

Sustainable Tourism Development and Coastal Environment Protection: Evidence from Aokas Municipality, Béjaïa, Algeria

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Abstract:

Coastal zones in developing countries face increasing pressure from uncontrolled urbanisation, mass tourism and poor environmental governance. Algeria, despite possessing nearly 1,600 km of Mediterranean coastline and exceptional natural heritage, has long underutilised its tourism potential. This paper examines how sustainable tourism development can simultaneously protect coastal ecosystems and stimulate local economic growth, using the municipality of Aokas, Béjaïa Province, as a case study. Drawing on field surveys ($n = 150$, Cronbach's $\alpha = 0.81$), spatial analysis of the ZEST Oued Zitouna using ArcGIS and multi-criteria decision-making (MCDM), and review of planning documents, the study identifies key tourism resources (beaches, karst cave, cape, forest ecosystems), assesses visitor demand patterns and evaluates existing infrastructure deficiencies. Results show that Aokas holds significant comparative advantages as a multi-form tourism destination — balneary, ecotourism, agrotourism and cultural — yet suffers from inadequate facilities, poor accessibility and absence of strategic planning. Key satisfaction scores reveal critical gaps in parking (1.8/5) and leisure facilities (2.0/5). The paper proposes an integrated coastal tourism development framework with a ZEST Oued Zitouna action plan aligned with ICZM and GIS-based spatial zoning. Findings contribute to the debate on sustainable coastal tourism governance in North Africa and offer a replicable GIS-MCDM planning model for Mediterranean developing contexts.

1. Introduction

Tourism has become one of the most dynamic sectors of the global economy, contributing significantly to employment, regional development, and international exchange [1]. However, its rapid expansion has also generated increasing environmental pressures, particularly in fragile ecosystems such as coastal zones [2]. These areas concentrate a large share of tourism flows while simultaneously hosting sensitive ecological systems, making them highly vulnerable to degradation, pollution, and overexploitation [3].

In recent years, the concept of sustainable tourism has gained renewed importance in both academic research and policy agendas, especially in the context of climate change, post-COVID recovery, and the growing awareness of overtourism. Contemporary studies emphasise that sustainable tourism must balance economic growth with environmental protection and social equity,

integrating long-term resilience and adaptive governance strategies [20, 21]. Moreover, coastal and marine tourism activities — such as beach tourism, diving, and recreational use — have been identified as major drivers of ecosystem stress, affecting biodiversity, water quality, and coastal geomorphology [10, 22].

Despite these challenges, sustainable tourism is increasingly viewed as a strategic pathway for economic diversification in developing countries. It offers opportunities to enhance local livelihoods while preserving natural and cultural heritage. However, achieving this balance requires integrated planning approaches, effective governance, and the application of spatial decision-making tools — notably GIS and MCDM — capable of managing competing land uses and environmental constraints [25].

Algeria represents a particularly relevant case in this context. Although endowed with approximately 1,600 km of Mediterranean coastline and rich

natural and cultural resources, the country remains underrepresented in international tourism flows. This paradox is largely attributed to structural constraints, including limited infrastructure, weak planning frameworks, and insufficient integration of sustainability principles into territorial development strategies [4, 13].

Within Algeria, the coastal region of Béjaïa stands out as a high-potential yet underdeveloped tourism destination. Among its municipalities, Aokas exhibits a unique concentration of natural assets — beaches, karst formations, forest ecosystems, and cultural landscapes — combined with increasing tourism pressure and environmental vulnerability. However, the absence of a coherent planning strategy and the lack of integrated coastal management mechanisms have limited the sustainable valorisation of these resources [14].

This study aims to address this gap by analysing how sustainable tourism development can simultaneously enhance environmental protection and improve territorial attractiveness in Aokas. Specifically, it seeks to: (i) identify and assess local tourism resources; (ii) analyse visitor demand and satisfaction patterns using a structured survey ($n = 150$); and (iii) propose a spatially integrated planning framework based on the ZEST (Zone d'Expansion et Sites Touristiques) approach, combining GIS analysis and MCDM techniques. By combining field surveys, spatial analysis, and institutional assessment, this research contributes to the growing body of literature on sustainable coastal tourism in developing contexts and provides a replicable GIS-MCDM model for integrated tourism planning in Mediterranean environments.

2. Theoretical framework: sustainable coastal tourism

2.1. Sustainable Tourism: Definitions and Principles

The concept of sustainable tourism emerged from the broader sustainable development paradigm articulated in the Brundtland Report [5] and subsequently operationalised for the tourism sector by the UNWTO [6]. Three foundational pillars structure the concept: environmental sustainability, socio-cultural integrity and long-term economic viability [7, 8]. In practice, sustainable tourism implies carrying capacity management, stakeholder participation, integrated spatial planning, and the development of diversified tourism forms — ecotourism, agrotourism, cultural tourism and balneary tourism — that distribute visitor flows and reduce pressure on sensitive ecosystems [9].

Recent literature highlights that sustainable tourism should not be viewed as a fixed model but rather as a dynamic and context-dependent process shaped by local environmental, socio-economic, and institutional conditions. According to Gössling et al. [20], sustainability in tourism requires systemic transformations, including demand management, decarbonisation strategies, and stronger regulatory frameworks. Similarly, Sharpley [23] argues that the persistent gap between sustainability discourse and practice reflects structural limitations in governance and market-driven tourism development.

