. For instance, Mahdi and Esztergár-Kiss [11] exemplifies how AHP adeptly consolidates travelers' subjective preferences in the selection of optimal accommodations, thereby highlighting AHP's capacity to navigate the intricacies of human preferences. Moreover, these studies demonstrate the pivotal role of GIS in facilitating rich spatial data visualization and comprehensive spatial analysis. Vijith and Dodge-Wan [7] and Kittipongvises et al. [14] particularly illustrate the critical function of GIS in mapping areas vulnerable to erosion and flood risks. Furthermore, GIS's capability in identifying potential groundwater zones is evidenced in Arulbalaji et al. [8]. The integration also showcases its merits in the realm of multi-criteria analysis [6, 9, 12], where it effectively addresses GIS's limitations in objectively weighing criteria, with AHP providing the necessary decision structure and criteria weighting. Finally, the studies underscore the value of AHP and GIS integration in aiding decision-makers across various contexts. The research by Pramanik [10], for example, reveals the utility of this integration in agricultural production decision-making. Bozdağ et al. [13] emphasizes its potential applications in sustainable agriculture development. In the domain of groundwater resource management [8, 9, 12], this integrated approach offers critical insights for regional planning and development decision-makers. Thus, these studies collectively affirm the role of AHP and GIS integration as a powerful tool in decision support, significantly broadening our understanding in this field. Table 1 shows the results of the studies of AHP and GIS integration.

Table 1. Journals that were used to study the integration of AHP and GIS

No.	Author	Title	Objective	Results
1.	Aburas et al. [6]	A Review of Land Suitability Analysis for Urban Growth by using the GIS-Based AHP	To assess the land suitability study using the GIS-based AHP, which is a multi-criteria analysis/evaluation method.	The findings delineate the fundamental attributes of land suitability analysis concerning urban expansion and categorize the diverse factors employed in model formulation. Land suitability analysis serves diverse purposes, encompassing the identification of optimal sites for urban expansion, anticipation of forthcoming land usage shifts, and establishment of ecological wastewater treatment systems. This study adds value by amalgamating GIS with the AHP as a multi-criteria assessment method for appraising land suitability in urban growth. The synergy between AHP and GIS tools holds the potential to surmount the constraints inherent in GIS by offering an objective mechanism to ascertain the relative importance of the employed criteria.
2.	Vijith and Dodge-Wan [7]	Modelling terrain erosion susceptibility of logged and regenerated forested regions in northern Borneo through the Analytical Hierarchy Process (AHP) and GIS techniques	Using the AHP and GIS, this study investigates how susceptible logged forest areas and regeneration are to erosion.	This study employs the combination of the AHP and GIS to evaluate the susceptibility of deforested and reforested areas to erosion. AHP, a semi-quantitative approach for multi-criteria decision-making, amalgamates expert insights, field data, and relative statistics. This method facilitates the attainment of well-informed and accurate decisions by comparing the influential factors governing erosion processes. In contrast, GIS furnishes a spatial framework for analyzing and visually representing data about terrain vulnerability to erosion. Through the fusion of these methodologies, this research generated a map depicting the Index of Terrain Erosion Susceptibility (ITES) and pinpointed the variables that exert the most substantial influence on susceptibility to erosion.
3.	Arulbalaji et al. [8]	GIS and AHP Techniques Based Delineation of Groundwater Potential Zones: A Case Study from Southern Western Ghats, India	Determining groundwater potential in the Vamanapuram river basin, India. In this case, GIS and AHP worked hand in hand.	The findings indicate the presence of five distinct categories for groundwater potential: highly favourable, favourable, moderate, limited, and highly limited. Data obtained from observation wells reveals that wells situated in areas with limited and highly limited groundwater potential exhibit a water yield ranging from 10 to 50 litres per minute (LPM), while those in moderately potential zones yield between 50 and 100 LPM. Wells located in areas of high and very high groundwater potential, however, yield water at rates of 100 to 200 LPM. Among the total of 34 observation wells used in this study, 29 of them aligned with the designated groundwater potential zones. The remaining five wells deviated from their zones due to their proximity to densely populated settlements or areas of intense agricultural activity. The integration of AHP and GIS proved instrumental in establishing groundwater potential zones, drawing from a diverse set of 12 thematic layers encompassing factors like geology, geomorphology, and land use. This comprehensive approach yielded a groundwater potential map with an accuracy level of approximately 85%.
4.	Sulaiman et al. [9]	A GIS-based AHP Method for Groundwater Potential Zone Assessment: A Review	This review aims to provide an overview of groundwater analysis and forecasting methods.	The outcome of this study presents a comprehensive exploration of techniques for analyzing groundwater potential zones utilizing GIS and AHP methodologies. The data for this research was sourced from various outlets, including previous studies and scholarly articles. A key takeaway from this investigation underscores the significance of groundwater potential modelling in the context of long-term planning and development endeavours. The integration of GIS-based AHP and Multiple Criteria Decision Analysis (MCDA) methods was employed to ascertain the influential factors dictating the demarcation of groundwater potential zones. Among the frequently employed factors in this research are slope, precipitation patterns, geomorphology, geological composition, drainage density, soil characteristics, and land usage. This study convincingly demonstrates that a synergistic application of these techniques can yield outcomes that are both precise and dependable when identifying groundwater potential zones.
5.	Pramanik [10]	Site suitability analysis for agricultural land use of Darjeeling district using AHP and GIS techniques	Analyzing land suitability for agricultural use in Darjeeling district using the AHP method and GIS technique.	In this study, the use of AHP and GIS methodologies facilitated the conduct of a land suitability assessment intended for agricultural purposes in Darjeeling district. The AHP method was used to determine the relative importance of various parameters affecting land suitability, while GIS technology was used to delineate and scrutinize the spatial data indispensable for the analysis. The study successfully created a comprehensive map showing the suitability of land for agricultural utilization in hilly areas. Approximately 5.31% of the land was deemed very suitable for agricultural enterprises, 29.82%moderately acceptable, 24.27% suitable, and 40.60% unfit, according to the study.

