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SPATIAL ALIGNMENT OF TOURISM SERVICES IN AL-BAHA REGION, SOUTHWESTERN SAUDI ARABIA, USING GIS-BASED ANALYSIS

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ABSTRACT

This study examines the assessment of the spatial alignment of future tourism services in the Al-Baha region, in line with Saudi Arabia's Vision 2030, which places the tourism sector at the heart of national transformation. The study adopts a descriptive-analytical approach and geospatial statistical analysis using ArcGIS Pro 3.4 software to analyze spatial distribution patterns and build a spatial prediction model for optimal tourist sites up to the year 2034. The relationship between area and spatial distribution was also examined by applying the Lorenz Curve using Excel 360. Among the most prominent results, Al-Baha region accounted for 42.40% of total tourism services. The Lorenz Curve analysis indicated a lack of equity in the distribution of tourism services among the governorates of Al-Baha region. The study also revealed a clear convergence in the proposed areas for future accommodation and tourism services due to their functional integration. Finally, Al-Aqiq governorate emerged as the largest area for future expansion, acquiring about 55% of the total proposed areas for accommodation and services. The proportion of eco-tourism areas in the governorate reached about 59.32% of the total area, due to its vast size and availability of infrastructure.

KEYWORDS: Spatial Distribution – Spatial Alignment – Future Prediction Modelling – Lorenz Curve.

1. INTRODUCTION

Tourism is considered one of the most important sustainable resources in the economy of the Kingdom of Saudi Arabia. Vision 2030 has placed the tourism sector at the heart of national transformation due to the Kingdom's rich natural, cultural, and historical assets. This has contributed to strengthening the status of tourism as a major economic and social driver that supports growth, provides job opportunities, and reinforces the Kingdom's presence as a global tourist destination (Saudi Tourism Authority, 2026).

Shobashi defined tourism planning as drawing a future projection of tourism activity in each country for a specific period. This requires inventorying the country's tourism resources to set the objectives of the tourism plan and achieve rapid and regular tourism development by preparing and implementing a coordinated program that covers all branches of tourism activity and all tourist areas in the country (Yahyaw, 2021, p. 179).

The scientific significance of this study lies in its support of Vision 2030 by shedding light on the spatial alignment of tourism services in the Al-Baha region in southwestern Saudi Arabia. The region's diverse natural phenomena—mountains, forests, waterfalls, and more—have contributed to growing interest in tourism, while its numerous human components, such as heritage sites, forts, museums, and traditional villages, further enhance its appeal.

The practical significance of the study emerges from the application of remote sensing technologies and Geographic Information Systems (GIS) in economic studies. Additionally, the region's need for studies related to tourism sector development is addressed by establishing a current tourism database and maps for the region, which will aid decision-makers in taking the necessary actions to develop the area.

1.1. Reasons for Choosing the Topic

The Kingdom of Saudi Arabia's Vision 2030 initiative to develop natural and heritage tourism sites is the main reason for studying this topic. Additionally, the spatial significance of the study area's location within Saudi Arabia contributes to its importance. The Kingdom's recent focus on the management of natural resources and historical and heritage areas, in line with Vision 2030's goals for tourism sector development, further motivates this research.

1.2. Study Objectives

This applied study aims to examine the future spatial suitability of tourism services in the Al-Baha region using Arc Map Pro 3.1 software.

1.3. Study Methods and Approaches

This study relied on the descriptive-analytical approach as the main method to describe and analysed the spatial distribution of tourism services and to determine the current spatial distribution patterns. In addition, geospatial statistical analysis was conducted to assess the future spatial suitability of tourism services in the study area using Geographic Information Systems (GIS) through Arc Map Pro 3.1.

1.4. Spatial Dimensions of the Study

The Al-Baha region is located in the southwest of the Kingdom of Saudi Arabia on the Hijaz Mountains, stretching between latitudes 19°26'16" and 20°49'57" North, and longitudes 40°50'1" and 42°8'26" East. It is bordered to the north and west by the Makkah region, and to the south and east by the Asir region, as shown in Figure 1. Al-Baha comprises nine governorates (Baljurashi, Al-Mandaq, Al-Mukhwah, Al-Hajrah, Bani Hasan, Ghamid Al-Zinad, Al-Aqiq, Al-Qura, and Qilwah). The total area of Al-Baha is estimated at 11,242.312 square kilometers, with a population of 339,174 as of 2022 (Emarah of Al-Baha Region, 2023).