2.2. Coastal Tourism and Environmental Pressures

Coastal zones concentrate the highest density of tourism activities globally, accounting for over 40% of all international tourist arrivals [1]. This concentration generates multiple environmental externalities: beach erosion, marine pollution, habitat destruction, seasonal waste accumulation and freshwater depletion [10]. In the Mediterranean context, Integrated Coastal Zone Management (ICZM) frameworks have been proposed as governance responses to reconcile tourism development with coastal ecosystem conservation [11]. In North Africa, implementation of such frameworks remains limited, creating research gaps that the present study partially addresses.

From a theoretical standpoint, these dynamics can be understood through the lens of socio-ecological systems, where tourism acts as both a driver of economic development and a source of environmental stress. Hall [24] emphasises the bidirectional relationship between tourism and environmental change, highlighting feedback mechanisms that can either enhance or degrade ecosystem resilience.

2.3. Tourism Development in Algeria: State of the Art

Algeria's tourism sector has been extensively studied in terms of its structural deficiencies and untapped potential [4, 13]. Scholars have highlighted the paradox between exceptional natural endowment and poor tourism performance, attributing the gap to insufficient public investment, the absence of a coherent sectoral strategy, and degradation of coastal heritage sites. The post-oil context has stimulated new policy initiatives — notably the Schéma Directeur d'Aménagement Touristique (SDAT 2030) — although implementation gaps persist. Béjaïa specifically has

received limited scholarly attention despite its recognised tourism potential [14].

2.4. Tourism Area Life Cycle and Destination Dynamics

The Tourism Area Life Cycle (TALC) remains one of the most influential models for understanding the evolution of tourism destinations [12]. It conceptualises tourism development as a sequence of stages — exploration, involvement, development, consolidation, stagnation, and decline or rejuvenation. While widely applied, contemporary scholars argue that tourism development trajectories are often non-linear and influenced by external shocks such as economic crises, pandemics, and climate change [8, 27]. In the context of Aokas, the application of TALC suggests the destination is situated in the “involvement” stage, characterised by emerging tourism activity and increasing local engagement.

2.5. Spatial Decision-Making in Tourism Planning

The increasing complexity of tourism planning has led to the growing use of spatial decision-making approaches integrating Geographic Information Systems (GIS) and multi-criteria decision-making (MCDM) techniques [25]. These tools enable the evaluation of multiple factors — environmental, economic, social, and infrastructural — in order to identify optimal locations for tourism development while minimising environmental impacts. This methodological alignment is central to the present study’s contribution and justifies its submission to IJCESEN, which focuses on computational and spatially-driven analytical approaches in applied science and engineering contexts.

3. Study area and methodology

3.1. Study Area

Aokas is a coastal municipality located in the province of Béjaïa (Fig. 1), north-eastern Algeria (36°38'N, 5°15'E). The commune extends over approximately 45 km² and is bounded to the north by the Mediterranean Sea, to the south by forested mountain ranges of the Kabyle massif, to the west by the city of Béjaïa (30 km) and to the east by the communes of Tichy and Melbou. Its coastal strip stretches over approximately 6 km, characterised by alternating sandy beaches, rocky headlands and a prominent coastal cape. The municipality presents a typical Mediterranean climate with hot dry summers (average July temperature: 27°C) and

mild wet winters, with average annual precipitation between 700 and 900 mm.

The topographic profile of the municipality is characterised by a marked altitudinal gradient, ranging from sea level to over 800 m in the Kabyle massif interior (Fig. 2), which constrains coastal accessibility and concentrates tourism pressure on the narrow littoral strip.

3.2. Research Design

This study adopts a mixed-methods research design, integrating quantitative, qualitative, and spatial analytical approaches. This triangulation enhances the robustness and reliability of the findings by combining multiple data sources and analytical perspectives. The research framework is structured around three main components: (i) analysis of tourism resources; (ii) assessment of visitor demand and satisfaction; (iii) spatial evaluation of the ZEST Oued Zitouna for sustainable tourism planning.

3.3. Data Collection

3.3.1. Quantitative Survey

A structured questionnaire was administered to a sample of 150 visitors during the peak tourist season (July–August 2023). The sample size was determined using Cochran’s formula for finite populations (confidence level: 95%; margin of error: $\pm 8\%$), yielding a minimum of 141 respondents; 150 valid questionnaires were retained. The survey included 19 items covering: socio-demographic characteristics, travel behaviour, length of stay, satisfaction with tourism services (5-point Likert scale), and intention to revisit. Internal consistency was assessed using Cronbach’s alpha ($\alpha = 0.81$, exceeding the threshold of 0.70), confirming instrument reliability. Content validity was ensured through literature review and expert evaluation by tourism and planning specialists.

3.3.2. Qualitative Data

Semi-structured interviews were conducted with six key stakeholders, including local authorities (APC), tourism administration (Direction du Tourisme de Béjaïa), and representatives of ONAT. These interviews aimed to explore governance structures, planning constraints, and institutional challenges related to tourism development. Interview data were analysed thematically.

3.3.3. Spatial Data and GIS Analysis

Spatial analysis was conducted using ArcGIS 10.8 to assess land use, accessibility, and environmental constraints within the ZEST Oued Zitouna.

Geographic data sources included field mapping (GPS), cadastral data, Landsat 8 satellite imagery (30 m resolution), and topographic maps (1:25,000). Analysis outputs include land use classification maps, accessibility rasters and environmental sensitivity zoning, as presented in Figures 1, 2 and 9.

