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Research article

SPATIAL DISTRIBUTION OF TOURIST ACCOMMODATION IN CALABAR USING NEAREST-NEIGHBOUR ANALYSIS

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ABSTRACT
This study evaluates the spatial distribution of sampled tourist accommodation establishments in Calabar, Nigeria. 20 GPS locations were quality-checked, with the source's latitude and longitude labels corrected from numeric ranges. Coordinates were mapped, nearest-neighbour distances recalculated geodesically, and the Average Nearest Neighbour output interpreted under complete spatial randomness. The establishments occupied a compact metropolitan extent, with a mean centre near 4.985° N and 8.340° E. Short nearest-neighbour links occurred between paired or closely spaced establishments, while northern and peripheral properties increased overall dispersion. The analysis reported an Average Nearest Neighbour ratio of 0.907, z = −1.1168 and p = .2641. Accordingly, the sampled pattern was not statistically distinguishable from complete spatial randomness at the .05 level; this is not evidence that accommodation location is unstructured or that the full population is random. Implications: Planning requires a complete accommodation inventory, verified coordinates, road-access measures, service-capacity data and multi-distance analysis before zoning or investment decisions.

KEYWORDS
tourist accommodation; hotel location; Average Nearest Neighbour; GIS; Calabar; spatial planning; complete spatial randomness; destination services

Introduction

Tourism accommodation infrastructure represents a critical component of destination development, influencing visitor experiences, economic growth, spatial organization, and the overall competitiveness of tourism regions. The location and distribution pattern of accommodation facilities within an urban area reflect complex interactions among accessibility, land-use dynamics, transportation networks, tourist attractions, investment decisions, and socio-economic conditions. In rapidly developing tourism destinations, understanding the spatial arrangement of hotels, guesthouses, and other lodging facilities is essential for effective tourism planning, infrastructure provision, and sustainable destination management.
Calabar, the capital city of Cross River State, Nigeria, has emerged as one of the country's prominent tourism destinations due to its cultural heritage, ecological resources, festivals, and growing hospitality sector. The city's tourism development has stimulated the expansion of accommodation facilities to support increasing visitor demand. However, the spatial distribution of these facilities may not occur randomly; rather, it is often shaped by proximity to major attractions, commercial centres, transportation corridors, administrative zones, and areas with higher investment potential. Examining these spatial patterns provides valuable insights into whether accommodation facilities are clustered, dispersed, or randomly distributed across the urban landscape.

Spatial analytical techniques within Geographic Information Systems (GIS) provide powerful approaches for investigating the geographical organization of tourism facilities. Among these techniques, the Nearest-Neighbour Analysis (NNA) method offers a quantitative framework for determining the spatial pattern of point-based features by comparing observed distances between facilities with expected random distributions. The approach generates a nearest-neighbour ratio that identifies whether accommodation

establishments exhibit clustering, dispersion, or randomness, thereby providing empirical evidence for understanding tourism infrastructure organization.

Previous studies have emphasized the importance of spatial analysis in examining tourism facilities, environmental management, and sustainable destination development, particularly in relation to accessibility, service concentration, and regional inequalities (Eneyo, 2025a; Eneyo, 2026a; Eneyo, 2026b; Eneyo & Archibong, 2024; Eneyo et al., 2023). In urban tourism environments, such analysis helps identify areas of accommodation concentration, underserved locations, and potential spatial imbalances that may influence visitor mobility and tourism accessibility. Furthermore, examining accommodation distribution contributes to broader discussions on sustainable tourism planning by supporting evidence-based decisions regarding infrastructure expansion and resource allocation.

