



### *Research article*

## **SUSTAINABILITY OF TOURISM INFRASTRUCTURE IN CROSS RIVER NATIONAL PARK, NIGERIA: STAKEHOLDER PERSPECTIVES AND IMPLICATIONS FOR SUSTAINABLE ECOTOURISM DEVELOPMENT**

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#### **ABSTRACT**

This study examined the sustainability of tourism infrastructure in Cross River National Park, Nigeria, from stakeholder perspectives and considered its implications for sustainable ecotourism development. A quantitative survey design was adopted, and questionnaire data were obtained from 400 respondents comprising local community members, visitors, park staff, tour operators, non-governmental organisations and government agencies. Descriptive statistics and one-way analysis of variance were used for analysis. Findings revealed a moderate level of infrastructure sustainability, with a grand mean of 3.54. Waste management systems recorded the highest mean score ( $M = 3.88$ ), followed by community participation ( $M = 3.75$ ), while natural resource protection ( $M = 3.30$ ) and maintenance of tourism facilities ( $M = 3.35$ ) were the weakest indicators. The ANOVA result showed significant differences in stakeholder perceptions,  $F(5, 394) = 3.487$ ,  $p = .005$ ,  $\eta^2 = .042$ . The study contributes protected-area evidence on the infrastructure-conservation nexus and concludes that sustainable ecotourism requires strengthened maintenance, conservation education, stakeholder collaboration, eco-friendly technologies and accountable park governance.

#### **KEYWORDS**

Tourism infrastructure sustainability; ecotourism development; stakeholder perceptions; community participation; Cross River National Park; biodiversity conservation; protected areas; Nigeria

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### **Introduction**

Tourism infrastructure is the material and institutional base through which destinations become accessible, usable and competitive. It includes transport networks, accommodation, communication systems, visitor centres, energy supply, water services, sanitation, safety systems, recreational amenities, trails, signage and the governance arrangements that keep these facilities functional. In protected areas, infrastructure performs an additional role: it must support visitor experience while protecting the ecological systems that justify tourism in the first place. Cross River National Park is therefore an important setting for examining infrastructure sustainability because tourism activities in the park are connected to rainforest biodiversity, conservation education, local livelihoods and the long-term attractiveness of nature-based destinations. Sustainable tourism infrastructure differs from ordinary tourism infrastructure because it is evaluated not only by availability but also by environmental responsibility, social inclusiveness, maintenance capacity and contribution to conservation. Roads, visitor shelters, lodges, trails, information boards and waste-management facilities may increase tourism use, but if they are poorly planned or poorly maintained, they may accelerate habitat pressure, pollution, visitor dissatisfaction and conflict with host communities. Sustainable infrastructure should therefore reduce ecological footprints, promote resource efficiency, strengthen community participation and support destination resilience

(He et al., 2021; Madanaguli & Dhir, 2023; Permana et al., 2024; Udonwa et al., 2022; Udonwa et al., 2024; Eneyo et al., 2023).

The need for sustainable infrastructure is particularly urgent in protected areas because such areas carry simultaneous conservation and development responsibilities. National parks are expected to conserve biodiversity, protect ecosystem services, support research, provide environmental education, create recreational opportunities and contribute to local development. These expectations are difficult to meet where access roads are weak, visitor facilities are deteriorating, waste-management systems are inconsistent, conservation education is limited or communities feel excluded from tourism benefits. In such contexts, infrastructure becomes not merely a technical matter but a governance issue affecting the credibility of ecotourism. Cross River National Park occupies a strategic position in Nigeria's protected-area and ecotourism landscape. The Park is recognised for its rainforest ecosystem, biological richness, scenic qualities and surrounding support-zone communities. It is divided into the Okwango and Oban divisions and contains ecological resources that can support biodiversity conservation, nature interpretation, scientific tourism and community-based ecotourism. However, the effectiveness of these opportunities depends on whether infrastructure development is sustainable, regularly maintained and perceived by stakeholders as supporting both conservation and visitor satisfaction.

Previous studies on tourism in Nigeria have examined tourism potential, ecotourism resources, visitor experiences, destination marketing and conservation challenges. However, comparatively fewer studies have focused directly on the sustainability of tourism infrastructure in national parks using multiple stakeholder perspectives. This gap is important because park staff, visitors, local community members, tour operators, non-governmental organisations and public agencies do not experience infrastructure in the same way. A visitor may evaluate accessibility and facilities, while community members may focus on livelihood benefits and resource protection. Park staff may assess maintenance and management constraints, while government officials may interpret infrastructure through policy and funding lenses. This study addresses the gap by examining the sustainability of tourism infrastructure in Cross River National Park and its implications for sustainable ecotourism development. The specific objectives are to examine the current state of tourism infrastructure in the park, evaluate the sustainability of such infrastructure, identify challenges affecting infrastructure sustainability and suggest strategies for improving sustainable tourism infrastructure development. The study contributes empirical evidence from a Nigerian national park and provides policy-relevant guidance for strengthening conservation, visitor satisfaction, community participation and sustainable destination governance.

## Literature review

Tourism infrastructure refers to the physical facilities, support services and institutional arrangements that enable tourism activities at a destination. It provides the foundation for accessibility, hospitality, interpretation, recreation and safety. Goeldner and Brent Ritchie (2011) identify infrastructure as a basic condition for destination competitiveness, while Jovanovic and Ilic (2016) show that transport, accommodation and public services influence tourism development. In protected areas, infrastructure includes not only roads and facilities but also trails, viewing platforms, conservation signage, waste systems, park offices, visitor information centres and communication systems that support safe and responsible visitation. Classical tourism planning literature emphasises that infrastructure shapes the spatial organisation of tourism. Gunn and Var (2002) argue that tourism planning requires the integration of attractions, services, access and information. Buhalis (2000) and Udonwa et al., (2022) similarly notes that destinations compete through a mix of resources, facilities, services and management systems. These insights remain relevant because a protected area may possess rich natural resources but fail to attract or satisfy visitors when basic facilities are weak. Infrastructure therefore connects resource potential with actual tourism performance.