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1.6. Previous Studies

Al-Harbi, Sabah Bin Barik, and Al-Dughairi, Mohammed Bin Ibrahim (2022). "Spatial Modeling for Evaluating Tourist Accommodation Facilities in Jeddah City Using Geographic Information Systems."

This study aimed to analyze the spatial distribution of tourist accommodation facilities in Jeddah. The research relied on key practical aspects of Geographic Information Systems (GIS), particularly spatial analysis, to uncover the

characteristics and patterns of spatial distribution of accommodation facilities and assess the efficiency of their distribution according to local standards. The study's methodology was linked to spatial analysis techniques within GIS software, transforming raw data into highly valuable information through analytical methods and operations such as spatial data collection modelling, matching, and distance analyses, all of which contributed to understanding spatial patterns and variations.

1.7. Similarities and Differences

Both studies share a focus on spatial analysis using Geographic Information Systems (GIS) and spatial modelling. However, the current study expands on this by examining tourism services more broadly, identifying optimal future locations, assessing the efficiency and adequacy of the current distribution, and addressing environmental and cultural challenges related to tourism services.

2. Al-Zabnah, Nasser Said, and Al-Sarani, Abeer Mohammed Ali (2022). "Building a Cartographic Model for Identifying Tourist Sites in Al-Ula Governorate."

This study aimed to build a cartographic model for determining tourist sites in Al-Ula Governorate using GIS technology. The research adopted various

approaches and methods, including the applied and analytical methods, the quantitative approach, and the cartographic technique. The study reviewed the process of building the ideal model for identifying tourist sites in Al-Ula, discussed the main findings and recommendations, and ultimately contributed to achieving optimal distribution for tourist site identification within the study area. This was accomplished by developing a GIS-based system for easier access and by constructing an ideal model for identifying tourist locations through the selection of the optimal distribution model. The study concluded that the distribution pattern of tourist sites in Al-Ula follows a centralized pattern.

1.8. Similarities and Differences

Both studies agree on identifying optimal sites for tourism services in the study area using GIS. However, the current study is distinguished by its focus on future locations of tourism services through the construction of a cartographic model using ArcGIS Pro 3.4.

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Figure 1: Spatial and administrative boundaries of Al-Baha Region in 2024

Source: Prepared by the student based on data from Al-Baha Municipality

2. THE SPATIAL DISTRIBUTION OF TOURISM SERVICES IN THE AL-BAHA REGION

Spatial distribution is one of the fundamentals of geography and serves as the primary axis from which researchers study the distribution of phenomena and services. Through spatial distribution, it is possible to determine whether this distribution follows a certain

pattern resulting from clear causes, or if it is random (Al-Farouq & Al-Jabri, 2009, p. 253).

The distribution of total tourism services by governorates in the Al-Baha region for the year 2024 highlights spatial differences between the governorates, illustrating the extent to which services are concentrated in certain locations over others.

Table (1) indicates the total distribution of tourism services across the governorates of the Al-Baha region in 2024, and measures the degree of their diversity.

region for the year 2024 highlights spatial differences between the governorates, illustrating the

extent to which services are concentrated in certain locations over others. Table (1) indicates the total distribution of tourism services across the governorates of the Al-Baha region in 2024 and measures the degree of their diversity.

Table 1: Numerical and Relative Distribution of Tourism Services by Governorates of Al-Baha Region, 2024, and Diversity Range Measurement

Governorate	Number of Services	%
Al-Baha	240	42.40
Baljurashi	143	25.27
Al-Mikhwah	35	6.18
Al-Aqiq	33	5.83
Qilwah	25	4.42
Al-Mandaq	29	5.12
Al-Qura	17	3.00
Bani Hasan	24	4.24
Ghamid Al-Zinad	7	1.24
Al-Hajrah	13	2.30
Total	566	100

Gini-Martin Coefficient: 0.74

Source: Prepared by the student based on field study data and the Ministry of Municipal and Rural Affairs in Al-Baha Region, 2023.