3.4. Data Analysis

Statistics v26, including descriptive statistics (means, frequencies, percentages) and satisfaction index calculation. A multi-criteria evaluation approach based on the Analytic Hierarchy Process (AHP) [26] was applied, integrating environmental sensitivity, infrastructural feasibility, and accessibility criteria for spatial suitability mapping within the ZEST. Results from surveys, interviews, and spatial analysis were cross-validated through methodological triangulation, ensuring consistency and reducing bias.

3.5. Limitations

This study presents several limitations: the survey was conducted during peak season only, potentially biasing visitor profiles toward summer tourism patterns; sample size ($n = 150$) remains moderate; and high-resolution spatial data availability was limited. Future research should incorporate longitudinal data, extended seasonal sampling and advanced spatial modelling techniques.

4. Results

4.1. Tourism Resource Assessment

The analysis of tourism resources in Aokas reveals a highly diversified and underexploited resource base, combining natural, cultural, and ecological assets (Table 4; Figure 3). Natural resources such as beaches and the Féérique Cave exhibit the highest tourism value, reflecting their strong attractiveness and accessibility. However, most resources remain either partially developed or entirely unexploited, indicating a significant gap between potential and actual tourism valorisation. From a spatial perspective, resource distribution shows a coastal concentration pattern, with inland assets (forests, traditional villages) largely disconnected from tourism circuits. This spatial imbalance limits diversification and reinforces seasonal pressure on coastal zones, consistent with findings in comparable Mediterranean contexts [24].

4.2. Tourism Infrastructure Assessment

Table 5 and Figure 4 provides a systematic assessment of tourism infrastructure in Aokas. All categories score below the satisfactory threshold (3/5), with parking (1/5), leisure facilities (1/5) and tourism signage (1/5) rated as critically deficient. Accommodation capacity remains extremely limited (<200 beds), constraining the ability of Aokas to transition from a day-trip destination to a stay-based tourism economy. The dominance of informal structures (secondary residences, unregulated camping) reflects weak governance and planning control [23].

4.3. Visitor Demand Analysis

Survey results ($n = 150$) reveal a predominantly domestic visitor profile with specific socio-demographic characteristics and visit behaviour patterns (Figure 5; Table 6). Geographically, 47% of visitors originate from Béjaïa Province, followed by Algiers (26%) and Tizi-Ouzou (14%), indicating a regional catchment area. Average length of stay is short — 70% of surveyed visitors reported a day trip or single overnight stay — reflecting a predominance of day-trippers and weekend visitors. This structural characteristic critically limits per-visitor expenditure and reduces the economic multiplier effect of tourism on the local economy. The high proportion of repeat visitors (78%) indicates genuine destination loyalty that improved quality could convert into extended stays and greater economic impact.

4.4. Visitor Satisfaction Assessment

Figure 6 presents the radar chart of mean satisfaction scores across nine service dimensions (5-point Likert scale). Critical deficiencies are observed in parking availability (1.8/5), internal mobility (2.2/5), environmental cleanliness (2.4/5) and leisure activities (2.0/5). Conversely, beach quality (4.1/5), security (3.8/5) and local hospitality (3.5/5) receive positive evaluations, confirming the intrinsic attractiveness of the destination despite its infrastructure deficiencies. Such discrepancies are typical in emerging destinations where natural capital compensates for infrastructural deficiencies but cannot sustain long-term competitiveness [20, 23].

4.5. Spatial and Functional Diagnosis of ZEST Oued Zitouna

The GIS-based spatial analysis reveals a strategically located but underutilised planning zone combining coastal, riverine, and forest ecosystems. The AHP-weighted suitability analysis

identified three priority development zones within the ZEST: (i) a high-suitability coastal strip (beach interface, pedestrian infrastructure); (ii) a medium-suitability riparian corridor (Oued Zitouna ecological restoration); and (iii) a conservation-priority forest zone (cork oak, biodiversity protection). Key constraints include lack of structured access, environmental degradation of riparian zones, and absence of functional zoning. Strategic opportunities include central location, ecological diversity, and proximity to existing tourism flows. These findings support integrated planning strategies aligned with ICZM principles [11].

5. Proposed Sustainable Tourism Development Framework

5.1. Multi-Form Tourism Strategy

Based on the resource inventory, demand analysis and spatial assessment, an integrated multi-form sustainable tourism development strategy for Aokas is proposed, articulated around four complementary tourism segments (Figure 7):

Ecotourism: Development of nature trails through the cork oak forest and along the Oued Zitouna corridor, interpretation infrastructure for the Féérique Cave, birdwatching circuits on the coastal headlands, and environmental education programmes. Carrying capacity limits must be established for all sensitive natural sites.

Agrotourism: Valorisation of local agricultural production (olive oil, figs, Kabyle artisanal products) through farm tourism circuits, rural gîtes, and a local produce market integrated into the ZEST. This segment can generate year-round income, reducing extreme seasonality.

Cultural tourism: Restoration and interpretation of the Château de la Comtesse, creation of a traditional Kabyle crafts centre in Ighil Wireme, development of heritage walking circuits connecting coastal and inland cultural sites.

Balneary tourism: Upgrading of beach facilities in compliance with Algerian coastal legislation (Law 02-02) [18], creation of differentiated beach zones (swimming, water sports, family, conservation), development of classified accommodation and establishment of a beach management concession system.

5.2. ZEST Oued Zitouna: Spatial Planning Proposal

The Zone d'Expansion et Sites Touristiques (ZEST) of Oued Zitouna constitutes the principal spatial planning instrument for operationalising the

sustainable tourism strategy. Located at the confluence of the Oued Zitouna with the coastal zone, the ZEST covers a strategic area of approximately 45 hectares integrating beach, riverine and forest environments. Table 7 details the proposed aménagement programme; Figure 8 presents the implementation timeline; Figure 9 shows the GIS-based land use zoning plan.

