

GEO-SPATIAL MAPPING AND SUITABILITY ANALYSIS OF ECOTOURISM RESOURCES IN NASARAWA STATE, NIGERIA

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Abstract

Ecotourism has become an important strategy for promoting biodiversity conservation, rural development, and sustainable economic growth. However, the spatial distribution and development potential of ecotourism resources in Nasarawa State, Nigeria, remain inadequately documented. This study assessed the spatial distribution of ecotourism resources, evaluated the major challenges affecting ecotourism development, and identified priority strategies for sustainable ecotourism planning. Spatial data were collected using a Garmin 76CSx Global Positioning System (GPS) receiver and analysed in ArcGIS 10.1, while socio-economic data were obtained from 382 valid questionnaires administered to host communities and tourism stakeholders. Descriptive statistics, Relative Importance Index (RII), Pearson Product–Moment Correlation, and Exploratory Factor Analysis (EFA) using Principal Component Analysis (PCA) were employed for data analysis. The results revealed that ecotourism resources are spatially clustered, with the northern highlands, central riverine corridor, and southeastern geo-cultural zone representing the most important tourism areas. Respondents identified insecurity (Mean = 4.65), inadequate funding (Mean = 4.63), poor road access (Mean = 4.52), and lack of government support (Mean = 4.50) as the major constraints to ecotourism development. Improved security (Mean = 4.37; RII = 0.87) and infrastructure development (Mean = 4.23; RII = 0.85) emerged as the highest-priority strategies for sustainable tourism planning. The factor analysis confirmed that the proposed strategies constitute a reliable framework for sustainable ecotourism development. The study concludes that integrating GIS and GPS technologies with stakeholder perceptions provides an effective decision-support framework for ecotourism planning, conservation, and investment in Nasarawa State.

Keywords: Ecotourism, Geographic Information Systems (GPS), Sustainable Tourism, Spatial Analysis, Nasarawa State, Nigeria.

Introduction

Ecotourism has emerged as one of the fastest-growing sectors of the global tourism industry because of its ability to simultaneously promote biodiversity conservation, generate economic opportunities, and improve the livelihoods of local communities (Kesavan, & Polisetty, 2025). Unlike conventional tourism, ecotourism emphasizes responsible travel to natural and cultural landscapes while ensuring environmental sustainability, community participation, and equitable distribution of socio-economic benefits (Singh, 2026). Consequently, governments, conservation agencies, and development organizations increasingly recognize ecotourism as an important strategy for achieving sustainable development and several of the United Nations Sustainable Development Goals (SDGs), particularly those related to poverty reduction, biodiversity conservation, decent work, and sustainable communities (Aniramu et al., 2025; Uduji & Okolo-Obasi, 2023).

Across Africa, ecotourism has become an important driver of rural development, conservation financing, and employment creation. Countries such as Kenya, Tanzania, Botswana, Namibia, and South Africa have successfully integrated wildlife conservation with tourism development, thereby generating substantial foreign exchange earnings while enhancing community participation in natural resource management (Adetola, 2023). Nevertheless, the success of ecotourism depends largely on effective planning, appropriate infrastructure, stakeholder collaboration, and scientific information that supports sustainable resource management (Zhang, & Deng, 2024). Weak governance, inadequate infrastructure, unequal benefit sharing, and environmental degradation continue to limit ecotourism development in many African countries (Karakuş, 2024; Aniramu et al., 2025).

Nigeria possesses enormous ecotourism potential due to its rich biodiversity, diverse ecosystems, scenic landscapes, and cultural heritage. Protected areas, waterfalls, wetlands, forests, wildlife reserves, and cultural landscapes provide opportunities for nature-based tourism capable of supporting economic diversification beyond dependence on the petroleum sector (Silva, et al., 2023). However, despite these abundant resources, ecotourism development remains constrained by inadequate infrastructure, weak institutional frameworks, poor marketing, insufficient investment, and limited empirical evidence to support tourism planning and policy formulation (Baloch, et al., 2023). Existing studies have largely focused on individual destinations or socio-economic issues, while comprehensive geospatial assessments integrating Geographic Information Systems (GIS), remote sensing, and stakeholder perspectives remain limited (Muhammad et al., 2024; Atamewan, 2023; Aniramu et al., 2025).