Tourism infrastructure may be classified into physical, cultural, service and governance components. Physical infrastructure includes roads, transport systems, accommodation, water supply, electricity, toilets, trails

and waste systems. Cultural infrastructure includes interpretive spaces, museums, festivals, heritage routes and community narratives. Service infrastructure includes guides, tour operations, banking, security and hospitality services, while governance infrastructure includes policies, management rules, monitoring arrangements and institutional coordination (Raina, 2005). This broader classification is useful for Cross River National Park because sustainable ecotourism depends on both material facilities and the human systems that manage them. Sustainable tourism infrastructure refers to infrastructure that is planned, constructed, used and maintained in ways that support present tourism needs without compromising ecological integrity, social wellbeing or future tourism opportunities. It requires the use of environmentally responsible materials, energy efficiency, waste reduction, water conservation, regular maintenance, accessibility, climate resilience and community participation. Scuttari et al. (2025) and Eneyo et al., (2024) emphasise that sustainable tourism requires evidence-based planning and continuous monitoring, while Osorio-Molina et al. (2023) show that tourism, energy and sustainability are closely connected through infrastructure choices and resource-use practices.

In protected areas, sustainable infrastructure must be conservation-sensitive. Paths and viewing platforms should reduce uncontrolled trampling, visitor centres should educate tourists, accommodation should minimise waste and energy use, and transport arrangements should reduce damage to sensitive habitats. Poor infrastructure can increase erosion, litter, water pollution, wildlife disturbance and visitor pressure. It can also create social costs where surrounding communities bear restrictions without receiving benefits. Sustainable infrastructure must therefore be judged through environmental, social and economic indicators rather than by physical presence alone. Stakeholder participation is central to sustainable infrastructure. Freeman's (1984) Stakeholder Theory argues that organisations and institutions must consider the interests of all groups affected by their activities. In tourism, these groups include local communities, visitors, park managers, government agencies, tourism operators, non-governmental organisations, researchers and investors. Nurranto (2025) and Panagiotopoulou and Skoultzos (2025) stress that sustainable destination management requires collaboration among multiple actors because no single institution controls all tourism resources, impacts and responsibilities. A park infrastructure plan that excludes host communities may be technically sound but socially weak.

Empirical studies show that sustainable infrastructure improves destination competitiveness and stakeholder support. Muresan et al. (2022) found that transport facilities, accommodation and environmental infrastructure supported rural tourism development and tourist satisfaction. Almeida-García et al. (2023) reported that residents' support for tourism development increased when infrastructure was perceived as environmentally responsible and socially beneficial. Rasoolimanesh et al. (2021) also demonstrated that infrastructure quality, visitor facilities and environmental education contribute to sustainable destination management in protected areas. These studies suggest that infrastructure sustainability should be assessed through the perceptions of those who use, manage and live with it. Recent scholarship further links infrastructure to resilience. Haller (2024) argues that sustainable infrastructure can improve destination attractiveness by strengthening environmental quality, safety, service delivery and visitor satisfaction. Romão et al. (2024) found that infrastructure investment can support regional sustainability when aligned with environmental and development policies. Zhang and Cheng (2023) also show that tourism development after disruptive events must consider residents' quality of life. These findings are relevant to Cross River National Park because protected-area infrastructure must remain functional despite rainfall, difficult terrain, funding constraints and human pressure.

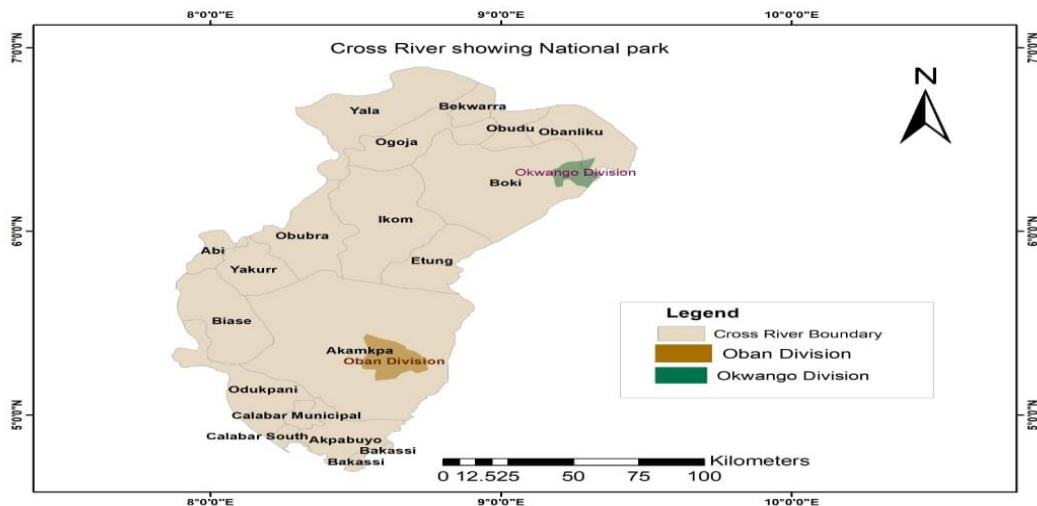
A further issue in sustainable infrastructure is financing and institutional continuity. Many protected-area facilities deteriorate not because they were poorly conceived at the beginning, but because maintenance budgets, staff capacity and monitoring systems are not sustained after construction. Sustainable infrastructure therefore requires life-cycle planning. This involves estimating the cost of construction, use, maintenance, replacement and environmental mitigation before projects are implemented. It also requires transparent revenue-use arrangements so that tourism income can support trail repair, waste control, interpretation materials, staff