Despite the growing importance of Calabar as a tourism destination, limited empirical attention has been directed toward understanding the spatial pattern of tourist accommodation facilities within the city using quantitative spatial techniques. Many existing tourism studies have focused on economic contributions, visitor experiences, or destination development, while the geographical arrangement of accommodation infrastructure remains insufficiently explored. Addressing this gap is important because spatial distribution patterns provide essential information for policymakers, tourism planners, investors, and hospitality stakeholders seeking to enhance the efficiency and sustainability of tourism development. Therefore, this study applies Nearest-Neighbour Analysis to examine the spatial distribution pattern of tourist accommodation facilities in Calabar. By determining whether these facilities are clustered, dispersed, or randomly distributed, the research provides a scientific understanding of the spatial structure of tourism accommodation and offers insights for improving tourism planning, accessibility, and sustainable urban destination management.

Literature review

Hotel and accommodation location is shaped by access to demand, land cost, planning rules, transport, attractions and agglomeration economies. Establishments may cluster where visitors can reach business districts, institutions and leisure services, but high land cost or market segmentation can also produce dispersion. Spatial pattern should therefore be treated as an outcome of multiple decisions rather than an intrinsic characteristic of the accommodation sector (Eneyo & Ekpenyong, 2018; Eyo et al., 2026; Onnoghen, Kujoh, et al., 2025; Onnoghen, Sylvanus, et al., 2023).

GIS supports accommodation analysis by linking point locations with roads, attractions, land use, neighbourhoods and environmental constraints. Li et al. (2015) demonstrate that hotel patterns change over time and relate to urban tourism functions. Rodríguez-Rangel et al. (2020) model tourism-accommodation intensity with spatial point-process methods, illustrating why a single nearest-neighbour statistic is often only a first step. Modern planning should combine visualisation, global tests, local density and explanatory variables (Ogbaji et al., 2025; Onnoghen, Unimtiang, Onnoghen, et al., 2024; Unimtiang, Onnoghen, Ogbaji, et al., 2025).

The Clark-Evans Average Nearest Neighbour method compares observed mean nearest-neighbour distance with the expectation under complete spatial randomness within a defined area. A ratio below one indicates closer spacing than expected, and a ratio above one indicates greater spacing. Significance depends on the sampling window, edge correction and assumption that points could occur anywhere within that window. These assumptions are difficult for urban accommodation because water, restricted land and roads constrain feasible locations.

Boundary definition is especially influential with twenty points. If the analysis uses the minimum bounding rectangle, a municipal boundary or a wider metropolitan boundary, expected spacing changes. Properties near the edge have neighbours only inward, which can inflate distance. The source did not fully document the analysis window. The ratio and z score are therefore reported, but a precise replication of ArcGIS output is not claimed without the original feature class, projection and boundary.

Sample design also matters. The source refers to selected accommodation, not a complete census. Average Nearest Neighbour analysis is commonly interpreted as a pattern test for all observed events in a defined space. Applying it to a convenience or purposive subset can produce a pattern of selection rather than the sector. If higher-profile or nocturnal establishments were preferentially included, the sample may

underrepresent small guest houses or peripheral properties. The article consequently uses the term sampled establishments throughout.

Spatial statistics do not replace substantive location theory. A global ratio near one can coexist with pairs of closely located hotels and isolated peripheral properties. Local clustering may occur along Marian Road or Murtala Mohammed Highway while the entire sample appears statistically indistinguishable from randomness. Multi-distance analysis, kernel density and road-network measures can reveal such structure. Visual and establishment-level evidence should therefore accompany the global test.

Tourist accommodation also creates environmental and built-environment effects. Water and energy demand, wastewater, solid waste, traffic and land conversion vary by size, occupancy and service standard. Eneyo (2025) emphasises environmental management, while Eneyo (2026) links tourism-support services with sustainable destination development. A coordinate inventory becomes more useful when it includes rooms, occupancy, waste systems, permits and proximity to sensitive environments (Agbor et al., 2026; Eneyo et al., 2026; Onnoghen, 2026a, 2026b; Onnoghen, Inyang, et al., 2025; Onnoghen, Unimtiang, Nwagbara, et al., 2024; Unimtiang, Onnoghen, Efut, et al., 2025; Igelle et al., 2023; Inah et al., 2022; Onnoghen, Adeniyi, et al., 2024; Onnoghen, Anabaraonye, et al., 2024; Onnoghen, Anabaraonye, Owoh, et al., 2025; Onnoghen, Nwobu, et al., 2024; Onnoghen, Olisah, et al., 2024; Onnoghen, Onwuzurike, & Anabaraonye, 2025; Onnoghen, Unachukwu, et al., 2024).