Nasarawa State represents one of Nigeria's most resource-rich yet underutilized ecotourism destinations (Oluwabunmi, 2025).. The state contains numerous natural attractions, including Farin Ruwa Waterfalls, Keana Salt Village, Maloney Hills, wildlife habitats, caves, rivers, forests, and culturally significant heritage sites distributed across different local government areas (Muhammad et al., 2024). These resources possess considerable potential to stimulate rural development, generate employment, promote biodiversity conservation, and improve household livelihoods (Shi, et al., 2025). However, there is no comprehensive geospatial inventory identifying the spatial distribution, accessibility, and suitability of these resources for sustainable ecotourism development. Furthermore, limited information exists regarding priority areas for tourism investment and conservation planning, thereby constraining evidence-based decision-making by policymakers, investors, and tourism managers. Previous studies have concentrated mainly on identifying tourism attractions or discussing development challenges without applying advanced GIS-based spatial analytical techniques to evaluate ecotourism suitability (Onyekwelu et al., 2024; Heliyon, 2023).

Therefore, this study aims to undertake a geo-spatial mapping and suitability analysis of ecotourism resources in Nasarawa State, Nigeria, to support sustainable tourism planning and development. Specifically, the study seeks to identify and map the spatial distribution of ecotourism resources using Geographic Information Systems (GIS) and Global Positioning System (GPS) techniques, evaluate the major challenges to ecotourism development, and identify priority strategies for sustainable ecotourism planning.

METHODOLOGY

Research Area

The study was conducted in Nasarawa State, North-Central Nigeria, located between latitudes 7°45'N and 9°25'N and longitudes 7°00'E and 9°37'E. The state shares boundaries with the Federal Capital Territory (FCT) to the west, Kaduna State to the north, Plateau State to the east, Benue and Kogi States to the south, and Taraba State to the southeast. It occupies an estimated land area of approximately 27,117 km² and comprises diverse ecological landscapes, including Guinea Savannah vegetation, forest patches, wetlands, hills, rivers, waterfalls, and culturally significant heritage sites. Major ecotourism attractions include Farin Ruwa Waterfalls, Keana Salt Village, Maloney Hills, Akiri Warm Spring, Gurku Hills, and several wildlife and cultural heritage sites distributed across the state. The ecological diversity, strategic location, and rich natural and cultural resources make Nasarawa State suitable for geospatial assessment of ecotourism resources and sustainable tourism planning.

Research Design

This study adopted a descriptive survey research design integrated with Geographic Information System (GIS) and Global Positioning System (GPS) techniques to assess the spatial distribution and suitability of ecotourism resources in Nasarawa State, Nigeria. The design was considered appropriate because it enabled the collection of both spatial and socio-economic data required to achieve the study objectives. The GIS component facilitated the mapping, visualization, and spatial analysis of ecotourism resources using their geographic coordinates, while the survey component provided information on stakeholders' perceptions of the challenges affecting ecotourism development and the strategies required for sustainable ecotourism planning. The integration of geospatial techniques with questionnaire-based data provided a comprehensive framework for evaluating ecotourism resources and supporting evidence-based tourism planning and decision-making in the study area.

Population of the Study

The target population for this study comprised residents of host communities and key stakeholders involved in ecotourism development across selected ecotourism destinations in Nasarawa State, Nigeria. The stakeholders included tourism administrators, community leaders, tourism entrepreneurs, and other individuals directly involved in the planning, management, conservation, and promotion of ecotourism resources. These groups were considered appropriate because of their knowledge and experience regarding the distribution, accessibility, development challenges, and sustainable management of ecotourism resources within the study area.

Sample Size Determination

The sample size for the study was determined using Cochran's (1977) formula for large populations at a 95% confidence level and a 5% margin of error. The minimum sample size was therefore approximately 384 respondents. To compensate for possible non-response and incomplete questionnaires, the sample size was increased to 400 respondents. A total of 400 questionnaires were administered, of which 382 were correctly completed and returned, representing a response rate of 95.5%. The 382 valid responses formed the basis for the statistical analyses.

Sampling Technique

A multistage sampling technique involving purposive and simple random sampling was employed for the selection of respondents. In the first stage, ecotourism destinations and their host communities

were purposively selected based on the presence of established ecotourism resources identified from the records of the Nasarawa State Ministry of Tourism and verified through field surveys. This approach ensured that only communities with recognized ecotourism attractions relevant to the objectives of the study were included.