training and conservation monitoring. Without such life-cycle planning, infrastructure may become visually present but functionally weak, and visitors may experience the park as under-maintained even where initial investment has occurred. The reviewed literature reveals two important gaps. First, much of the empirical evidence on tourism infrastructure sustainability comes from international or urban destination contexts, with limited attention to Nigerian national parks. Second, studies often treat stakeholders as a single group rather than comparing perceptions across communities, visitors, park staff, tour operators, NGOs and government officials. This study fills these gaps by using stakeholder perceptions to examine whether tourism infrastructure in Cross River National Park is sustainable and whether different stakeholder groups evaluate sustainability differently. The study was anchored on Stakeholder Theory because infrastructure sustainability depends on the participation, responsibilities and interests of multiple groups. It was also informed by sustainable tourism development principles, which require a balance between environmental protection, economic viability and social equity. The null hypothesis tested was that there is no significant difference among stakeholders' perceptions regarding the sustainability of tourism infrastructure in Cross River National Park. The alternative hypothesis was that significant differences exist among stakeholders' perceptions of tourism infrastructure sustainability.

## Methodology

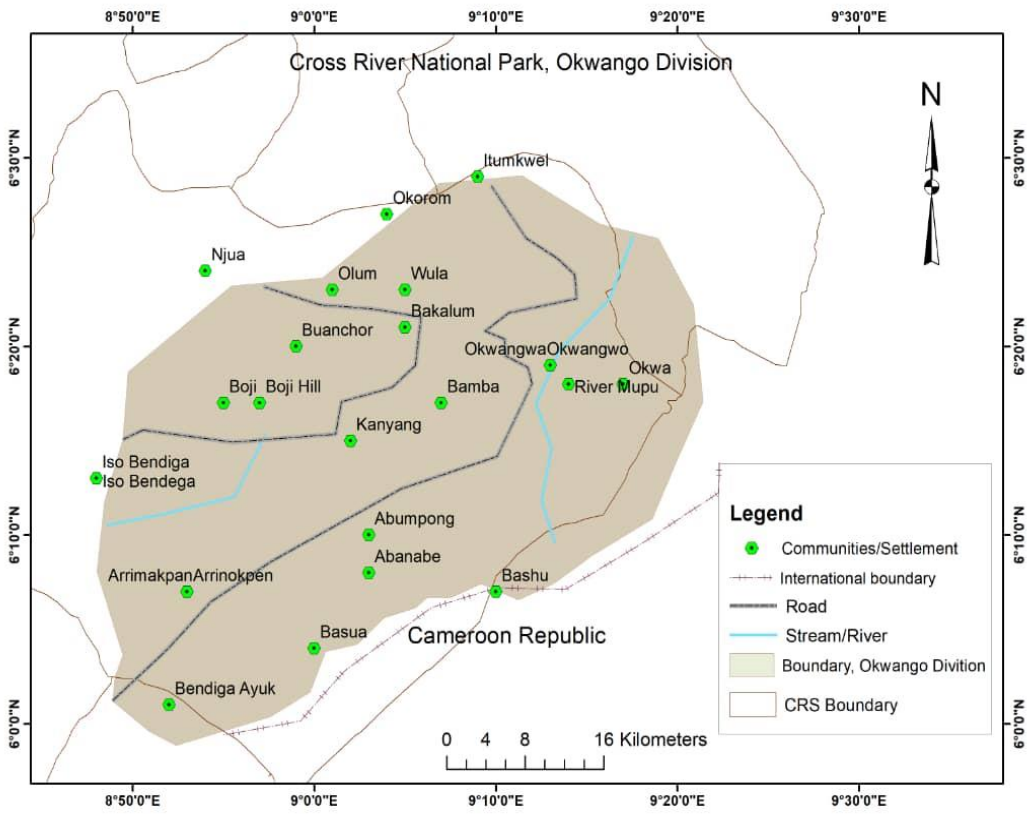
The study adopted a quantitative survey research design. The design was appropriate because the research sought to obtain structured data from multiple stakeholder groups at a defined point in time. Survey research allows the researcher to measure perceptions, compare responses and describe patterns across a relatively large sample. In this study, the design enabled the assessment of tourism infrastructure sustainability using indicators such as environmentally friendly facilities, natural resource protection, waste management, conservation education, facility maintenance and community participation.

The study was conducted in Cross River National Park, Nigeria. The Park is located in Cross River State, within the South-South geopolitical region, and lies approximately between latitude 5 degrees 00 minutes N and 7 degrees 10 minutes N and longitude 8 degrees 00 minutes E and 9 degrees 35 minutes E. The Park was established in 1991 and is divided into two main administrative divisions: Okwango and Oban. Figure 1 shows the location of the park within Cross River State, while Figures 2 and 3 show the Okwango and Oban divisions. These maps are retained because they provide the spatial context needed to understand the scale, ecological setting and stakeholder geography of the research.