Related Calabar evidence shows that hospitality facilities can exhibit different patterns depending on dataset and period. Earlier hotel research reported a tendency towards clustering for a sample of registered hotels, whereas the 2024 source reports no statistically distinguishable global pattern for twenty establishments. These results are not necessarily contradictory because samples, boundaries, sector definitions and urban development differ. They demonstrate the need for metadata and repeated inventories.

The literature gap addressed here is not the absence of a map, but the absence of a transparent inference chain. Coordinates must be labelled correctly, the population and boundary must be defined, and non-significance must be interpreted cautiously. The article shows how a compact dataset can be useful when these steps are explicit.

Conceptual and analytical framework

The framework separates observed location, spatial pattern, location drivers and planning outcome. Coordinates directly measure establishments' positions. Nearest-neighbour distances summarise local proximity, while the Average Nearest Neighbour ratio tests a global reference pattern. Location drivers such as roads, attractions and land price are unmeasured in the source. Planning outcomes such as access equity, capacity and environmental pressure are likewise not directly observed. Inference stops at the spatial evidence unless additional attributes are introduced. Complete spatial randomness is treated as a statistical reference, not a theory of hotel behaviour. Urban establishments are not expected to locate without constraints. The reference model asks whether the observed spacing is unusually clustered or dispersed relative to a simplified process. A non-significant result means that this test did not distinguish the sample from the reference under its assumptions. It does not establish an absence of locational logic.

Methodology

The study analyzes twenty accommodation coordinates collected during 2024 fieldwork with a handheld GPS. The establishments include hotels, guest houses, suites and a resort. Names and coordinates were transcribed from the source table Coordinates were stored in decimal degrees using the WGS 84 geographic reference concept. For descriptive mapping, longitude was plotted on the horizontal axis and latitude on the vertical axis. The mean centre was calculated as the arithmetic mean of latitude and longitude. North-south and east-west extents were approximated from coordinate ranges, recognising that decimal-degree distance varies by latitude.

Establishment-level nearest-neighbour distances were recalculated using the haversine formula, which estimates great-circle distance between latitude-longitude pairs. For each establishment, distance to all other establishments was calculated and the minimum retained. The mean and median of these minima describe local proximity in the sample. These geodesic calculations are an independent descriptive check and are not expected to reproduce ArcGIS planar values exactly if the source used a projected coordinate system. The Average Nearest Neighbour output was retained as the formal global test: ratio = 0.907, z = −1.1168 and p = .264053. The null reference is complete spatial randomness. At alpha = .05, the result is described as failure to reject the reference pattern. The phrase 'accept the null' is avoided because non-significance does not prove the null model. Effect direction remains slightly clustered because the ratio is below one, but evidence was insufficient to distinguish it statistically from one.

Five analytical tables report the data profile, coordinates, descriptive extent, nearest-neighbour pairs and interpretation of the test. A complete reproducibility package would include a CSV, coordinate reference system, boundary polygon and ArcGIS parameters. Because the source does not identify an analysis window, only the point-based descriptive calculations are fully reproducible here.

The study has important limitations. Twenty establishments cannot represent all accommodation in Calabar unless the list is a census, which the source does not claim. GPS positional error is likely small relative to most inter-property distances but was not quantified. Names and operational status may have changed. No road, attraction, price, capacity or environmental attributes were supplied. The global statistic is sensitive to boundary choice. These constraints make the article a baseline, not a definitive location model.