The previous table and Figure (2) indicate that Al-Baha region ranked first in total number of services, with 240 services representing 42.18% of all tourism services. This is attributed to the region’s significance as the business hub and administrative capital. It is followed by Baljurashi Governorate, which serves as an important commercial center for Al-Baha, with a total of 143 tourism services, accounting for 25.13% of the total tourism services.

In third place comes Al-Makhwah Governorate, with 35 services representing about 6% of the total tourism services. This is due to the presence of Thi Ain Heritage Village, one of the most important heritage villages in the Kingdom. A similar percentage is observed in Al-Aqiq Governorate, which has 33 tourism services, also accounting for approximately 6% of the total. Al-Aqiq includes King Saud Airport, Al-Baha University, and the largest

sports city in the region, King Saud Sports City.

Al-Mandaq Governorate ranked fifth, with 29 services, constituting about 5.12% of the total tourism services. In sixth place are Qilwah and Bani Hasan Governorates, each with around 4% of the total services.

Al-Qura Governorate has 17 tourism services, representing nearly 3% of the total, followed by Al-Hajrah Governorate with around 2.3%. Finally, Ghamid Al-Zinad Governorate has 7 services, comprising about 1.24% of the total tourism services.

The Gibsson-Martin Index measures the diversity of tourism services in Al-Baha by governorate. The index value of 0.74 indicates a high degree of concentration in the distribution of services among the governorates, meaning that Al-Baha and Baljurashi governorates capture a larger share compared to others. This reflects a relative weakness in service diversity within the governorates.

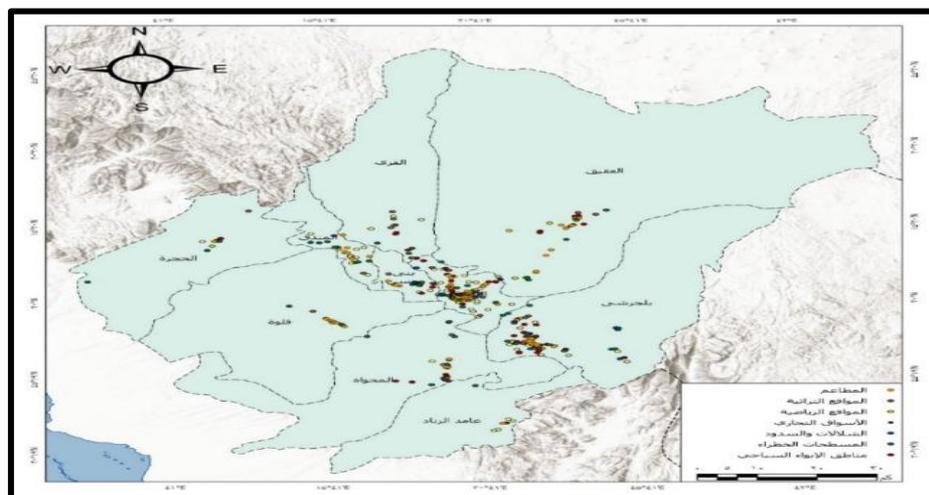


Figure 2: Spatial distribution of tourism services in the governorates of Al-Baha region for the year 2024.

Source: Prepared by the student based on data from Table (1).

2.1. The Relationship Between the Distribution of Tourism Services and the Area of Al-Baha Region

Geographers use the Lorenz Curve to measure the degree of concentration of a phenomenon, the efficiency of its distribution, and the extent of disparity between variables. The further the graphical representation is from the line of symmetry, the higher the level of disparity, meaning lower distribution efficiency of services. The Gini coefficient

represents the distance between the ideal distribution line and the actual distribution line; it expresses the extent of inequality, with values ranging from 0 to 1. The Gini coefficient is calculated using the following formula:

$$Gini = 1 - \sum [(Y_i + Y_{i-1}) \cdot (X_i - X_{i-1})^2]$$

Xi: Cumulative percentage of area (expressed as a decimal fraction)

Table:

Governorate	Count	% of Services	Area (km ²)	% of Area	Cumulative % of Services (Ascending)	Cumulative % of Area (Ascending)	Gini Value
Ghamid Al-Zinad	7	1.24	258.8	2.3	0	0	-
Al-Hajrah	13	2.30	124	1.1	3.54	3.4	0.0012
Al-Qura	17	3.00	568.8	5.1	6.54	8.5	0.0051
Bani Hasan	24	4.24	346	3.1	10.78	11.6	0.0054
Qilwah	25	4.42	1161.6	10	15.20	21.9	0.028
Al-Mandaq	29	5.12	923.2	8.2	20.32	30.1	0.029
Al-Aqiq	33	5.83	1251.7	11	26.15	41.2	0.051
Al-Mikhwah	35	6.18	1317.2	12	32.33	52.9	0.069
Baljurashi	143	25.30	1503.4	13	57.60	66.3	0.12
Al-Baha	240	42.40	3787	34	100	100	0.55
Total	566	100	11242	100	-	-	0.86

Source: Prepared by the student using Excel, based on data from Al-Baha Municipality, 2024.

We conclude from the data in Table (2) and Figure (3) that the cumulative frequencies of services and area indicate a significant disparity between area size and the distribution of services, reflecting inefficiency in distribution. It is evident that 40% of the area contains only about 25–35% of the services, which

points to a concentration of services in specific locations, while the remaining 60% of the area accounts for most services. The calculated Gini coefficient of 0.14 further confirms the presence of inequality in the distribution, highlighting the lack of efficiency and fairness in the allocation of services..

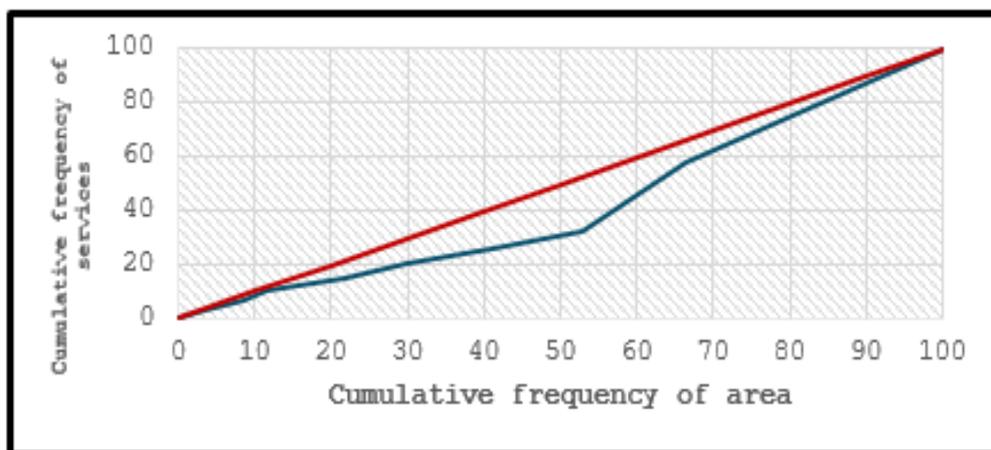


Figure 3: Lorenz curve illustrating the relationship between the distribution of tourism services and area in Al-Baha region in 2024.

Source: Prepared by the student using Excel, based on data from Table (2).

2.2. Future Projection of Tourism Services in Al-Baha Region

Given the growing role of tourism as one of the sustainable resources in the economy of the Kingdom of Saudi Arabia, the future direction for development – both generally and within the tourism sector in particular – focuses on leveraging geospatial technologies to support sustainable tourism planning. The Model Builder tool in ArcGIS Pro 3.4 is

among the effective tools that contribute to spatial data analysis and the construction of predictive models. These models help identify promising tourism sites, assess land suitability, and support decision-makers in future planning (Yahyaw, 2015, p. 358). Figure (3) illustrates the procedures followed in building the structural model for evaluating optimal tourism sites in Al-Baha region up to the year 2034.

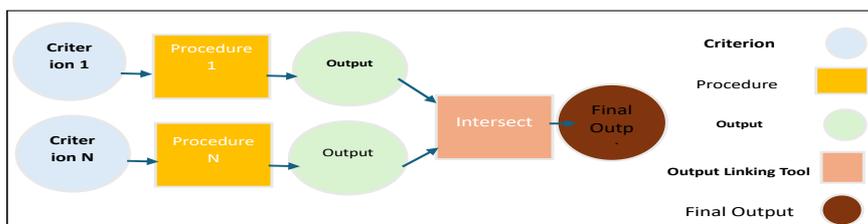


Figure 3: Procedures followed in constructing the structural model for evaluating optimal tourism sites in Al-Baha region up to the year 2034

This approach contributes to enhancing the efficiency of investing in tourism resources and achieving the goals of Saudi Vision 2030 for balanced and sustainable tourism sector development. It does so by studying the future direction of accommodation areas, tourism services, and environmental sites, relying on spatial analysis and geospatial modelling.