6. Discussions

6.1. Tourism Resource Potential and Underexploitation

The analysis demonstrates that Aokas has a diverse portfolio of tourism resources, including coastal, ecological, and cultural assets (Table 4; Figure 3). Beaches and Féérique Cave attract most visitors, while inland resources such as cork oak forests and Ighil Wireme village remain underutilised. This spatial concentration mirrors patterns observed in Mediterranean tourism systems, where coastal dependency leads to environmental pressures and underutilisation of hinterland resources [24, 25]. The low exploitation of inland assets indicates a latent potential that could diversify the tourism offer and reduce seasonality effects. Integrating inland ecotourism and cultural heritage routes could enhance the destination's resilience, mitigate environmental stress on coastal areas, and increase overall tourism revenue.

6.2. Infrastructure Deficiencies and Bottlenecks

Tourism infrastructure scores are critically low in accommodation, parking, leisure, and internal mobility (Table 5). With fewer than 200 beds, Aokas functions predominantly as a day-trip destination, limiting economic spillovers from tourism [23, 28]. The prevalence of informal structures reflects weak governance and insufficient spatial planning. Public-private partnerships, regulatory reinforcement, and phased infrastructure investment can support a transition to a stay-based tourism economy.

6.3. Visitor Demand and Market Maturity

Visitor data indicate a regional, short-stay tourism profile, with 42% day-trippers and 70% of stays ≤ 1 night (Table 6; Figure 5). Despite this, high repeat visitation (78%) and return intention (84%) indicate strong destination loyalty, a critical factor in early-stage tourism development consistent with the TALC "involvement" stage [12, 29]. Marketing efforts should focus on converting day-trippers to overnight visitors and promoting off-season tourism

to reduce peak-season pressure and enhance economic benefits.

6.4. Visitor Satisfaction and Service Gaps

Visitor satisfaction is polarised: high for natural assets (beaches: 4.1/5, safety: 3.8/5) but low for infrastructure and services (parking: 1.8/5, cleanliness: 2.4/5, leisure: 2.0/5) (Figure 6). This mismatch is typical in emerging destinations where natural capital compensates for service deficiencies but cannot sustain long-term competitiveness [30, 31]. Targeted interventions to improve parking management, recreational facilities, and environmental maintenance are essential to enhance overall satisfaction and long-term sustainability.

6.5. Spatial Planning and ZEST Oued Zitouna

The GIS-MCDM analysis of the ZEST Oued Zitouna area confirms strategic opportunities for integrated tourism development, combining coastal, riverine, and forest ecosystems (Table 7; Figures 8 & 9). ICZM and AHP-based functional zoning can balance development with conservation, ensuring sustainability while leveraging ecological diversity [11, 32]. The critical challenge — common to many Algerian municipalities — lies in translating planning instruments into effective regulatory enforcement and sustained public investment. The findings of this study corroborate and extend existing research on the tourism-environment nexus in North African coastal contexts [4, 13], and demonstrate that the widespread paradox of high natural endowment coexisting with underdeveloped and environmentally degraded tourism activity is attributable to governance deficits rather than any intrinsic limitation of the resource base.

Table 1. Sustainable Coastal Tourism: Key Theoretical Frameworks Applied in This Study

Framework	Key Authors	Application in Aokas Study
Sustainable Tourism (3 pillars)	Butler (1999) [8]; UNWTO (2005) [6]	Multi-form strategy: eco-, agro-, cultural, balneary tourism
Tourism Area Life Cycle (TALC)	Butler (1980) [12]	Diagnosis of destination maturity stage
Integrated Coastal Zone Management	Billé (2008) [11]; Coccossis & Mexa (2004) [17]	ZEST planning & 100 m setback enforcement
GIS & MCDM Spatial Analysis	Malczewski (2006) [25]; Saaty (1980) [26]	Suitability mapping & zoning of ZEST Oued Zitouna
Community-Based Tourism	Bramwell & Lane (2012) [16]	LTDC governance & stakeholder participation

Note. LTDC = Local Tourism Development Committee; ZEST = Zone d'Expansion et Sites Touristiques.