In the second stage, respondents comprising residents of the host communities and key stakeholders involved in ecotourism development were selected using simple random sampling. This ensured that every eligible respondent within the selected communities had an equal opportunity of participating in the study, thereby minimizing selection bias and enhancing the representativeness of the sample. A total of 400 questionnaires were administered, out of which 382 were correctly completed and returned for analysis, representing a response rate of 95.5%.

Instrument for Data Collection

Data for this study were collected using a researcher-developed questionnaire titled Ecotourism Development Assessment Questionnaire (EDAQ) and geospatial data collection instruments. The EDAQ was designed to elicit information from residents of host communities and key stakeholders on the challenges affecting ecotourism development and the strategies required for sustainable ecotourism planning in Nasarawa State. The questionnaire consisted of two sections. Section A obtained respondents' demographic information, while Section B contained items on ecotourism development challenges and sustainable development strategies measured on a five-point Likert scale ranging from Strongly Agree (5) to Strongly Disagree (1).

Geospatial data were collected using a Garmin 76CSx Global Positioning System (GPS) receiver to obtain the geographic coordinates of identified ecotourism sites. The coordinates, together with secondary spatial datasets obtained from the Nasarawa State Ministry of Tourism and other relevant sources, were imported into ArcGIS 10.1 for mapping, spatial database development, and geospatial analysis. The combination of questionnaire responses and geospatial data provided comprehensive information for assessing the spatial distribution, development challenges, and sustainable management of ecotourism resources in the study area.

Validation of the Instrument

The Ecotourism Development Assessment Questionnaire (EDAQ) was subjected to face and content validation to ascertain its suitability for data collection. The instrument was reviewed by experts in Tourism Studies, Geographic Information Systems (GIS), and Measurement and Evaluation. The validators examined the questionnaire items for clarity, relevance, adequacy, content coverage, and

alignment with the objectives of the study. Their observations, comments, and recommendations were incorporated into the final version of the instrument before administration to respondents.

Reliability of the Instrument

The reliability of the Ecotourism Development Assessment Questionnaire (EDAQ) was established using the Cronbach's Alpha method to determine the internal consistency of the instrument. A pilot study was conducted among respondents with characteristics similar to those of the study population but outside the selected study communities to avoid contamination of the main study. The data obtained from the pilot survey were analysed using the Statistical Package for the Social Sciences (SPSS), and a Cronbach's Alpha reliability coefficient of **0.84** was obtained. The coefficient exceeded the recommended minimum threshold of 0.70, indicating that the instrument possessed satisfactory internal consistency and was therefore considered reliable for data collection.

Method of Data Collection

Data for this study were collected from both primary and secondary sources. Primary data were obtained through field surveys and the administration of the validated Ecotourism Development Assessment Questionnaire (EDAQ) to residents of host communities and key stakeholders involved in ecotourism development across the selected study areas in Nasarawa State. The questionnaires were administered personally by the researcher with the assistance of trained research assistants to ensure a high response rate and proper completion of the instrument. Out of the 400 questionnaires administered, 382 were correctly completed and retrieved, representing a response rate of 95.5%. Spatial data were obtained through field observations using a Garmin 76CSx Global Positioning System (GPS) receiver to capture the geographic coordinates of ecotourism sites. The GPS data were complemented with secondary spatial datasets, including the inventory of ecotourism resources and administrative maps obtained from the Nasarawa State Ministry of Tourism and other relevant agencies. The field survey also provided an opportunity to verify the location and current status of the identified ecotourism resources. The integration of the questionnaire responses with the spatial datasets provided comprehensive information for assessing the spatial distribution, development challenges, and sustainable development potential of ecotourism resources in Nasarawa State.