3. OUTLOOK FOR ACCOMMODATION AND TOURISM SERVICE AREAS

The future orientation of accommodation and tourism service areas is a fundamental pillar in supporting sustainable tourism development. Its aim is to improve the distribution and diversity of such

areas in line with increasing tourism growth and evolving environmental and social requirements. This approach relies on the application of planning standards that facilitate the construction of predictive spatial models, which help identify the most suitable locations for establishing and developing accommodation and tourism service areas. This ensures the integration between preserving natural resources and stimulating economic development in accordance with Saudi Vision 2030 (Al-Otaibi, 2015, p. 44). Table (2) presents the planning criteria adopted for identifying optimal locations for accommodation and tourism service areas in Al-Baha region up to the year 2034.

Table 2: Approved Planning Criteria for Determining Optimal Locations of Accommodation Areas and Tourism Services in Al-Baha Region until 2034

Criterion	Condition
Land Cover (Open/Vacant Areas)	Area greater than 500 km ²
Slope	Less than 30°
Roads	Distance from roads: 500 km
Distance from Accommodation Areas	500 m
Distance from Tourism Services	500 m
Land Use (Industrial Areas)	3 km buffer distance
Wadis (Valleys)	Distance from wadis: 1 km

Source: Prepared by the student based on data from the Ministry of Municipal, Rural Affairs, and Housing, 2015, pp. 200–2012.

The criteria were determined based on several factors, including planning standards for regional and local public services at various levels, previous studies, scientific expertise, and fieldwork. Figure (4)

presents the Model Builder workflow for identifying future locations of accommodation and tourism service areas.

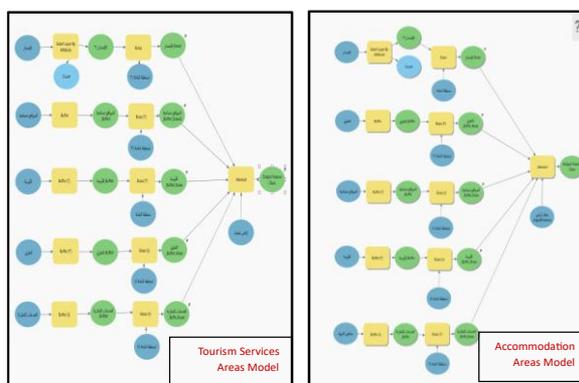


Figure 4: Model Builder workflow for identifying future locations of tourism services and accommodation areas in Al-Baha region up to 2034.

Source: Prepared by the student based on the application of the hierarchical analysis method (Model Builder) using ArcMap Pro 3.4

Table 3: Numerical and Relative Distribution of the Total Areas of Future Projected Sites for Accommodation Areas and Tourism Services by Governorates of Al-Baha Region until 2034.

Governorate	Accommodation Areas (km ²)	%	Tourism Services (km ²)	%
Al-Baha	3.69	0.14	2.13	0.08
Baljurashi	345.13	12.75	341.21	12.85
Al-Mikhwah	182.28	6.73	168.78	6.35
Al-Aqiq	1481.80	54.73	1447.78	54.51
Qilwah	210.40	7.77	197.77	7.45
Al-Mandaq	1.98	0.07	1.59	0.06
Al-Qura	257.00	9.49	246.71	9.29
Bani Hasan	0.003	0.0001	0.36	0.01
Ghamid Al-Zinad	80.90	2.99	68.87	2.59
Al-Hajrah	144.34	5.33	180.85	6.81
Total	2707.52	100	2656.10	100

Source: Prepared by the student using ArcMap Pro 3.4.