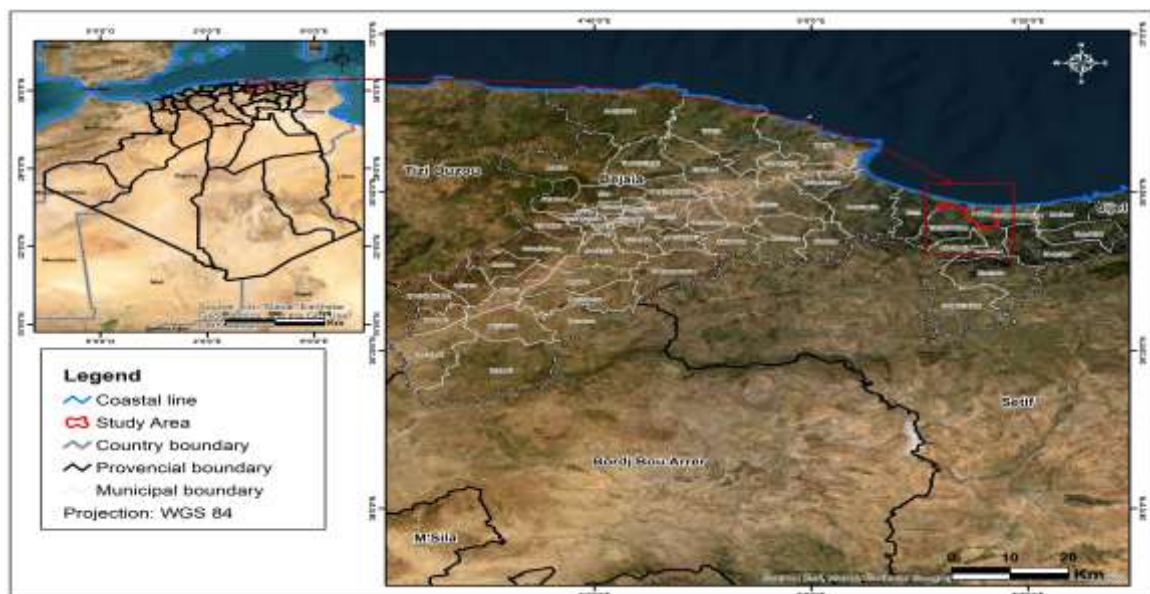


Figure 1. Location map of Aokas Municipality, Béjaïa Province, Algeria, showing principal tourism resources and the ZEST Oued Zitouna boundary.

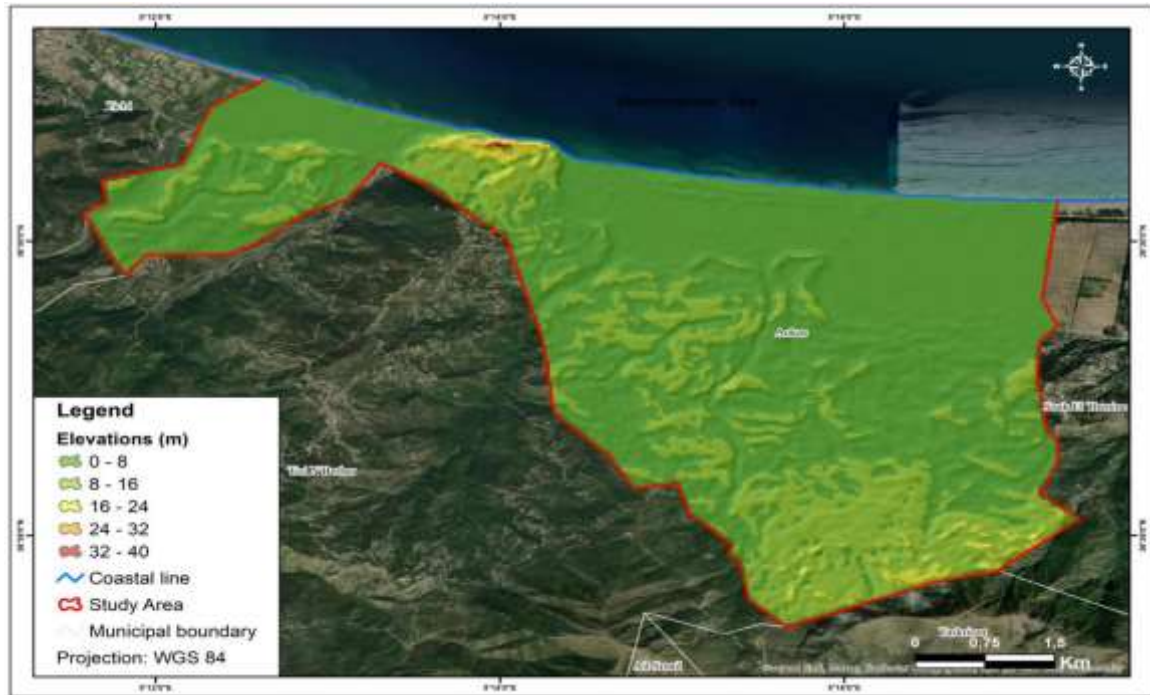


Figure 2. Elevation map of Aokas Municipality, Béjaïa Province, Algeria.

Table 2. Key Geographic and Demographic Characteristics of Aokas Municipality

Indicator	Value	Source
Surface area	~45 km ²	DPAT Béjaïa, 2020
Coastal strip length	~6 km	Field survey, 2023
Population (2020 est.)	~22,000 inhabitants	ONS Algeria, 2020
Population density	~489 inh./km ²	Calculated
Annual rainfall	700–900 mm	ONM Station Béjaïa
Average summer temperature	27°C (July)	ONM Station Béjaïa
Distance to Béjaïa city	30 km (RN9)	Field survey
Classified beaches	3 authorised, 1 supervised	Direction Tourisme Béjaïa, 2022
Accommodation capacity (classified)	< 200 beds	Direction Tourisme Béjaïa, 2022

Note. ONS = Office National des Statistiques; ONM = Office National de Météorologie; DPAT = Direction de la Planification et de l'Aménagement du Territoire.

Table 3. Research Methodology Summary

Method	Instrument / Tool	Sample / Scope	Purpose
Quantitative survey	Structured questionnaire (19 items)	n = 150 visitors, peak season 2023	Visitor profile & satisfaction
Qualitative interviews	Semi-structured interview guide	6 key informants (ONAT, APC, Tourism Dir.)	Institutional context & governance
Spatial analysis (GIS-MCDM)	ArcGIS 10.8 + AHP	ZEST Oued Zitouna (~45 ha)	Land use & suitability mapping
Documentary review	Planning docs, statistics, literature	PDAU, SDAT 2030, ONS data	Policy & theoretical framework

Note. APC = Assemblée Populaire Communale; PDAU = Plan Directeur d'Aménagement et d'Urbanisme; AHP = Analytic Hierarchy Process.