Method of Data Analysis

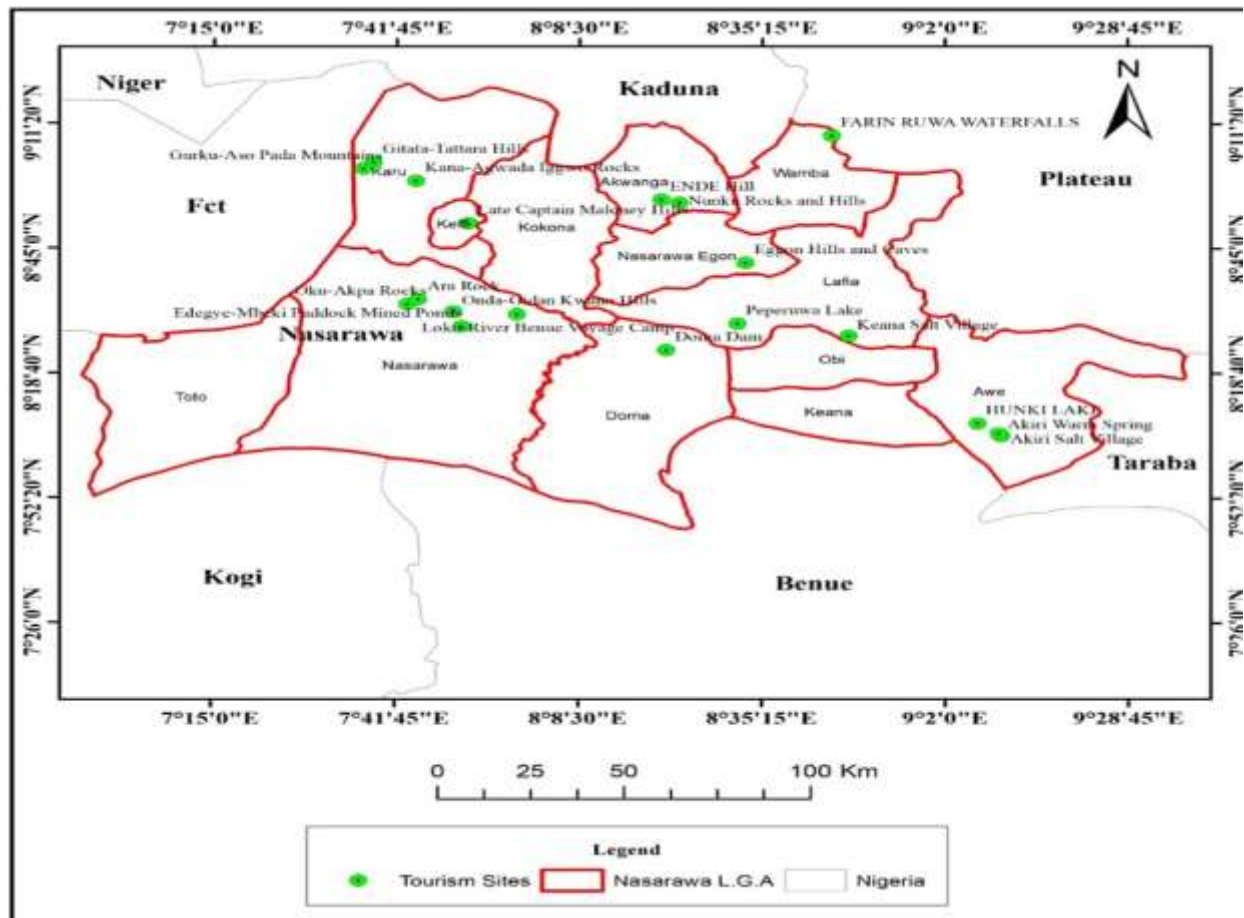
The data collected for this study were analysed using both geospatial and statistical techniques. Spatial data obtained from the Global Positioning System (GPS) survey were imported into ArcGIS 10.1 to develop a geodatabase and generate maps showing the spatial distribution of ecotourism

resources in Nasarawa State. Point pattern analysis was employed to examine the distribution and clustering of the identified ecotourism sites, while other spatial analyses were used to support the assessment of ecotourism suitability.

The questionnaire data were coded and analysed using the Statistical Package for the Social Sciences (SPSS) version 27. Descriptive statistics, including frequency, percentage, mean, and standard deviation, were used to summarize respondents' demographic characteristics and assess the challenges affecting ecotourism development as well as the strategies for sustainable ecotourism planning. The Relative Importance Index (RII) was computed to rank the identified challenges and proposed strategies according to their perceived significance. Pearson Product–Moment Correlation (PPMC) was employed to determine the relationships among the identified challenges affecting ecotourism development. Exploratory Factor Analysis (EFA) using Principal Component Analysis (PCA) was conducted to identify the underlying dimensions of the proposed sustainable ecotourism strategies. The suitability of the data for factor analysis was assessed using the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy and Bartlett's Test of Sphericity. Components with eigenvalues greater than one were retained for interpretation, while factor loadings of 0.50 and above were considered significant. All inferential statistical analyses were conducted at a 0.05 level of significance, and the null hypothesis was rejected where the p-value was less than 0.05; otherwise, it was not rejected.