The previous table shows the close similarity in size between the optimal future sites for accommodation areas and tourism service areas. The total future area for accommodation zones is about 2,707.52 km², while for tourism services it is 2,656.1 km². This similarity is attributed to the high degree of alignment in planning requirements and standards, as well as the overlap between accommodation locations and the concentration of tourism services such as restaurants, recreational activities, and tourist facilities, reflecting their complementary relationship. The results can be analyzed as follows:

- **Al-Aqiq Governorate ranked first** in terms of total future area for both categories, accounting for more than half of the overall future areas. The future area for accommodation and tourism services represents approximately 55% of the total, due to the governorate’s vast available land that can be exploited for major tourism projects supporting regional tourism development—especially since Al-Aqiq hosts King Saud Domestic Airport and has a concentration of both public and private universities.
- **Baljurashi Governorate ranked second**, with the proportion of future expansion areas for tourism

services at about 58.12% of the total, compared to 12.75% for accommodation areas. This distribution enables the development of both tourism services and accommodation sectors without putting pressure on current resources, helping to ensure tourism sustainability.

- **Al-Qura, Qilwah, and Al-Makhwah governorates** recorded similar proportions for both tourism services and accommodation sectors. Despite the availability of vast areas, the presence of multiple industrial sites and a network of branching valleys relative to the governorate areas has limited the spread of future sites.
- **In fifth place are Al-Hajrah and Ghamid Al-Zinad governorates.** The proportion of future expansion areas for tourism services reached 6.81% of the total in Al-Hajrah and 2.59% in Ghamid Al-Zinad. The future area for accommodation sites was about 3.06% for Al-Hajrah and 2.99% for Ghamid Al-Zinad.
- **Finally, Al-Baha and Bani Hasan governorates** recorded the lowest areas for future sites, due to the concentration of current services.

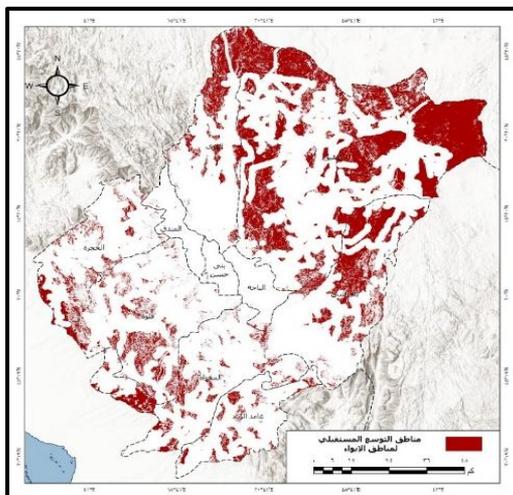


Figure 5: Future expansion areas of eco-tourism sites in Al-Baha region up to the year 2034.

Source: Prepared by the student based on the application of the hierarchical analysis method (Model Builder) using ArcMap Pro 3.4

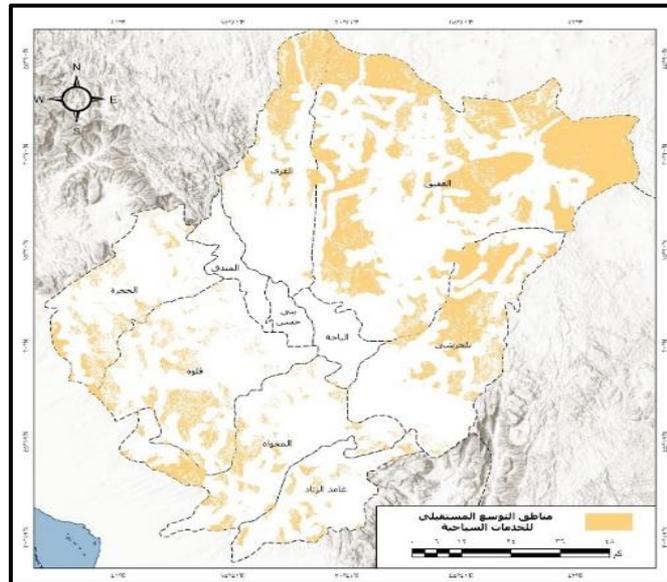


Figure 6: Future expansion areas of eco-tourism sites in Al-Baha region up to the year 2034.
 Source: Prepared by the student based on the application of the hierarchical analysis method (Model Builder) using ArcMap Pro 3.4