Table 4. Inventory of Tourism Resources — Aokas Municipality

Resource	Type	Tourism Value (1–5)	Development Status
Féérique Cave (Grotte d'Aokas)	Natural / Geotourism	4.5	Partially developed
Sandy beaches (3 authorised)	Natural / Balneary	4.7	Basic infrastructure
Cap d'Aokas	Natural / Scenic	3.9	Undeveloped
Cork oak forest (inland)	Natural / Ecotourism	4.2	No infrastructure
Oued Zitouna corridor	Natural / Riparian	3.5	Degraded
Kabyle village Ighil Wireme	Cultural / Heritage	3.8	No interpretation
Château de la Comtesse	Cultural / Historical	3.2	Degraded
Olive groves & agricultural land	Economic / Agrotourism	3.0	No tourism use
Endemic fauna (raptors, reptiles)	Natural / Biodiversity	3.8	Not valorised

Note. Tourism value scores based on expert assessment and visitor preference survey. Development status assessed through field survey (2023).

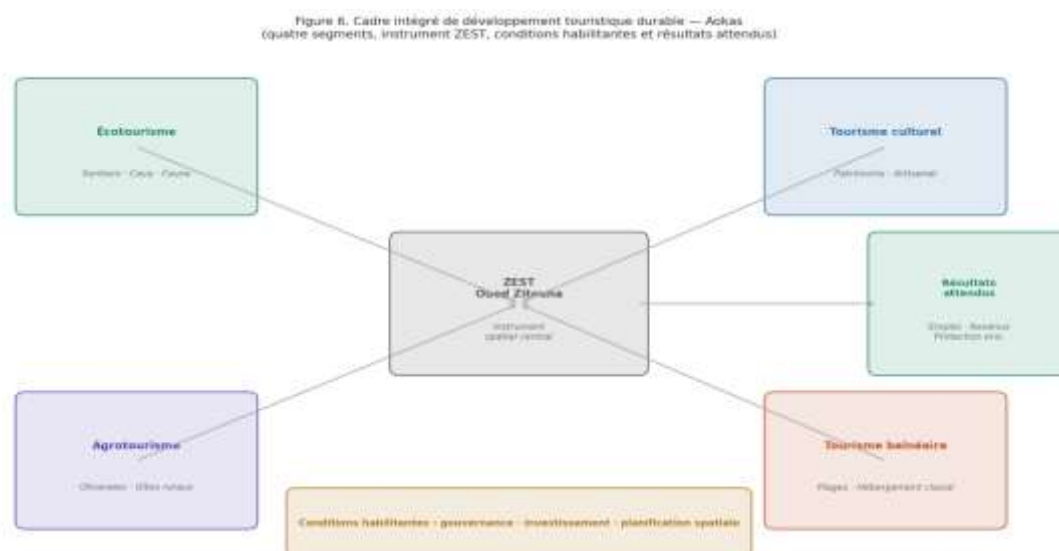


Figure 3. Tourism resource assessment matrix — Aokas Municipality. Bubble size proportional to tourism value. Resources in the upper-right quadrant represent immediate development priorities. Source: field survey and expert assessment (2023).

Table 5. Tourism Infrastructure Assessment — Aokas (2023)

Infrastructure Category	Current Status	Adequacy Rating (1=Critical — 5=Good)
Hotel accommodation (classified)	< 200 beds; 2 classified establishments	2 / 5
Canvas camping / seasonal sites	3–4 informal sites; variable quality	2 / 5
Road access (RN9)	Single coastal road; severe peak congestion	2 / 5
Parking infrastructure	Critically deficient; no organised lots	1 / 5
Beach sanitation facilities	Minimal; insufficient for summer peak	2 / 5
Leisure & recreational facilities	Virtually absent outside beach	1 / 5
Tourism signage & interpretation	Absent	1 / 5
Public transport to Aokas	Limited bus service; irregular schedule	2 / 5

Note. Adequacy ratings based on field assessment and visitor satisfaction survey (n = 150).