RESULTS AND DISCUSSION

Spatial Distribution of Ecotourism Resources in Nasarawa State



Spatial Distribution of Ecotourism Sites in Nasarawa State:

Source: Modified from Administrative Map of Nasarawa state .

The GIS analysis revealed that ecotourism resources in Nasarawa State are unevenly distributed, forming distinct spatial clusters influenced by physical landscapes, hydrological systems, geological formations, accessibility, and cultural heritage. The geospatial database developed from GPS field observations provides the first comprehensive inventory of the state's ecotourism resources and serves as a valuable tool for evidence-based tourism planning. The northern and northeastern zones contain the highest concentration of ecotourism attractions, including hills, inselbergs, waterfalls, and rocky landscapes such as Farin Ruwa Waterfalls, highlighting the importance of topography and geological diversity in supporting nature-based tourism. The central zone is characterized by riverine and aquatic resources, including lakes, dams, warm springs, and sections of the River Benue, offering opportunities for recreation, boating, fishing, and biodiversity conservation. In the

southeastern axis, particularly Awe and Keana, geo-cultural resources combine traditional salt-processing activities with unique geological features, creating strong potential for geo-heritage and community-based tourism. Although the western part of the state benefits from proximity to the Federal Capital Territory, it contains comparatively fewer ecotourism resources, indicating that natural resource endowment has a greater influence on spatial distribution than accessibility alone. Overall, the findings demonstrate that GIS and GPS technologies provide an effective decision-support

Evaluate the Challenges to Ecotourism Development in Nasarawa State

Table 1 Challenges to Ecotourism Development

Challenge	Mean	SD	RII
Poor road access	4.52	0.88	0.93
Inadequate funding	4.63	0.79	0.93
Lack of government support	4.50	0.85	0.92
Insecurity	4.65	0.76	0.91
Environmental degradation	4.44	0.91	0.90
Low community awareness	4.33	0.94	0.90
Poor marketing & promotion	4.49	0.87	0.89
Lack of trained personnel	4.61	0.81	0.87

Source: Author, 2026

The perceived challenges affecting ecotourism development are presented in Table 1. All assessed variables recorded high mean scores (4.33–4.65) and Relative Importance Index (RII) values (0.87–0.93), indicating that respondents considered them major constraints to sustainable ecotourism development. The highest-ranked challenges were insecurity with the Mean of 4.65, inadequate funding (Mean = 4.63; RII = 0.93), poor road access (Mean = 4.52; RII = 0.93), lack of government support (Mean = 4.50; RII = 0.92), and lack of trained personnel (Mean = 4.61; RII = 0.87). Environmental degradation (Mean = 4.44; RII = 0.90), low community awareness (Mean = 4.33; RII = 0.90), and poor marketing and promotion (Mean = 4.49; RII = 0.89) were also identified as significant barriers.

These findings suggest that physical infrastructure, financial resources, institutional capacity, and security are the principal determinants of ecotourism suitability in Nasarawa State. Poor road networks reduce site accessibility and visitor mobility, while inadequate funding limits infrastructure provision, conservation activities, destination management, and community benefit-sharing.

Similarly, insecurity discourages tourist visitation, private investment, and local participation, thereby reducing the competitiveness of ecotourism destinations. Weak government support and inadequate technical capacity further constrain effective planning, policy implementation, and sustainable resource management.

Table 2 Pearson Correlation Matrix on Relationships of the variables of Challenges to Ecotourism Development

Variable	1	2	3	4	5	6	7	8
1 Poor road access	1							
2 Inadequate funding	0.72**	1						
3 Lack of govt support	0.70**	0.78**	1					
4 Insecurity	0.68**	0.74**	0.76**	1				
5.Environmental degradation	0.60**	0.65**	0.67**	0.62**	1			
6 Low community awareness	0.58**	0.63**	0.69**	0.61**	0.72**	1		
7 Poor marketing	0.66**	0.73**	0.71**	0.69**	0.64**	0.68**	1	
8 Lack of trained personnel	0.69**	0.81**	0.75**	0.72**	0.66**	0.74**	0.77**	1

p < 0.01

Source: Author, 2026

The Result on table 2 shows the Pearson Correlation Matrix on Relationships of the variables of Challenges to Ecotourism Development. The result shows that All coefficients are Positive and Strong with $r = 0.58-0.81$ and statistically significant of $p < 0.01$. This indicates that respondents who perceive one challenge as severe tend to perceive others as severe as well. The strongest correlation is between Inadequate funding and Lack of trained personnel ($r = 0.81$). This suggests financial constraints directly affect human capital development. Without funding, training programs and technical capacity remain limited. While Lack of government support and Insecurity ($r = 0.76$). This implies institutional weakness is associated with broader governance and security concerns.