4. OUTLOOK FOR ECO-TOURISM AREAS

The planning and management process for eco-tourism involves several key aspects aimed at achieving the principles of environmental sustainability, recognizing eco-tourism as a relatively low-cost economic resource. This requires selecting specific sites that ensure the protection of natural resources, as these resources represent a domain of economic investment that contributes to the

development of the tourism sector in the study area. Accordingly, it is essential that future eco-tourism sites meet a set of environmental and planning criteria that allow investors to utilize these sites for tourism without causing adverse effects on the natural environment (Abu Rahma, Al-Alwan, Dradkeh & Kafi, 2014, pp. 81-83). Table (4) presents the planning criteria adopted for identifying optimal locations for eco-tourism areas in Al-Baha region up to the year 2034.

Table 4: Planning Criteria Adopted for Identifying Optimal Locations for Eco-Tourism Areas in Al-Baha Region up to 2034.

Governorate	Accommodation Areas (km ²)	%	Tourism Services (km ²)	%
Al-Baha	3.69	0.14	2.13	0.08
Baljurashi	345.13	12.75	341.21	12.85
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Total	2707.52	100	2656.10	100

Source: Prepared by the student based on data from the Ministry of Municipal, Rural Affairs, and Housing, 2015, pp. 200-2012.

From Table (4), we can conclude that there is a clear difference between the planning criteria for future eco-tourism sites and those for future accommodation and tourism service areas. This difference is due to the specific requirements of environmental sites, which aim to utilize these locations appropriately without harming their natural components.

We observe that the land cover in eco-tourism sites

includes vegetation areas and water bodies, rather than open spaces, as these elements are among the main factors attracting tourists. These sites also comply with the slope criterion to ensure ease of access.

The planning criteria for environmental sites emphasize the need to avoid areas with negative impacts such as pollution and noise. Therefore, the table specifies a minimum distance of 2 km from

roads and 5 km from industrial areas. The requirement to be at least 1 km away from valleys is intended to ensure visitor safety and reduce natural

risks. Figure (7) illustrates the Model Builder workflow for identifying future locations of eco-tourism sites.

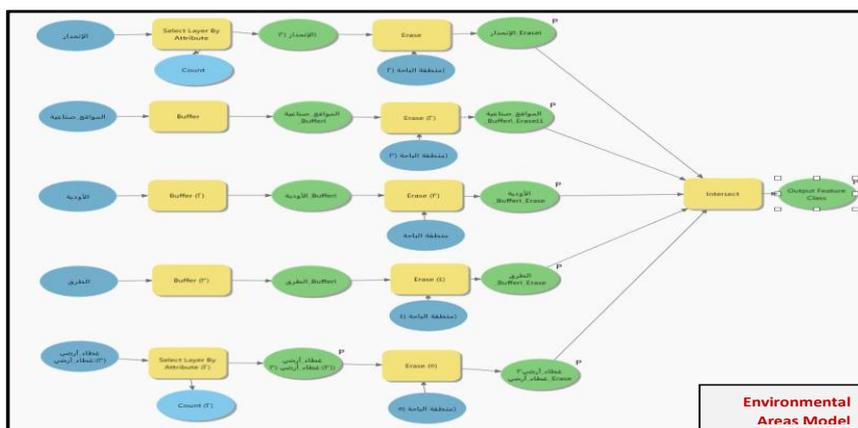


Figure 7: Model Builder workflow for identifying locations of eco-tourism areas in Al-Baha region up to the year 2034.

Source: Prepared by the student based on the application of the hierarchical analysis method (Model Builder) using ArcMap Pro 3.4

Table (6) shows the numerical and percentage distribution of the total areas of projected future sites for accommodation and tourism services by governorate in Al-Baha region up to the year 2034.

Table 6: Numerical and Relative Distribution of the Total Areas of Future Projected Eco-Tourism Sites by Governorates of Al-Baha Region until 2034

Governorate	Eco-Tourism Areas (km ²)	%
Al-Baha	0.02	0.01
Baljurashi	40.46	28.62
Al-Mikhwah	4.76	3.37
Al-Aqiq	59.32	41.97
Qilwah	10.68	7.56
Al-Mandaq	0.94	0.67
Al-Qura	12.37	8.75
Bani Hasan	0.003	0.002
Ghamid Al-Zinad	1.61	1.14
Al-Hajrah	11.19	7.92
Total	141.35	100

Source: Prepared by the student using ArcMap Pro 3.4.