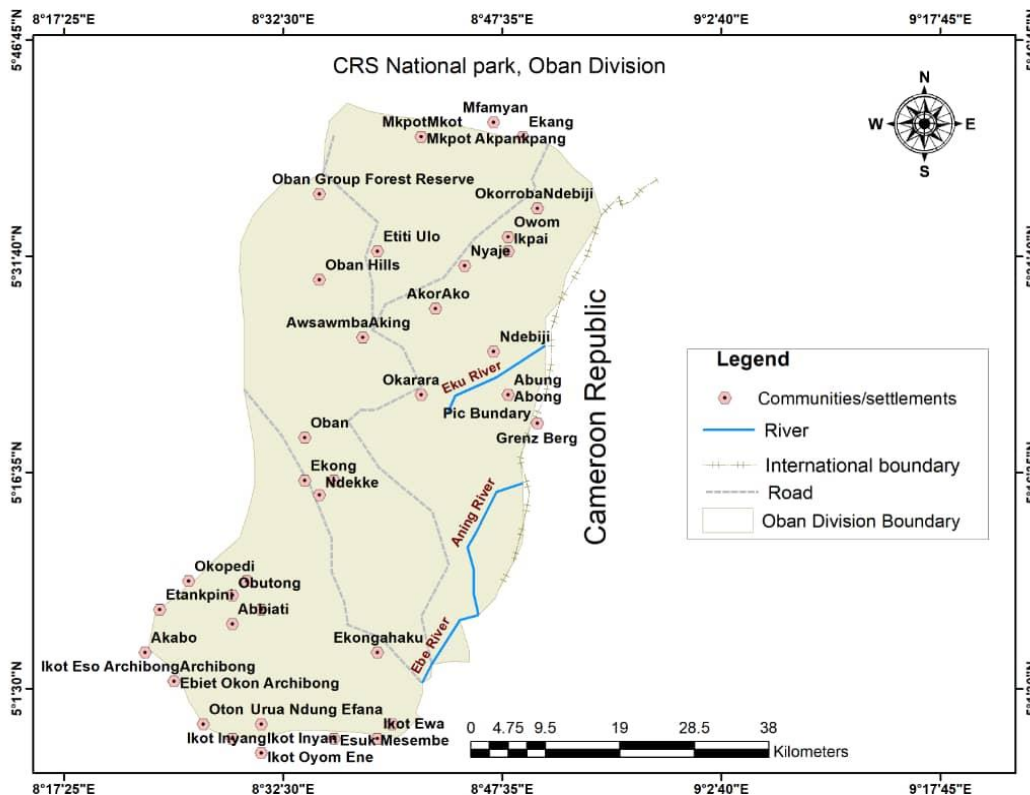
**Figure 1. Map of Cross River State showing Cross River National Park.**

Source: GIS Lab, Department of Geography and Environmental Science, University of Calabar, Nigeria, 2018.



**Figure 2. Map of Cross River National Park, Okwango Division.**

Source: GIS Lab, Department of Geography and Environmental Science, University of Calabar, Nigeria, 2018.



**Figure 3. Map of Cross River National Park, Oban Division.**

Source: GIS Lab, Department of Geography and Environmental Science, University of Calabar, Nigeria, 2018.

The Park area experiences a humid tropical climate with a long rainy season extending from March or April to October. Mean temperatures are generally high and annual rainfall ranges from about 1,800 mm to 3,000 mm, with peak rainfall usually occurring around July (Adejuwon, 2012; Emaziye et al., 2012). The ecological setting includes mangrove areas in the wider coastal environment, rainforest vegetation in the central and southern parts of the state and savanna-related vegetation toward the north. The Okwango Division is particularly important for biodiversity, and both divisions are linked to support-zone communities whose livelihoods and conservation responsibilities make them relevant stakeholders.

The target population comprised stakeholders involved in or affected by tourism infrastructure development in Cross River National Park. These stakeholders included local community members, visitors, park staff, non-governmental organisations, tour operators and government agencies responsible for tourism and environmental management. The population of support-zone communities was projected from available census data to 2026 using a 2.1% annual growth rate, producing an estimated 125,000 local community members. Other stakeholder groups included visitors, park staff, NGOs, tour operators and government agencies. Table 1 presents the population distribution used for the study.

**Table 1. Population of stakeholder groups.**

| S/N | Stakeholder group       | Population |
|-----|-------------------------|------------|
| 1   | Local community members | 125,000    |
| 2   | Park staff              | 430        |
| 3   | Visitors                | 15,000     |
| 4   | NGOs                    | 2,000      |
| 5   | Tour operators          | 2,000      |
| 6   | Government agencies     | 1,000      |
|     | Total                   | 145,430    |

Source: Researcher's fieldwork, 2026.

The sample size was determined using the Yamane (1967) formula for finite populations at a 95% confidence level and 5% level of precision. Based on the total population of 145,430, the computed sample was approximately 399 respondents and was rounded to 400 to ensure adequate representation and compensate for possible non-response. The final response rate was 100% because questionnaires were administered directly and retrieved immediately with the assistance of trained field assistants. A stratified random sampling technique was used to ensure that the different stakeholder groups were represented. The strata were local community members, visitors, park staff, NGOs, tour operators and government agencies. Within each stratum, simple random sampling was applied as far as field conditions permitted. This approach was appropriate because stakeholders differ in their levels of interaction with park infrastructure and their perceptions of sustainability. Local community members constituted the largest group because they live within the support-zone context and are most directly affected by park management decisions. Primary data were collected with a structured questionnaire administered over a four-week period. The instrument had two sections. Section A collected demographic information such as sex, age, marital status, education, stakeholder category and frequency of visit to the park. Section B measured tourism infrastructure sustainability using a five-point Likert scale ranging from Strongly Agree (5) to Strongly Disagree (1). The indicators covered environmentally friendly materials, natural resource protection, waste management systems, conservation education programmes, maintenance of tourism facilities and community participation in tourism planning and activities.

Validity and reliability procedures were observed. The questionnaire was reviewed by experts in tourism and environmental sustainability for content, construct and face validity. A pilot study involving 20 respondents was conducted before the main survey, and feedback was used to refine unclear or ambiguous items. Internal consistency reliability was assessed using Cronbach's alpha in SPSS version 27, producing a coefficient of 0.82. This exceeded the commonly accepted threshold of 0.70 and indicated that the instrument was reliable for measuring stakeholder perceptions of tourism infrastructure sustainability. Data were analysed using descriptive statistics and one-way analysis of variance. Frequencies and percentages were used for demographic and item-level results, while means and standard deviations were used to rank sustainability indicators. A mean score above 3.00 was interpreted as acceptance of the sustainability indicator. One-way ANOVA was used to test whether stakeholder groups differed significantly in their perceptions of infrastructure sustainability. Tukey HSD post hoc analysis was used to identify the specific stakeholder comparisons responsible for significant differences. Statistical significance was assessed at the 0.05 level. Ethical considerations were addressed throughout the study. Respondents were informed about the purpose of the research, voluntary participation, confidentiality and their right to withdraw. No personal identifiers were collected, and responses were reported in aggregate form. Ethical clearance was obtained from a recognised research ethics committee, and the research was conducted in a manner that avoided harm to respondents and respected community and institutional protocols.