Strategies to be prioritized for Sustainable Ecotourism development planning in Nasarawa State.

Table 3 Strategies to be prioritized for Sustainable Ecotourism

Variable	Mean	SD	RII
Community empowerment	4.10	0.98	0.82
Environmental protection	3.93	1.06	0.79
Infrastructure development	4.23	0.90	0.85
Policy reform	3.83	1.12	0.77
Capacity building	4.00	1.03	0.80
Improved security	4.37	0.86	0.87

Source: Author, 2026

Table 3 shows that all proposed strategies were considered important for sustainable ecotourism development, with mean scores ranging from 3.83 to 4.37 and RII values between 0.77 and 0.87. Improved security (Mean = 4.37; RII = 0.87) emerged as the highest priority, followed by infrastructure development (Mean = 4.23; RII = 0.85), community empowerment (Mean = 4.10; RII = 0.82), capacity building (Mean = 4.00; RII = 0.80), environmental protection (Mean = 3.93; RII = 0.79), and policy reform (Mean = 3.83; RII = 0.77). Overall, the findings indicate that sustainable ecotourism in Nasarawa State requires an integrated approach that prioritizes security, infrastructure, community participation, environmental conservation, and effective governance to enhance destination competitiveness and ensure long-term sustainability

Table 4 Factor loadings

Variable	Loading
Community empowerment	0.81
Environmental protection	0.76
Infrastructure development	0.88
Policy reform	0.72
Capacity building	0.79
Improved security	0.91

Source: Author, 2026

Factor Analysis of Sustainable Ecotourism Strategies

Exploratory Factor Analysis (EFA) using Principal Component Analysis (PCA) was conducted to validate the strategies for sustainable ecotourism development. The data in table 4 were suitable for factor analysis, with a Kaiser–Meyer–Olkin (KMO) value of 0.84 and a significant Bartlett's Test of

Sphericity ($p < 0.05$). PCA extracted one dominant factor with an eigenvalue of 4.21, explaining approximately 70% of the total variance. All six strategy variables loaded strongly on this factor, with loadings ranging from 0.72 to 0.91, demonstrating strong construct validity and internal consistency. These findings indicate that the identified strategies collectively represent a reliable and integrated framework for promoting sustainable ecotourism development through improved security, infrastructure, community participation, capacity building, environmental protection, and policy support.

CONCLUSION

The study successfully demonstrated the application of GIS and GPS technologies in mapping ecotourism resources and supporting sustainable tourism planning in Nasarawa State. The spatial analysis revealed that ecotourism resources are concentrated within distinct ecological zones rather than being randomly distributed, with the northern highlands, central riverine corridor, and southeastern geo-cultural landscape constituting the state's principal ecotourism clusters. These findings provide the first comprehensive geospatial inventory of ecotourism resources in the state and establish a valuable baseline for tourism planning and conservation.

The study also established that sustainable ecotourism development is constrained by interconnected challenges, particularly insecurity, inadequate funding, poor road infrastructure, weak institutional support, environmental degradation, and limited technical capacity. The strong correlations among these variables indicate that improvements in one area are likely to influence others, highlighting the need for integrated policy interventions. Furthermore, respondents consistently prioritized improved security, infrastructure development, community empowerment, capacity building, environmental protection, and policy reform as essential strategies for achieving sustainable ecotourism. The factor analysis confirmed that these strategies form a coherent framework for sustainable tourism development.

The study concludes that integrating geospatial technologies with stakeholder-based assessments provides an effective decision-support framework for identifying priority investment areas, guiding conservation initiatives, and promoting sustainable ecotourism development in Nasarawa State. Such an approach will enhance environmental conservation, improve rural livelihoods, diversify the state's economy, and support evidence-based tourism policy and planning.