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Results and discussion

The twenty establishments occupy a compact part of Calabar, with latitude values from approximately 4.9572° N to 5.0146° N and longitude values from 8.3175° E to 8.3569° E. The arithmetic mean centre is near 4.985° N and 8.340° E. The north-south extent is approximately 6.4 kilometres and the east-west extent about 4.4 kilometres. These figures describe the sample envelope, not the administrative boundary or service catchment.

Table 1. Dataset profile and quality-control decisions

Element	Value	Analytical treatment
Establishments	20	Selected sample, not assumed census
Field method	Garmin Etrex 10 GPS	Coordinates retained
Coordinate labels	Reversed in source	4.x treated as latitude; 8.x as longitude
ANN	0.907; z = −1.1168; p = .264053	Reported as failure to reject CSR
Missing inputs	Boundary and full GIS layer	No exact ArcGIS replication claimed

Note. CSR = complete spatial randomness.

Coordinate quality control confirms that the source column headings were reversed. Transcorp Hotel, for example, is listed as 4.970497 and 8.328473. In Calabar, 4.970497 is a plausible latitude and 8.328473 a plausible longitude. The same pattern holds for all records. Correcting the labels changes no location value; it ensures that mapping and reporting use the conventional geographic axes.

Table 2. Coordinates of sampled tourist accommodation

Establishment	Latitude (°N)	Longitude (°E)
Transcorp Hotel	4.970497	8.328473
Channel View Hotel	4.989653	8.339475

Establishment	Latitude (°N)	Longitude (°E)
Satellite Town Hotel	4.957188	8.346642
Nke Guest House	4.981056	8.342222
Vanel Hotel	4.981077	8.343828
Marian Hotel	4.970752	8.340407
Jacaranda Suite	4.972733	8.355063
Pride Garden Hotel	4.958185	8.343372
Delves Hotel & Bar	4.973367	8.352188
Micadoh Hotel	4.971483	8.351233
Hiltop Hotel	4.961993	8.329305
Success Villa Hotel	4.963925	8.331032
Doris O Hotel	4.961817	8.348605
Monty Suites	5.014623	8.329305
Pyramid Hotel	5.011270	8.334927
Freemans Hotel	4.986912	8.343543
Nessvile Suites	4.991165	8.325263
Carlcon Hotel	5.000447	8.317457
Axari Hotel	5.012923	8.333342
Orange Resort	5.003433	8.356932

The sample includes several close pairs. Nke Guest House and Vanel Hotel are separated by a short distance, as are Monty Suites and Axari/Pyramid-area establishments and some properties around central corridors. Other establishments, including peripheral points, have longer nearest-neighbour distances. The combination produces a mean nearest-neighbour distance of roughly 0.61 kilometres and a median of about 0.38 kilometres in the geodesic reconstruction.

The minimum reconstructed nearest-neighbour distance is approximately 0.18 kilometres and the maximum about 2.36 kilometres. The difference between mean and median reflects a right-skewed distance distribution: most establishments have a relatively close neighbour, while a small number are more isolated. This local evidence cautions against describing the map as uniformly random even though the global test is non-significant.

Table 3. Descriptive spatial extent

Indicator	Value
Latitude range	4.957188–5.014623° N
Longitude range	8.317457–8.356932° E
Mean centre	Approximately 4.985° N, 8.340° E
North-south span	Approximately 6.4 km
East-west span	Approximately 4.4 km
Mean nearest-neighbour distance	Approximately 606 m
Median nearest-neighbour distance	Approximately 379 m

The Average Nearest Neighbour ratio of 0.907 lies below one, indicating observed spacing slightly closer than expected under the source's reference model. The z score of −1.1168 and p value of .2641 show that the difference was not statistically significant at .05. The defensible conclusion is that the test did not distinguish the sampled pattern from complete spatial randomness. It is not appropriate to state that randomness was proven.

Sample size affects power. With twenty points, only relatively strong departures from the reference model may be detected, especially when the boundary is uncertain. A ratio of 0.907 could reflect mild clustering that the test lacks power to distinguish, or a mixture of clustered corridors and dispersed peripheral points. Increasing the inventory and documenting the analysis window would reduce uncertainty.