## Results and discussion

The results are presented in line with the objectives of the study. The first part reports demographic characteristics and stakeholder engagement with the park. The second part presents the infrastructure sustainability indicators and interprets their implications for sustainable ecotourism development. The third part discusses mean scores, ANOVA results and post hoc comparisons. Tables and figures are referenced directly in the discussion so that the statistical evidence is linked with policy and management interpretation.

**Table 2.** Sex distribution of respondents.

| Sex    | Frequency (n) | Percentage (%) |
|--------|---------------|----------------|
| Male   | 230           | 57.5           |
| Female | 170           | 42.5           |
| Total  | 400           | 100            |

Source: Researcher's fieldwork, 2026.

**Table 3. Age distribution of respondents.**

| Age bracket (years) | Frequency (n) | Percentage (%) |
|---------------------|---------------|----------------|
| 18-25               | 80            | 20.0           |
| 26-35               | 120           | 30.0           |
| 36-45               | 100           | 25.0           |
| 46-55               | 60            | 15.0           |
| 56 and above        | 40            | 10.0           |
| Total               | 400           | 100            |

Source: Researcher's fieldwork, 2026.

Tables 2 to 7 show that the study captured a broad stakeholder profile. Male respondents represented 57.5% of the sample, while female respondents represented 42.5%. Although males were slightly more represented, the inclusion of both genders is important because tourism infrastructure affects employment, visitor experience, community participation and conservation responsibilities across gender lines. The age distribution in Table 3 shows that respondents aged 26-35 years formed the largest group (30.0%), followed by those aged 36-45 years (25.0%). This indicates that many respondents were within economically active age groups and were likely to understand the operational and livelihood implications of park infrastructure. The marital and educational profiles in Tables 4 and 5 further strengthen the relevance of the responses. Married respondents constituted 50.0% of the sample, suggesting that many participants were connected to household-level livelihood considerations. Educationally, 40.0% had secondary education and 32.5% had tertiary education. This literacy profile suggests that a large proportion of respondents could interpret conservation and infrastructure questions meaningfully. The stakeholder distribution in Table 6 confirms that local community members were the largest group (40.0%), followed by visitors (30.0%) and park staff (15.0%). This is appropriate because community members experience the park as a livelihood and conservation space, visitors experience it as a tourism product and park staff experience it as a management system.

**Table 4. Marital status of respondents.**

| Marital status | Frequency (n) | Percentage (%) |
|----------------|---------------|----------------|
| Single         | 150           | 37.5           |
| Married        | 200           | 50.0           |
| Divorced       | 30            | 7.5            |
| Widowed        | 20            | 5.0            |
| Total          | 400           | 100            |

Source: Researcher's fieldwork, 2026.

**Table 5. Educational level of respondents.**

| Educational level | Frequency (n) | Percentage (%) |
|-------------------|---------------|----------------|
| Primary           | 90            | 22.5           |
| Secondary         | 160           | 40.0           |
| Tertiary          | 130           | 32.5           |
| Others            | 20            | 5.0            |
| Total             | 400           | 100            |

Source: Researcher's fieldwork, 2026.

**Table 6. Occupational distribution of respondents by stakeholder group.**

| Occupation/stakeholder group | Frequency (n) | Percentage (%) |
|------------------------------|---------------|----------------|
| Local community members      | 160           | 40.0           |
| Visitors                     | 120           | 30.0           |
| Park staff                   | 60            | 15.0           |
| Tour operators               | 30            | 7.5            |
| NGOs                         | 20            | 5.0            |
| Government officials         | 10            | 2.5            |
| Total                        | 400           | 100            |

Source: Researcher's fieldwork, 2026.

The frequency-of-visit data in Table 7 show that 35.0% of respondents visited occasionally, 22.5% visited frequently and 15.0% worked in the park. This level of interaction is important because stakeholder perceptions of infrastructure sustainability are more credible when respondents have direct or repeated contact with the park environment. Occasional visitors can assess accessibility and visitor facilities, frequent users can

observe changes over time, and staff can speak to maintenance and management conditions. The data therefore provide a useful basis for evaluating infrastructure sustainability from multiple experiential positions.

**Table 7. Frequency of visit to Cross River National Park.**

| Frequency of visit | Frequency (n) | Percentage (%) |
|--------------------|---------------|----------------|
| First time         | 110           | 27.5           |
| Occasionally       | 140           | 35.0           |
| Frequently         | 90            | 22.5           |
| Work here          | 60            | 15.0           |
| Total              | 400           | 100            |

Source: Researcher's fieldwork, 2026.

**Table 8. Perception that park facilities are built with environmentally friendly materials.**

| S/N | Response option   | Frequency (n) | Percentage (%) |
|-----|-------------------|---------------|----------------|
| 1   | Strongly agree    | 120           | 30.0           |
| 2   | Agree             | 80            | 20.0           |
| 3   | Neutral           | 100           | 25.0           |
| 4   | Disagree          | 70            | 17.5           |
| 5   | Strongly disagree | 30            | 7.5            |
|     | Total             | 400           | 100            |

Source: Researcher's fieldwork, 2026.

The item-level results in Tables 8 to 13 show a generally moderate but uneven sustainability profile. Table 8 indicates that 50.0% of respondents agreed or strongly agreed that park facilities were built with environmentally friendly materials, while 25.0% were neutral and 25.0% disagreed or strongly disagreed. This result suggests that eco-friendly construction practices are visible to some stakeholders but not yet sufficiently consistent or well communicated. In a national park, the use of environmentally appropriate materials is important because facilities should blend with the landscape, minimise waste, reduce heat and resource use, and demonstrate the conservation message that the park seeks to promote. Table 9 shows a weaker perception of natural resource protection from tourism pressure. Only 43.0% of respondents agreed or strongly agreed that natural resources were adequately protected, while 33.0% were neutral and 24.0% disagreed or strongly disagreed. This pattern is significant because resource protection is the foundation of sustainable ecotourism. A high proportion of neutral responses may indicate uncertainty about monitoring, enforcement or visible conservation outcomes. It may also suggest that stakeholders observe some conservation efforts but remain unsure whether tourism pressure is being managed effectively.