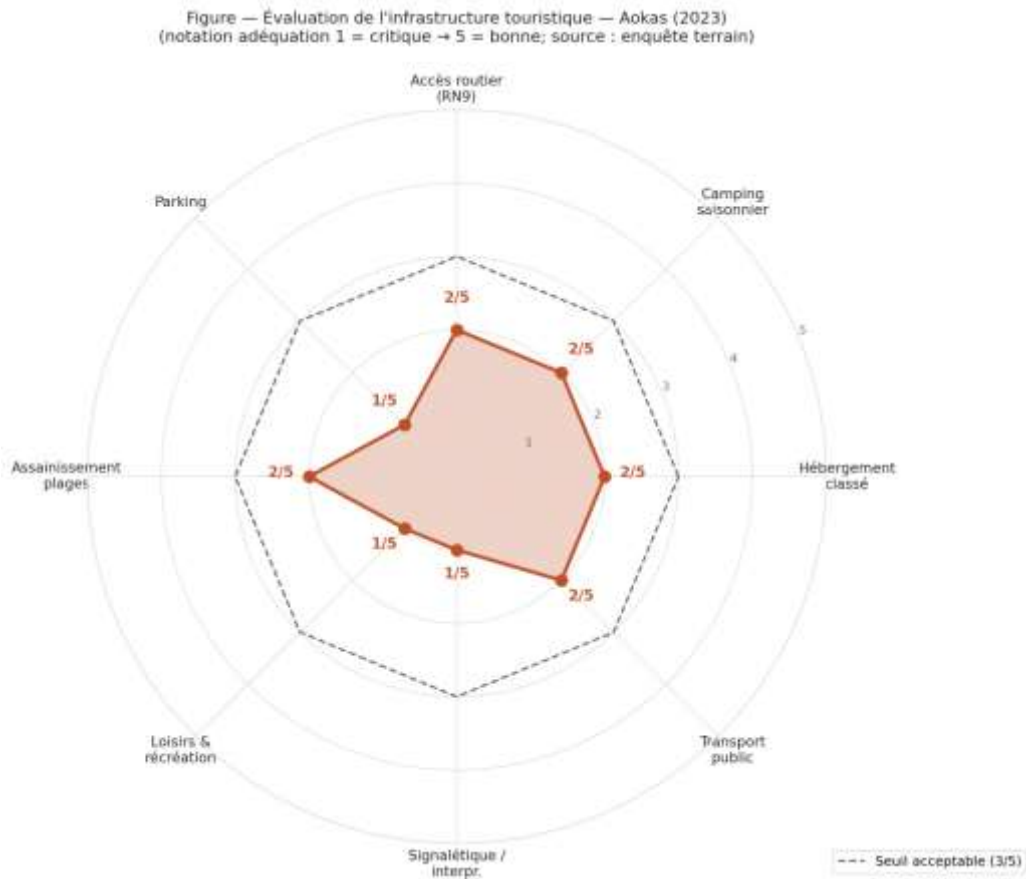


Figure 4. Infrastructure adequacy radar — Aokas (2023). Scores on a 1–5 adequacy scale; dashed line marks the acceptable threshold (3/5). All categories fall below the threshold, signalling systemic deficiency. Source: field assessment and visitor survey (2023).

Figure 2 & 3. Profil comportemental des visiteurs — Aokas (n = 150)

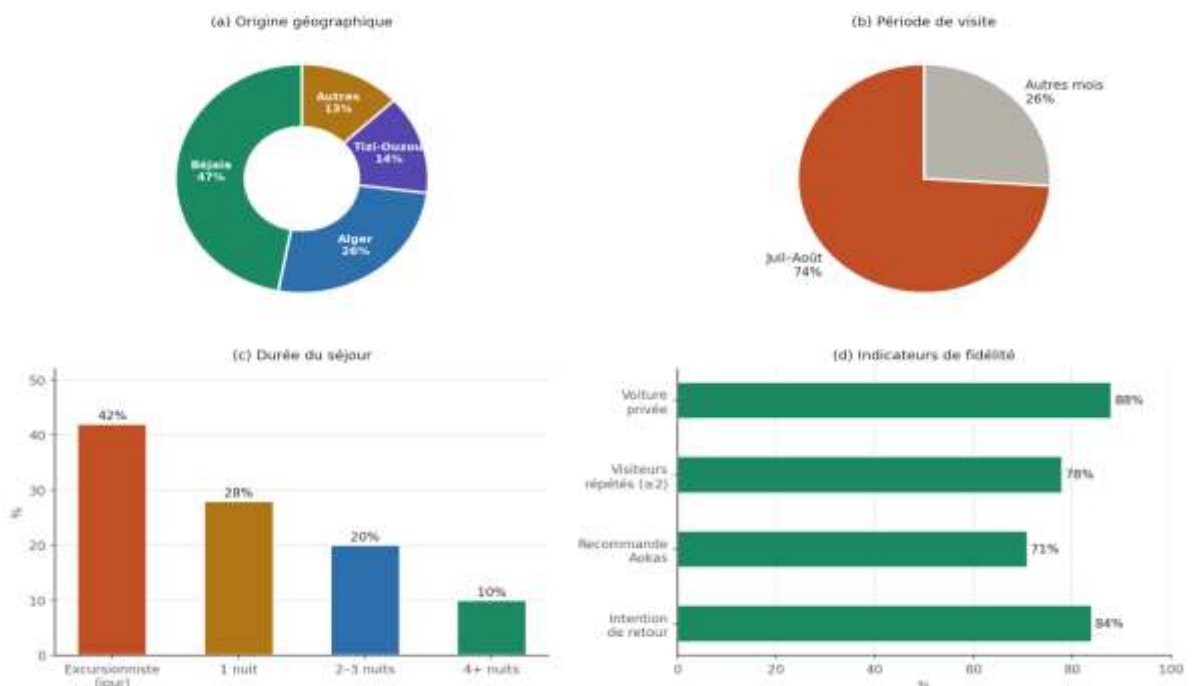


Figure 5. Visitor profile and behavioural characteristics — Aokas (n = 150). (a) Geographic origin; (b) Visit season; (c) Length of stay; (d) Loyalty and mobility indicators. Source: visitor survey, peak season July–August 2023.

Table 6. Key Visitor Behaviour Indicators — Aokas Survey (n = 150)

Indicator	Result	Implication
Day-trippers (no overnight stay)	42%	Low per-visit expenditure
Visitors from Béjaïa Province	47%	Short regional catchment
First-time visitors	22%	Moderate awareness — growth potential
Repeat visitors (≥ 2 visits)	78%	Strong destination loyalty
Summer season (Jul–Aug)	74%	Critical seasonality challenge
Intention to return	84%	High latent loyalty
Recommended Aokas to others	71%	Positive word-of-mouth
Arrived by private car	88%	Explains parking pressure