RECOMMENDATION

Based on the findings of the study, the following recommendations are proposed:

1. The Nasarawa State Government should develop a comprehensive GIS-based ecotourism database to support tourism planning, monitoring, and investment decision-making.
2. Priority investment should be directed toward the northern highland, central riverine, and southeastern geo-cultural zones because of their high ecotourism potential.
3. Government should improve road networks, visitor facilities, electricity, water supply, and communication infrastructure to enhance accessibility and visitor experience at major ecotourism destinations.
4. Security around ecotourism sites should be strengthened through increased surveillance, collaboration with security agencies, and community-based security initiatives to improve tourist confidence.
5. Sustainable financing mechanisms involving government, private investors, and development partners should be established to support ecotourism infrastructure, conservation programmes, and destination management.
6. Local communities should be actively involved in ecotourism planning, management, and benefit-sharing through community-based tourism initiatives, skills acquisition programmes, and entrepreneurship development.

REFERENCES

- Adetola, B. O. (2023). Biodiversity conservation and tourism sustainability in Africa. In *Sustainable utilization and conservation of Africa's biological resources and environment* (pp. 35–60). Springer Nature.
- Aniramu, O., Okebugwu, J., Olawale, J., Odelola, R., & Aniramu, T. (2025). Structural equation modelling of tourism development in Nigerian eco-destinations: A framework for sustainable growth. *Sustainable Earth Reviews*, 8, Article 8. <https://doi.org/10.1186/s42055-025-00108-y>
- Atamewan, E. E. (2023). Application of sustainable architectural design principles to enhance ecotourism in Cross River State, Nigeria. *Journal of Studies in Science and Engineering*, 3(2), 1fe–13. <https://doi.org/10.53898/josse2023321>

- Baloch, Q. B., Shah, S. N., Iqbal, N., Sheeraz, M., Asadullah, M., Mahar, S., & Khan, A. U. (2023). Impact of tourism development upon environmental sustainability: A suggested framework for sustainable ecotourism. *Environmental Science and Pollution Research*, 30(3), 5917–5930.
- Karakuş, C. B. (2024). Assessment of ecotourism potentiality based on GIS-based fuzzy logarithm methodology of additive weights (F-LMAW) method for sustainable natural resource management. *Environment, Development and Sustainability*, 26(10), 27001–27055. <https://doi.org/10.1007/s10668-024-05283-0>
- Kesavan, V., & Polisetty, A. (2025). A holistic view of ecotourism and the different ways of applying technology to drive ecotourism towards sustainable development. In *Navigating mass tourism to island destinations: Preservation and cultural heritage challenges* (pp. 1–36). IGI Global Scientific Publishing.
- Muhammad, A. S., Muhammadu, M. U., & Ahmed, M. (2024). Spatial distribution and potentials of ecotourism resources in Kano State, Nigeria. *African Journal of Social and Behavioural Sciences*, 14(5), 2082–2093.
- Oluwabunmi, A. (2026). Sweat to wealth: Unlocking Nigeria's tourism and economic potential through agriculture, fishing, and animal rearing. *Journal of Journalism and Media Management*, 2(1), 1–7. <https://doi.org/10.61440/JJMM.2026.v2.33>
- Onyekwelu, C. A., Inalegwu, E. O., Okafor, U. P., Asuoha, G. C., Ide, A. B., & Isaac, P. O. (2024). GIS-based cartographic approach to mapping of eco-tourism zones in Enugu State. *IOSR Journal of Humanities and Social Science*, 29(6, Series 6), 11–16. <https://doi.org/10.9790/0837-2906061116>
- Shi, H., Zhang, L., Song, B., & He, C. (2022). The impact of ecotourism on local rural households' livelihood around Wolong Nature Reserve. *Forestry Economics Review*, 4(1), 2–18.
- Silva, S., Silva, L. F., & Vieira, A. (2023). Protected areas and nature-based tourism: A 30-year bibliometric review. *Sustainability*, 15(15), Article 11698.
- Singh, M. (2026). *Ecotourism: Principles and global practices*. Educohack Press.
- Uduji, J. I., & Okolo-Obasi, N. V. E. (2023). Ecotourism for transformative and youth

development in Sub-Saharan Africa: The role of corporate social responsibility in Nigeria's oil host communities. *Journal of Tourism and Cultural Change*, 21(5)

Yasin, K. H., & Woldemariam, G. W. (2023). GIS-based ecotourism potentiality mapping in the East Hararghe Zone, Ethiopia. *Heliyon*, 9(8), e18567.

Zhang, Y., & Deng, B. (2024). Exploring the nexus of smart technologies and sustainable ecotourism: A systematic review. *Heliyon*, 10(11), e31996.