**Table 9. Assessment of natural resource protection from tourism pressure.**

| S/N | Response option   | Frequency (n) | Percentage (%) |
|-----|-------------------|---------------|----------------|
| 1   | Strongly agree    | 68            | 17.0           |
| 2   | Agree             | 104           | 26.0           |
| 3   | Neutral           | 132           | 33.0           |
| 4   | Disagree          | 72            | 18.0           |
| 5   | Strongly disagree | 24            | 6.0            |
|     | Total             | 400           | 100            |

Source: Researcher's fieldwork, 2026.

Waste management recorded the strongest item-level result. Table 10 shows that 70.0% of respondents agreed or strongly agreed that waste management systems were implemented in the park. This supports the mean-score finding in Table 14 and suggests that sanitation and waste control are among the more visible sustainability practices in Cross River National Park. However, 20.0% neutrality and 10.0% disagreement indicate that waste management should still be improved, particularly in high-use areas, access routes, visitor stops and community interfaces.

**Table 10. Perception of waste management systems.**

| S/N | Response option | Frequency (n) | Percentage (%) |
|-----|-----------------|---------------|----------------|
| 1   | Strongly agree  | 120           | 30.0           |
| 2   | Agree           | 160           | 40.0           |
| 3   | Neutral         | 80            | 20.0           |
| 4   | Disagree        | 32            | 8.0            |

|   |                   |     |     |
|---|-------------------|-----|-----|
| 5 | Strongly disagree | 8   | 2.0 |
|   | Total             | 400 | 100 |

Source: Researcher's fieldwork, 2026.

Conservation education and facility maintenance produced more moderate results. Table 11 shows that 55.0% of respondents perceived conservation education programmes as available, but one-quarter disagreed. Conservation education is central to ecotourism because tourists need to understand the ecological value of the park, responsible behaviour, waste control and the importance of supporting local conservation goals. Table 12 shows that only 45.0% of respondents agreed that facilities were regularly maintained, while 35.0% were neutral. This is a warning sign because sustainable infrastructure depends as much on maintenance as on initial construction. A facility that is built but not maintained eventually becomes a source of visitor dissatisfaction and environmental risk.

**Table 11. Availability of conservation education programmes for tourists.**

| S/N | Response option   | Frequency (n) | Percentage (%) |
|-----|-------------------|---------------|----------------|
| 1   | Strongly agree    | 120           | 30.0           |
| 2   | Agree             | 100           | 25.0           |
| 3   | Neutral           | 80            | 20.0           |
| 4   | Disagree          | 60            | 15.0           |
| 5   | Strongly disagree | 40            | 10.0           |
|     | Total             | 400           | 100            |

Source: Researcher's fieldwork, 2026.

**Table 12. Perception of regular maintenance of tourism facilities.**

| S/N | Response option   | Frequency (n) | Percentage (%) |
|-----|-------------------|---------------|----------------|
| 1   | Strongly agree    | 60            | 15.0           |
| 2   | Agree             | 120           | 30.0           |
| 3   | Neutral           | 140           | 35.0           |
| 4   | Disagree          | 60            | 15.0           |
| 5   | Strongly disagree | 20            | 5.0            |
|     | Total             | 400           | 100            |

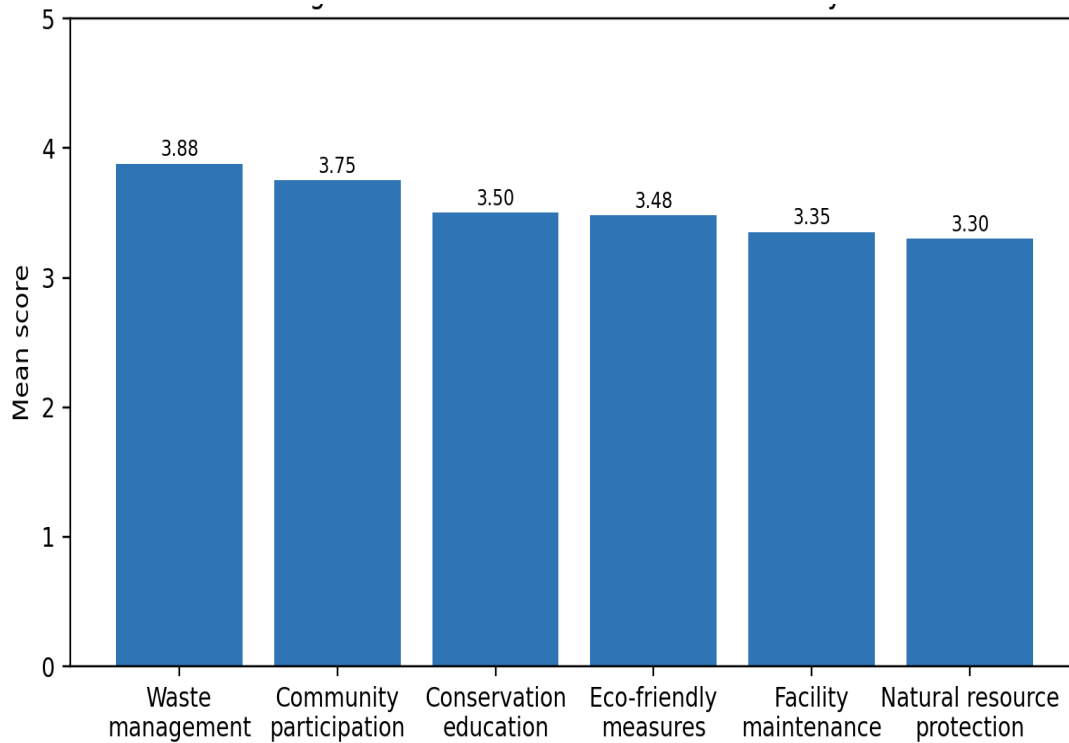
Source: Researcher's fieldwork, 2026.