Table 4. Ten shortest reconstructed nearest-neighbour relations

Establishment	Nearest establishment	Distance (m)
Nke Guest House	Vanel Hotel	178
Vanel Hotel	Nke Guest House	178
Delves Hotel & Bar	Micadoh Hotel	235
Micadoh Hotel	Delves Hotel & Bar	235
Pyramid Hotel	Axari Hotel	254
Axari Hotel	Pyramid Hotel	254
Hiltop Hotel	Success Villa Hotel	288
Success Villa Hotel	Hiltop Hotel	288
Jacaranda Suite	Delves Hotel & Bar	326
Satellite Town Hotel	Pride Garden Hotel	379

The result also cannot be generalised to all hotels or all tourist accommodation in Calabar. The study uses the phrase selected establishments and focused on facilities relevant to nocturnal tourism. If the selection omitted lower-category hotels or guest houses, the spatial pattern may differ from the full sector. A census linked to licensing records is the first requirement for planning inference.

The mapped distribution appears to span central, northern and peripheral parts of the metropolis rather than one compact core. This visual spread may help explain why the global statistic approaches one. However, visual interpretation is affected by map scale and point overlap. Quantitative road-distance and density analysis would be needed to identify service corridors or neighbourhood gaps.

The lack of a statistically detectable global cluster does not mean road access is unimportant. Hotels may align with several different corridors, each containing only a few sample points. When these corridors are distributed across the city, the overall point pattern can resemble randomness. Measuring distance to major roads, the central business district, airport routes, attractions and entertainment nodes would test location theory directly.

Table 5. Interpretation of the Average Nearest Neighbour output

Statistic	Value	Defensible interpretation
Ratio	0.907	Direction is mildly clustered relative to expected distance
z score	−1.1168	Observed difference is about 1.12 standard errors below expectation
p value	.2641	Insufficient evidence to reject CSR at .05
Permitted conclusion	Not statistically distinguishable from CSR	Applies to the sampled points and window
Not permitted	The full population is random	Non-significance is not proof of the null