6.	Mahdi and Esztergár-Kiss [11]	Modelling the Accommodation Preferences of Tourists by Combining Fuzzy-AHP and GIS Methods	This research supports tourists' decision-making in choosing optimal accommodations by integrating fuzzy Analytic Hierarchy Process (FAHP) techniques and GIS.	In this study, the AHP technique was applied to attribute weights to the criteria employed for selecting the most suitable lodging options. Through the implementation of AHP, the preferences of travellers can be synthesized and weighted to inform decisions. Furthermore, the integration of GIS methods was employed to amalgamate the criteria's weighted values and to visually represent the chosen lodging locations on a geographical map. As a result, the synergy between AHP and GIS enhances the capacity to aid travellers in making informed choices when it comes to selecting the most optimal accommodations.
7.	Tashayo et al. [12]	Land suitability assessment for maize farming using a GIS-AHP method for a semi-arid region, in Iran	The purpose of this research was to identify areas in Iran's Marvdasht plain where limestone and saline-sodic soils would be ideal for growing maize. The soil, climatic, and topographical property weights were estimated using an AHP approach that was integrated with GIS and geostatistics.	Tis study was to identify areas in Iran's Marvdasht Plain where limestone and saline-sodic soils would be ideal for cultivating maize. Through the use of geostatistics and an integrated AHP methodology. This study determined the weights of soil, climate, and topography factors. The results showed that soil texture was the most influential factor (0.20), followed by electrical conductivity (0.121), slope (1.0), and pH (0.118) in determining land suitability for maize cultivation. The resulting map identified 38.72% highly suitable (76,646.7 ha), 26.89% moderately suitable (53,216.0 ha), 23.98% moderately suitable (47,473 ha), and 10.41% unsuitable (20,586.4 ha) for agricultural land. This study underscores the importance of integrating data on soil properties, climate, topography, and local expertise as a basic step in crop-specific agriculture. The use of the AHP GIS method provides valuable guidance for farmers in selecting optimal maize cultivation locations.
8.	Bozdağ et al. [13]	AHP and GIS-based land suitability analysis for Cihanbeyli (Turkey) County	This study presents a unified strategy for utilizing GIS and the AHP method to enhance site suitability assessments for agricultural purposes.	The findings revealed the presence of eight distinct soil types within the study area, encompassing alluvial, regosol, hydromor, reddish-brown, brown soil, saline, calcareous, and lithosol. Furthermore, the quality of irrigation water significantly influences the determination of agricultural land suitability. The study further generated both land suitability and soil suitability maps, serving as valuable references for agricultural planning purposes. These outcomes enable the identification of zones apt for both irrigated agriculture and dry farming. The analysis demonstrated that approximately 7.18% of the total area is conducive to irrigated agriculture, whereas 56.77% is suitable for dry farming.
9.	Dedeoğlu and Dengiz [15]	Generating of land suitability index for wheat with hybrid system aproach using AHP and GIS	This study aims to generate a land suitability index (WSI) for wheat cultivation using a hybrid system approach that includes expert and scientific knowledge weighted by the AHP method. This approach was integrated into GIS based on Linear Combination Technique.	The findings demonstrated that approximately 32.05% of the study area fell under the category of high and moderate suitability, while the remaining 67.95% of the total study region exhibited attributes that rendered them less conducive or unsuitable for cultivating wheat. The primary influencers on the Wheat Suitability Index (WSI) values were found to be soil depth, texture, and slope. The WSI model's efficacy was also validated by testing it against five years of crop yield data and NDVI values, affirming the model's precision in classifying land suitable for wheat cultivation. This study underscores the potency of combining AHP and GIS methodologies to systematically assess land appropriateness for growing wheat. By comprehensively evaluating a range of physical, chemical, and topographic factors, the WSI model facilitates precise land categorization and serves as a valuable tool in agricultural decision-making. Moreover, the model's adaptability to different land conditions makes it versatile and practical.
10.	Kittipongvises et al. [14]	AHP-GIS analysis for flood hazard assessment of the communities nearby the world heritage site on Ayutthaya Island, Thailand	The study conducted an assessment of flood hazards and analyzed the contribution of experience to community flood readiness in Ayutthaya Island, Thailand	Utilizing the AHP methodology coupled with GIS analysis, the investigation unveiled that roughly 52.63% of localities within the community and 44.8% of UNESCO World Heritage Sites (WHS) face elevated flood risk. Among these, the Pratuchai sub-district emerged as the area with the most pronounced flood hazard level. The primary catalysts for flooding within the community encompass water runoff and road congestion. Through regression analysis, an inverse relationship between previous flood experiences and the level of residents' flood preparedness was observed. The study also brought to light that a mere fraction of respondents had accessed flood readiness information, while almost half of them did not express a sense of readiness for forthcoming floods within their locality.