Table 13 presents one of the more positive findings: 67.5% of respondents agreed that the park encourages community participation in tourism activities. This is important because local community support is essential for conservation, visitor safety, interpretation and benefit-sharing. Nevertheless, 17.5% of respondents disagreed, showing that community participation is not experienced equally by all stakeholders. Sustainable participation should move beyond consultation to include employment, guide services, local enterprise support, conservation education, joint monitoring and transparent benefit-sharing arrangements.

**Table 13. Perception that the park encourages community participation in tourism activities.**

| S/N | Response option   | Frequency (n) | Percentage (%) |
|-----|-------------------|---------------|----------------|
| 1   | Strongly agree    | 120           | 30.0           |
| 2   | Agree             | 150           | 37.5           |
| 3   | Neutral           | 60            | 15.0           |
| 4   | Disagree          | 50            | 12.5           |
| 5   | Strongly disagree | 20            | 5.0            |
|     | Total             | 400           | 100            |

Source: Researcher's fieldwork, 2026.



**Figure 4.** Mean ratings of tourism infrastructure sustainability indicators.

Source: Researcher's fieldwork, 2026.

**Table 14.** Mean ratings of tourism infrastructure sustainability indicators.

| Sustainability indicator          | Mean score | Std. deviation | Rank | Decision |
|-----------------------------------|------------|----------------|------|----------|
| Waste management system           | 3.88       | 0.94           | 1st  | Accepted |
| Community participation           | 3.75       | 1.02           | 2nd  | Accepted |
| Conservation education programmes | 3.50       | 1.10           | 3rd  | Accepted |
| Environmentally friendly measures | 3.48       | 1.21           | 4th  | Accepted |
| Maintenance of tourism facilities | 3.35       | 1.18           | 5th  | Accepted |
| Natural resource protection       | 3.30       | 1.09           | 6th  | Accepted |
| Grand mean                        | = 3.54     |                |      |          |

Source: Researcher's fieldwork, 2026.

However, the lowest-ranked indicators are the most strategically important for long-term sustainability. Maintenance of tourism facilities recorded a mean score of 3.35, while natural resource protection recorded the lowest mean of 3.30. This finding is critical because protected-area tourism cannot be sustainable where infrastructure is not maintained and natural resources are not adequately protected from visitor pressure. A moderate rating may appear acceptable statistically, but from a conservation-management perspective it signals the need for urgent improvement. The park's long-term competitiveness depends on the quality of its natural capital and the reliability of its facilities.

**Table 15.** ANOVA showing differences in stakeholders' perceptions of tourism infrastructure sustainability.

| Source of variation | Sum of squares | df  | Mean square | F     | Sig.  |
|---------------------|----------------|-----|-------------|-------|-------|
| Between groups      | 24.562         | 5   | 4.912       | 3.487 | 0.005 |
| Within group        | 555.438        | 394 | 1.410       |       |       |
| Total               | 580.000        | 399 |             |       |       |

Source: Researcher's fieldwork, 2026.

Table 14 and Figure 4 summarise the sustainability indicators using mean scores. The grand mean of 3.54 indicates a moderate level of tourism infrastructure sustainability in Cross River National Park. All six indicators exceeded the 3.00 decision benchmark, but the ranking shows clear differences in strength. Waste management recorded the highest mean score ( $M = 3.88$ ), followed by community participation ( $M = 3.75$ ). These results

suggest that stakeholders recognise visible efforts in sanitation and community involvement. They also show that the park has a foundation on which stronger sustainable ecotourism management can be built.

**Table 16. Tukey HSD post hoc multiple comparisons of stakeholders' perceptions of tourism infrastructure sustainability.**

| Comparison                      | Mean difference | Sig. (p-value) | Decision    |
|---------------------------------|-----------------|----------------|-------------|
| Park staff vs visitors          | 0.42            | .021           | Significant |
| Park staff vs community members | 0.39            | .034           | Significant |

Source: Researcher's fieldwork, 2026.

The findings align with Goeldner and Brent Ritchie (2011) and Jovanovic and Ilic (2016), who identify infrastructure as central to destination performance. They also support Haller's (2024) argument that sustainable infrastructure enhances environmental quality and destination attractiveness. In the context of Cross River National Park, infrastructure sustainability should not be measured only by the presence of facilities. It should be measured by whether those facilities reduce environmental pressure, improve visitor learning, support conservation, serve communities and remain functional over time. The ANOVA result in Table 15 shows a statistically significant difference in stakeholders' perceptions of tourism infrastructure sustainability,  $F(5, 394) = 3.487$ ,  $p = .005$ . Since the significance value is below .05, the null hypothesis is rejected. This means that stakeholder groups do not perceive infrastructure sustainability in exactly the same way. The effect size, eta squared = .042, indicates a small-to-moderate practical effect. Although the statistical effect is not large, it is meaningful because it shows that experience, role and proximity influence how sustainability is understood.

The Tukey HSD post hoc result in Table 16 shows that park staff had significantly higher perception scores than visitors and local community members. This difference is understandable. Park staff may be more familiar with management efforts, internal maintenance plans and conservation activities that are not always visible to visitors or local residents. Visitors may judge infrastructure mainly through access, facilities, cleanliness, interpretation and comfort. Local community members may evaluate sustainability through livelihood benefits, access restrictions, participation and perceived fairness. These differences confirm the value of using a stakeholder approach rather than relying on a single respondent category. The result also carries an important warning for park management. If staff perceive infrastructure sustainability more positively than visitors and communities, there may be a communication and experience gap. Management efforts may exist, but if visitors do not experience them or communities do not benefit from them, sustainability remains incomplete. Stakeholder Theory suggests that sustainable outcomes require the recognition of multiple interests (Freeman, 1984). For Cross River National Park, this means that infrastructure planning should involve structured consultation, feedback mechanisms, community participation, visitor surveys and transparent reporting of conservation and maintenance activities.