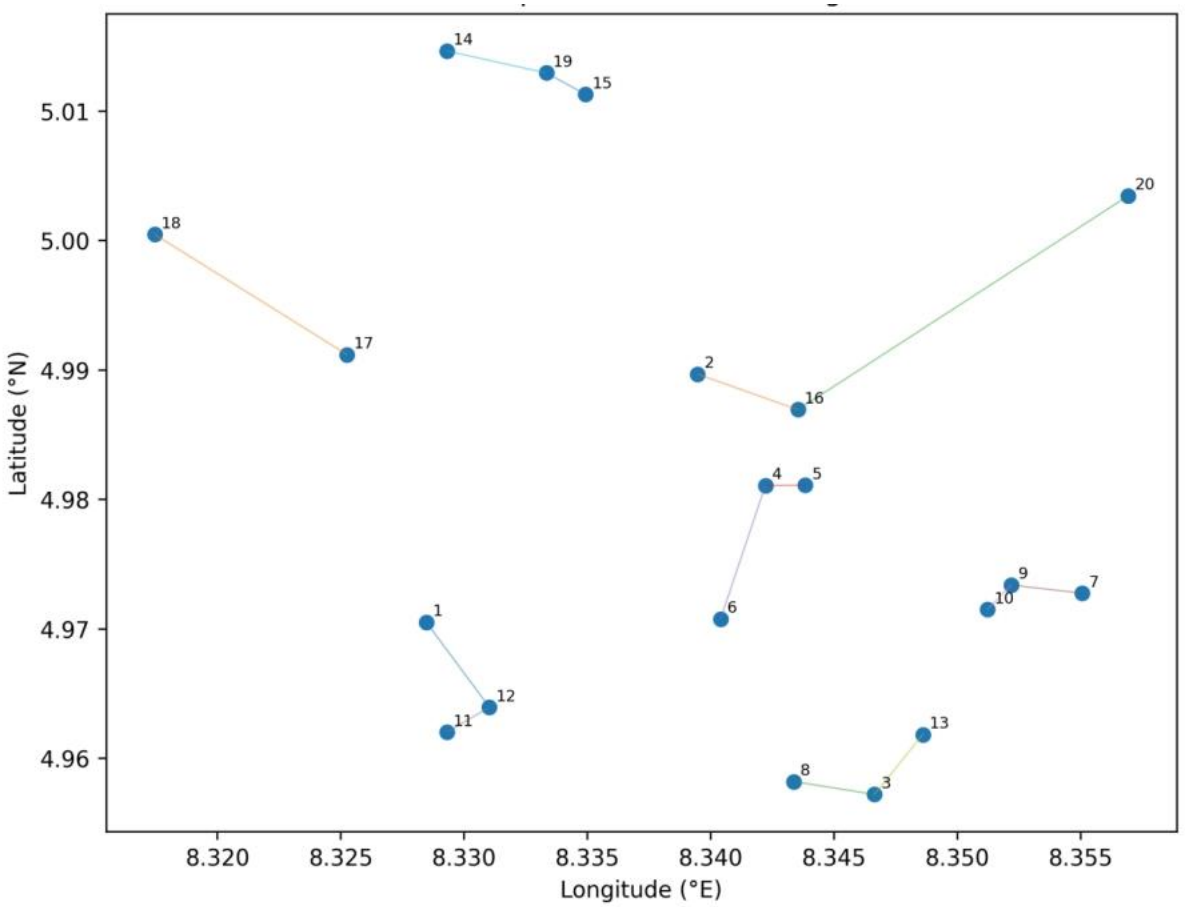

Figure 1. Spatial distribution and mean centre of sampled tourist accommodation in Calabar

The location pattern has service implications even without statistical clustering. Closely spaced establishments may benefit from shared transport, restaurants and security but also compete for parking, labour and utility capacity. Isolated establishments may serve underserved areas or face higher transport and emergency-response costs. These hypotheses require attribute and network data; the point pattern alone cannot assess business performance.

Environmental planning likewise needs establishment size and operating characteristics. Two points receive equal weight in nearest-neighbour analysis even if one is a large hotel and the other a small guest house. Water demand, wastewater and traffic depend on capacity and occupancy. Weighted accessibility and environmental-load mapping would be more useful for infrastructure planning than an unweighted dot map alone.

The sample can support a practical monitoring database. Each point should have a unique identifier, verified name, category, room capacity, operational status, licence, road access, water and sanitation system, waste arrangement, accessibility features and emergency contacts. Annual updates would show openings, closures and reclassification. Coordinates should be checked with a defined accuracy standard and stored in an interoperable format.

A complete spatial inventory would allow multiple analyses. Kernel density could identify intensity surfaces; network analysis could calculate travel time to attractions and emergency services; spatial joins could summarise establishments by planning zone; and point-process models could test association with land use or roads. Each method answers a different question. Average Nearest Neighbour should remain one diagnostic rather than the entire spatial assessment.

The figure shows the mean centre but should not be interpreted as the optimal location for new accommodation. An optimal facility model requires demand, land availability, cost, access and environmental constraints. The mean centre is simply a descriptive balance point of the observed coordinates. Conflating it with a planning recommendation would exceed the data.

The source mentions recreational spots and nocturnal patronage in its narrative, but the supplied table contains only accommodation coordinates and no complete recreational-site dataset. This article therefore does not claim to analyse accommodation-recreation co-location or patronage volume. Those components could form a valuable follow-up if the underlying records are recovered. Excluding unsupported variables protects the integrity of the current analysis.

The strongest conclusion from the sample is methodological and spatial. The establishments are distributed across a compact metropolitan envelope, contain several close local pairs and include more isolated points. The global test did not detect a significant departure from complete spatial randomness. Planning conclusions require a complete inventory and explanatory attributes. This conclusion is strong because it follows exactly what the data and test can support.