3.2 Research challenges and solutions offered

The studies presented by [6-15], present a series of interesting challenges in the integration of the Analysis of Hierarchical Process (AHP) method with Geographic Information Systems (GIS) in the context of land suitability analysis. One of the challenges often encountered is the complexity of collecting, integrating and processing data from different sources. Aburas et al. [6] highlighted the importance of integrating social and economic factors in determining suitable locations for urban development. Vijith and Dodge-Wan [7] found that complex geo-environmental variables influence the level of erosion susceptibility on logged and regenerated land. Arulbalaji et al. [8] realized that groundwater suitability requires multidisciplinary analysis with multiple data layers. Sulaiman et al. [9] pointed out that managing groundwater resources requires an in-depth understanding of the complex factors that influence it. Pramanik [10] highlighted the complexity of considering geological and socio-economic factors in agricultural land suitability assessment. Mahdi and Esztergár-Kiss [11] addressed challenges in subjective preference assessment through the AHP method. Tashayo et al. [12] emphasized the need for a holistic analysis to identify factors affecting agricultural land suitability. Bozdağ et al. [13] integrated AHP and GIS approaches in supporting sustainable agricultural policies. Kittipongvises et al. [14] and Dedeoğlu and Dengiz [15] faced challenges in integrating spatial and non-spatial data in land suitability assessment.