The major challenges implied by the findings include poor road accessibility, inconsistent maintenance, limited conservation education, uneven community participation and pressure on natural resources. These challenges are interconnected. Poor roads limit visitor numbers and reduce revenue for maintenance. Weak maintenance reduces visitor satisfaction and may discourage repeat visitation. Limited conservation education weakens responsible tourist behaviour. Uneven community participation may reduce local support for park rules. Weak protection of natural resources threatens the ecological base of ecotourism. Sustainable infrastructure policy must therefore treat these challenges as a connected system. For park managers, the indicator ranking provides a practical monitoring template. Waste management and participation should be consolidated because they are already visible strengths, while maintenance and natural-resource protection should become priority intervention areas. Conservation education should also be linked to all other indicators because informed visitors are more likely to use facilities responsibly and support park rules. A simple annual sustainability dashboard could track each indicator, compare stakeholder feedback and identify whether investments are improving conditions. This would help move the park from occasional assessment to continuous learning.

Overall, the results show that Cross River National Park has a moderate sustainability foundation but requires strategic upgrading. Waste management and community participation provide encouraging evidence, but natural resource protection and maintenance need stronger attention. The significant ANOVA result shows that stakeholders experience the park differently, and this difference should be used constructively. Rather than treating divergent perceptions as a problem, park managers can use them as evidence for adaptive governance, targeted investment and participatory monitoring.

## Implications/conclusion

The study has important implications for sustainable ecotourism development in Cross River National Park. First, infrastructure planning should be integrated with conservation management. Roads, trails, visitor shelters, interpretation centres, sanitation facilities and energy systems should be designed to reduce ecological pressure rather than simply increase access. The low ranking of natural resource protection indicates that infrastructure development must be accompanied by visitor-control measures, habitat monitoring, clear signage, enforcement of conservation rules and responsible waste-management practices.

Second, routine maintenance should become a formal management priority. The moderate score for maintenance shows that stakeholders are not fully convinced that tourism facilities are regularly maintained for long-term use. Maintenance should be budgeted, scheduled, monitored and reported. Park authorities should maintain an infrastructure register covering roads, trails, toilets, visitor centres, signs, waste bins, water points and safety facilities. Such a register would make it easier to identify deterioration early and allocate resources before facilities become unusable. Third, conservation education should be expanded and made more visible. Ecotourism is not only about visiting natural areas; it is also about learning, interpretation and responsible behaviour. Conservation education should be provided through trained guides, visitor information materials, school outreach, signage, digital platforms and community programmes. Visitors should understand why certain areas are restricted, why waste control matters, how tourism pressure affects wildlife and how their spending can support conservation and community wellbeing.

Fourth, community participation should move from general involvement to structured benefit-sharing and co-management. The relatively positive rating for community participation is encouraging, but sustainable participation requires clear mechanisms. These may include local guide associations, craft markets, community conservation committees, employment pathways, revenue-sharing arrangements, training for youth and women and transparent consultation before infrastructure projects are implemented. When host communities experience tangible benefits, they are more likely to support conservation rules and protect park resources.

Fifth, stakeholder feedback should be institutionalised. The ANOVA result showed significant differences among stakeholder perceptions, with park staff rating sustainability more positively than visitors and community members. This difference should guide management action. Regular visitor satisfaction surveys, community forums, operator consultations and staff review meetings should be used to identify infrastructure weaknesses. Feedback systems would allow park management to compare internal assessments with user experiences and community expectations. The study concludes that tourism infrastructure sustainability in Cross River National Park is moderate rather than strong. Waste management systems and community participation are the strongest indicators, while natural resource protection and facility maintenance require greater attention. The significant difference in stakeholder perceptions demonstrates that sustainability is experienced differently by those who manage, visit, use and live around the park. Therefore, sustainable ecotourism development in Cross River National Park requires stronger infrastructure maintenance, conservation education, eco-friendly technologies, stakeholder collaboration, community benefit-sharing and evidence-based park governance.

In practical terms, the findings suggest that park infrastructure should be treated as a sustainability system rather than as a collection of disconnected facilities. Waste bins, roads, trails, visitor centres, signs, energy supply, water points, community access routes and interpretive materials all influence one another. When one

element is weak, the visitor experience and conservation outcome can be weakened. For example, good waste facilities are less effective if visitors are not educated on responsible behaviour, and community participation is less meaningful if local groups are not involved in maintenance and monitoring. A systems approach would allow park management to link infrastructure investment with conservation goals, visitor satisfaction, community benefit and long-term financial planning.

Future research should combine perception data with ecological and technical infrastructure audits. Useful indicators would include trail condition, waste volume, facility functionality, visitor carrying capacity, water and energy use, wildlife disturbance, community income from tourism and cost of maintenance. Longitudinal studies would also help determine whether infrastructure sustainability improves over time and whether stakeholder perceptions become more aligned after management interventions. Such evidence would strengthen the transition from moderate infrastructure sustainability to a more resilient and internationally competitive ecotourism model.

## Declarations

**Ethics approval and consent to participate:** Ethical clearance was obtained from the appropriate research ethics committee. Respondents participated voluntarily after being informed of the purpose of the study, confidentiality conditions and their right to withdraw.

**Consent for publication:** The author approved the manuscript for journal submission and publication.

**Availability of data and materials:** The dataset used for the analysis is available from the corresponding author on reasonable request.

**Competing interests:** The author declares no competing interests.

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**Authors' contributions:** The author conceptualised the study, coordinated data collection, analysed the data and prepared the manuscript.

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