From the previous table, we can infer that the total area of eco-tourism sites is approximately 141.35 km². This limited area is due to the strict planning requirements and criteria designed to avoid negative impacts and harm to natural resources. The table’s results can be analyzed as follows:

- **Al-Aqiq Governorate** remains in the lead, with eco-tourism areas accounting for about 59.32% of the total. This is attributed to the vast size of Al-Aqiq, as well as its location within the Tihama highlands, which are characterized by gentle slopes.
- **Baljurashi Governorate** ranks second, comprising about 40.46% of the total area. Although it is one of the governorates where tourism services are concentrated, the large areas of vegetation cover and the distance of water

bodies from service centers contribute to this ranking.

- **In third place are Al-Qura (about 12.37%), Al-Hajrah (about 11.19%), and Qilwah (about 10.68%)** of the total areas. This is due to the low density of services and limited urban expansion, alongside the extensive vegetation cover and water bodies.
- **Fourth place includes Al-Makhwah and Ghamid Al-Zinad**, each with proportions not exceeding 5% of the total area, due to the limited spread of vegetation and water bodies.
- **The lowest proportions are found in Al-Mandaq, Al-Baha, and finally Bani Hasan**, attributed to the concentration of tourism services and the extensive spread of urban areas.

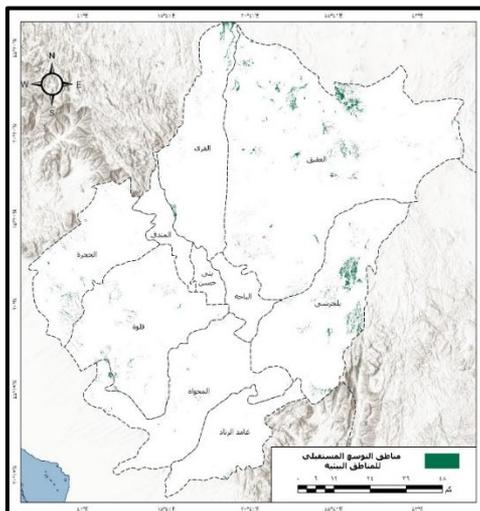


Figure 7: Future expansion areas of eco-tourism sites in Al-Baha region up to the year 2034.

Source: Prepared by the student based on the application of the hierarchical analysis method (Model Builder) using ArcMap Pro 3.4.

5. CONCLUSION:

Through the study of the spatial distribution of tourism services, it was found that Al-Baha Governorate ranked first in total tourism services in 2024, accounting for about 42.40% of all tourism services. This is due to its administrative importance, strategic central location within the region, high population density, and the availability of infrastructure services.

It is followed by Baljurashi Governorate, which accounts for about 25.27% of total tourism services. This is attributed to its commercial significance, high population density, and the presence of services that support the tourism sector.

The results of the Model Builder analysis for accommodation areas, tourism services, and eco-tourism sites indicate a clear similarity in the proposed future areas for accommodation and tourism services. This is due to the high degree of alignment in planning criteria and the functional interdependence between the two, as accommodation sites often overlap with the spread of tourism services. Al-Aqiq Governorate emerged as the largest area for future expansion, supported by its vast area and available infrastructure elements. It is followed by Baljurashi Governorate, which has developmental potential that allows for balanced and sustainable tourism sector development, while expansion opportunities are limited in some governorates due to existing natural and urban constraints.

Regarding eco-tourism, its future area is relatively limited compared to other tourism activities, due to the strict planning requirements aimed at protecting vegetation cover, water bodies, and minimizing

negative impacts. Al-Aqiq and Baljurashi governorates lead in terms of suitable future eco-tourism sites, while other governorates have less potential due to higher urban density or limited environmental resources.

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Regarding eco-tourism, its future area is relatively limited compared to other tourism activities, due to the strict planning requirements aimed at protecting vegetation cover, water bodies, and minimizing negative impacts. Al-Aqiq and Baljurashi governorates lead in terms of suitable future eco-tourism sites, while other governorates have less potential due to higher urban density or limited environmental resources. This confirms that planning for this type of tourism is fundamentally based on sustainability and the conservation of natural resources.

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