To overcome these challenges, several approaches have been taken. Aburas et al. [6] described the use of AHP as a multi-criteria method to overcome the limitation of assigning objective weights to land suitability criteria. Vijith and Dodge-Wan [7] refer to an AHP and GIS approach that integrates expert knowledge and field data in assessing erosion vulnerability. In order to identify areas with groundwater potential, Arulbalaji et al. [8] effectively integrated various thematic data layers. Sulaiman et al. [9] proposed the integration of AHP and GIS in groundwater potential zone assessment by considering various influencing factors. Pramanik [10] detailed the need for more in-depth analysis with various local and regional parameters. Mahdi and Esztergár-Kiss [11] emphasized the value of AHP in weighting decision-making preferences. Tashayo et al. [12] and Bozdağ et al. [13] combined AHP with GIS to produce maps that provide important information for decision-makers. Kittipongvises et al. [14] and Dedeoğlu and Dengiz [15] used a combination of AHP and GIS to address the complexity of spatial and non-spatial data.

4. DISCUSSION

AHP and GIS are favourable methods for research topics that interest many disciplines. From this literature review, we evaluate the critical approach. AHP generally identifies factors affecting the city growth based on functional analysis of SIG. AHP can be explored simultaneously for complex cases included in competitive criteria [6]. The rapid technological development of this society is affecting geography. SIG helps research in geography to analyse, interpret and visualize geographical information production [16]. The SWOT-AHP approach has proven beneficial to identify and measure relatively significantly from the main factor that affects GIS and effectively facilitates GIS planning [17].

Integrating GIS and AHP is an efficient tool for solving the central issue of selecting the right location for a landfill [18]. Integration of AHP and GIS brought competitive advantages to spatial analysis. By exploring AHP, relative interests between criteria and sub-criteria can be measured systematically. Later, spatial information in GIS can be integrated into the study. This factor makes it possible to generate informed decisions in geographical contexts. Characteristic probabilities and vulnerability to erosion from the sample with regenerated tropical forest in Sarawak, north Borneo, have been proven using GIS and AHP methods [7]. Previous research found that GIS and AHP based on the LSA method is used for finding compatibility of Cihanbeyli regency and helping agricultural production by using land characteristic, climates, topography, and groundwater on that are [13].

However, several aspects need more attention for using this method. First, complex AHP and subjective analytical processes can be a considerable challenge. The Assessment process can be based on relative criteria and sub-criteria that need participation from various stakeholders, ultimately affecting the result. Moreover, collecting spatial data in GIS is complex and time-consuming. Using GIS and AHP to identify the location of the study area for low to high groundwater areas is challenging, considering the location of the water reservoir [19]. Considering the complexity of choosing a water reservoir location, AHP is determined as the GIS combination of the decision-making process through multicriteria analysis on selecting a water reservoir location [20].

Later, it is essential to focus on data quality and analytical accuracy in this integration process. Data in AHP and GIS must be valid, accurate, and representable. Mistakes in data or analysis will lead us to wrong decisions. Therefore, we need a precise validation system for the data and method represented. Decisions on supporting DAS management can be made by exploring the GIS hydrology model based on geographical factors. The model represents the interaction between humans and the environment for purpose, preference, and problems introduced by the organization and policy maker [21].

Moreover, the integration of AHP and GIS needs sufficient technical ability. Researchers need to understand the concept of AHP and the utilization of GIS to optimize the potency of the two methods. The competencies required are hierarchal analysis, spatial analysis, data manipulation, and result interpretation. Using GIS, decision-makers in planning and development have access to useful geospatial information that is connected with information technology and communication [22]. Based on Felicity Aphiwe and Walter Musakwa (2020), SIG is recognized as a multitasked technology and generates results like actual visual dimensions that bring enormous potency to increase and generate informed spatial decisions [23]. For evaluating water stream risk, this paper proposes an approach in vulnerable index combining AHP and GIS [24].

The integrated method of AHP and GIS in the decision-making process over a new approach to analyse complex problems in a spatial context helps analyze complex spatial issues. Thus, for researchers, challenges in analytical complexity, data quality and technical ability must be recognized carefully. Then, this integration process can be an effective instrument and valuable in the decision-making process in various issues like areal planning, natural resources management, and infrastructure development. By combining GIS and long-distance sensing sensors, the AHP approach can be practically used. Practical factors of AHP, like groundwater zonation, water reservoir, areal management, and soil condition, can be simplified as spatial information on GIS and AHP, making it easier to find groundwater [9]. This result shows that the method that combines AHP and GIS is assisting us in evaluating the quality of the environment. It helps us in spatial analysis context [25].