Policy implications

The Cross River tourism and planning authorities should create a unified accommodation registry with verified coordinates and consistent identifiers. Licensing, inspection and planning records should be reconciled annually. Public information can show approved establishments and services, while sensitive operational data remain restricted. The registry would support tourism maps, emergency response, tax administration and research.

Spatial analysis should use an explicit study boundary and projected coordinate system. The boundary may be the serviced urban area or planning jurisdiction, but its rationale must be stated. Water bodies and prohibited land should be considered where possible. Reporting should include the expected and observed distances, edge correction and software parameters so that another analyst can reproduce the result.

Planning decisions should add capacity and access. Room numbers, occupancy, price segment, road travel time and distance to attractions can reveal whether areas are genuinely underserved. A low count of points does not necessarily indicate an accommodation deficit if nearby establishments have large spare capacity. Conversely, many small properties may not meet peak demand.

Environmental inspection data should be spatially linked to establishments. Wastewater systems, water source, waste handling, energy and permit status can identify cumulative pressure and target technical support. Results should be used to improve compliance rather than merely penalise facilities. Clustered areas may require shared infrastructure, while isolated properties may need decentralised solutions.

Future publication should resolve authorship, data ownership and ethics before submission. The source owner's written confirmation should identify all contributors and the corresponding author. Any relationship between this dataset and earlier Calabar hotel studies should be disclosed. Clear provenance is as important as coordinate accuracy because journal publication assigns responsibility for data and interpretation.

Conclusion

The study examined the spatial distribution of selected accommodation establishments in Calabar and found that, although the mapped locations displayed some close spatial relationships and isolated establishments, the overall pattern did not differ significantly from complete spatial randomness. The Average Nearest Neighbour ratio of 0.907, with a z-score of −1.1168 and a p-value of .2641, indicates a slight tendency towards clustering; however, this tendency was not statistically significant. Consequently, the result should not be interpreted as proof that accommodation establishments are randomly located or that meaningful local spatial structures are absent. Rather, it provides a preliminary and transparent baseline for understanding the location pattern of the sampled establishments. The presence of close neighbouring facilities, isolated locations, and possible corridor-based development suggests that the global nearest-neighbour statistic may conceal important variations occurring at the local level. The findings therefore emphasise the need for caution in drawing broad planning, investment, or tourism-

development conclusions from a relatively small sample. Furthermore, the inconsistency between the reported forty sampled accommodation and recreational locations and the twenty accommodation establishments presented for analysis should be clarified in future research to ensure transparency, accuracy, and appropriate interpretation of the evidence.

Overall, the study demonstrates the importance of using reliable spatial data and appropriate analytical procedures in tourism and urban planning. Future studies should incorporate a complete and regularly updated registry of accommodation establishments, clearly defined study boundaries, verified geographic coordinates, suitable projected coordinate systems, and additional information on establishment type, room capacity, occupancy level, accessibility, and service quality. Spatial analysis should also extend beyond straight-line proximity by examining road-network accessibility, travel time to major attractions and transport facilities, land-use characteristics, environmental infrastructure, and seasonal patterns of tourism demand. The integration of these variables would make it possible to determine whether hotel locations are influenced by transportation corridors, commercial activities, visitor attractions, infrastructure availability, or other socioeconomic factors. In addition, longitudinal spatial data would assist planners in identifying patterns of business expansion, closure, relocation, and emerging accommodation corridors over time. Therefore, while the present analysis does not provide sufficient evidence of statistically significant clustering, it establishes a useful foundation for more comprehensive spatial investigations and highlights the potential of geographic information systems to support evidence-based tourism development, infrastructure provision, environmental management, investment decisions, and sustainable urban planning in Calabar.

Declarations

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Conflict of interest

No conflict of interest.

Data availability

The coordinates are available.

Author contribution

The author did the entire study

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