For notes, integrating the AHP and GIS methods is a promising approach in location-based decision-making. Identifying the critical success factors (CSFs) for successful GIS implementation is a primary concern for GIS managers and practitioners; however, it is still possible to overcome it. Despite the fact that CSFs have been the subject of much research in the literature on GIS installation and administration, no one has formally ranked them [26]. Despite this fact, several challenges need to be addressed in this integration process.

First, the main challenge is the complexity of combining these two techniques. The AHP method analyzes preferences and relative weights among various decision criteria, while GIS is used to visualize and analyze spatial data. Integrating these two methods requires a strong understanding of both and the technical skills needed to incorporate them correctly. After the Geographic Information System (GIS) estimation model is generated, the selected shipyard locations are assessed for the validity evaluation of the model [27].

Secondly, the other challenges are the existence of needed data. AHP requires preferential data and vital criteria comparison; meanwhile, GIS needs high-quality spatial data. From our understanding and knowledge, a similar case for modelling and spatial GIS management [28]. Combining those two data can make them complex and need efforts to process and attempt to compress data that is consistent and compatible. Moreover, we need to think about the data scale. AHP methods work with comparable data, while GIS works in spatial data related to geographical data. Calibrating different data scales can lead to issues, especially in translating the result and comprehensive spatial preference. Previous research showed that AHP and WLC in the early stage can trigger better decision-making processes, helping people find the proper landfill better than the Boolean system. My study using Arc Gis found that the suitable landfill will have a 74 ha area and can accept 130 tons of waste daily for the next 20 years [29].

The last challenge is the interpretation and conclusive result. Integrating AHP and GIS will result in complex and variation results, including the criteria weight, alternative ranks, and spatial visualization. Understanding the impact righteously and communicating it effectively to the stakeholders will be challenging, for example, here from the accommodation business. Previous research shows that the lowest factor influencing accommodation selling is the free cancellation service. The importance level is around 0,182 points. Breakfast and distance from the centre have similarly equal importance. For recommendation, several accommodation managements like room discounts, adding services, or developing rooms may affect the accommodation business [11]. From several natural questionable situations in AHP, several researchers have used fuzzy concepts to dissipate the method, while several researchers are against it. So far, the effort to change AHP into the fuzzy method and compare AHP to fuzzy it has been done in various theories but no practical example. The lack of valuable practice pushes me to define the decision-making process using GIS [30].

5. LIMITATIONS OF THE STUDY

This study encounters two primary limitations: firstly, the limited availability of reflective journals about the integration of AHP and GIS; and secondly, the incorporation of articles spanning diverse disciplines, thereby preventing focused examination of a specific material concerning decision-making.

6. CONCLUSION

The integration of AHP and GIS in decision-making has garnered considerable interest in recent scholarly discourse. An exhaustive literature review has facilitated a deeper comprehension of the potential and advantages inherent in this approach. It has been discerned that the amalgamation of AHP and GIS offers substantial benefits in location-based decision-making processes. The AHP method provides a structured approach to weigh criteria and sub-criteria, whereas GIS enables detailed spatial analysis. The fusion of these methodologies enables the identification of optimal options and enhances the overall quality of decision outcomes. Furthermore, it has been revealed that the combination of AHP and GIS contributes to increased transparency and accountability in decision-making. The spatial insights rendered by GIS equip decision-makers with the ability to visualize the impacts of their decisions across various locations or regions. This integration lays the groundwork for more informed decisions, taking into consideration pertinent geographical factors.

Nonetheless, the potential challenges associated with the integration of AHP and GIS cannot be overlooked. Reviews indicate that this approach can be intricate and necessitates meticulous modelling. The effective implementation of this method is contingent upon access to comprehensive spatial data and robust computational resources. Hence, the successful deployment of this approach is largely dependent on the availability of these resources and the requisite technical expertise.

In summary, the literature review underscores the real potential to refine the quality of location-based decision-making and to deepen the understanding of the geographical implications of various decisions. However, it is imperative to acknowledge and address the technical complexities and challenges that accompany the practical application of this integrated approach.

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