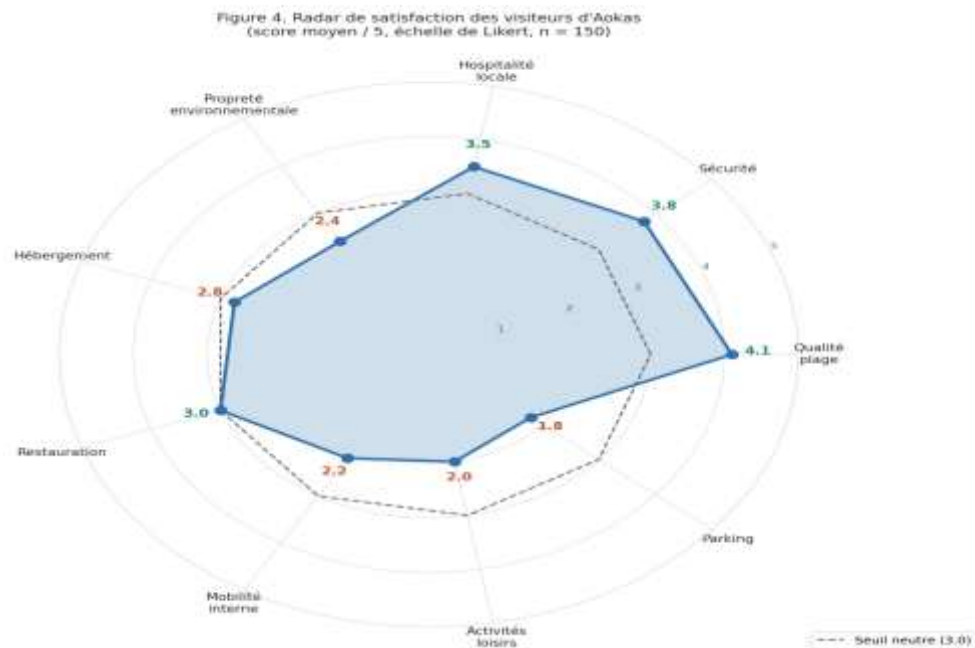


Figure 6. Visitor satisfaction radar chart — Aokas (mean scores on 5-point Likert scale, n = 150). Values below the dashed neutral threshold (3.0) indicate critical deficiencies requiring priority action. Source: visitor survey, July–August 2023.

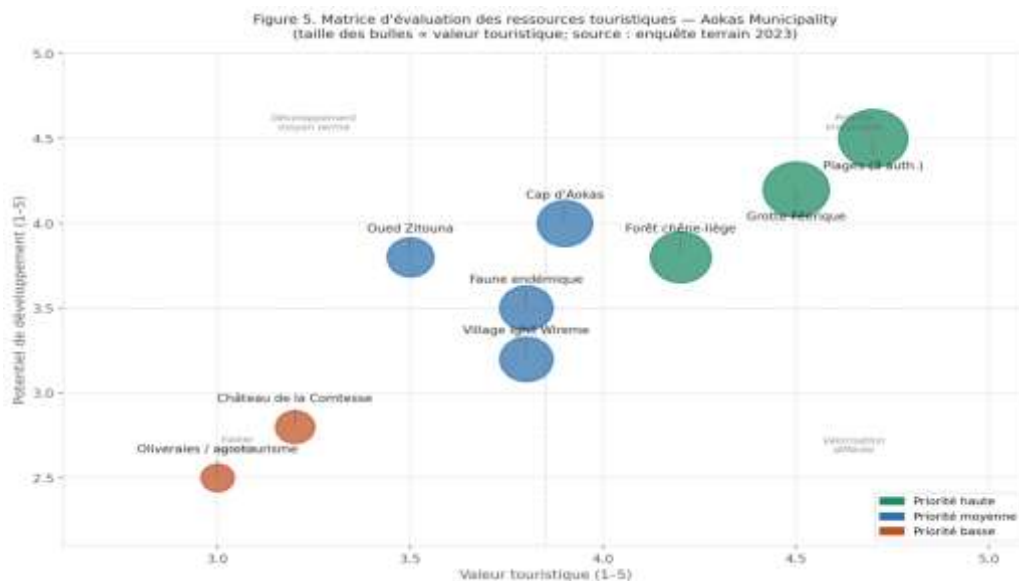


Figure 7. Integrated sustainable tourism development framework for Aokas: four tourism segments, ZEST Oued Zitouna as spatial instrument, enabling conditions and expected outcomes.

Table 7. Proposed Aménagement Programme — ZEST Oued Zitouna

Coastal promenade	Pedestrian walkway linking beach zones, cave entrance and cape viewpoint	High (Years 1–2)
Visitor & reception centre	Gateway facility: information, ticketing, interpretation, first aid	High (Years 1–2)
Eco-camping & glamping	Classified camping compliant with hydraulic setbacks; max. 150 pitches	High (Years 1–2)
Water sports infrastructure	Non-motorised water sports: kayaking, paddleboarding, snorkelling trails	Medium (Years 3–5)
Local products market	Kabyle gastronomy & artisanal products; linked to agrotourism circuit	Medium (Years 3–5)
Dedicated parking + shuttle	Off-setback parking area with electric shuttle to beach zones	High (Years 1–2)
Nature & forest trails	Marked trails (cork oak forest, Oued Zitouna): 3 circuits, 5–12 km	Medium (Years 3–5)
Ecological restoration	Riparian vegetation replanting along Oued Zitouna corridor	Medium (Years 3–5)
Beach Management Plan (PAP)	Seasonal zoning, capacity limits, environmental monitoring protocol	High (Years 1–2)

Note. PAP = Plan d'Aménagement de Plage.

Figure 7b. Plan d'aménagement ZEST Oued Zitouna — Calendrier de mise en œuvre

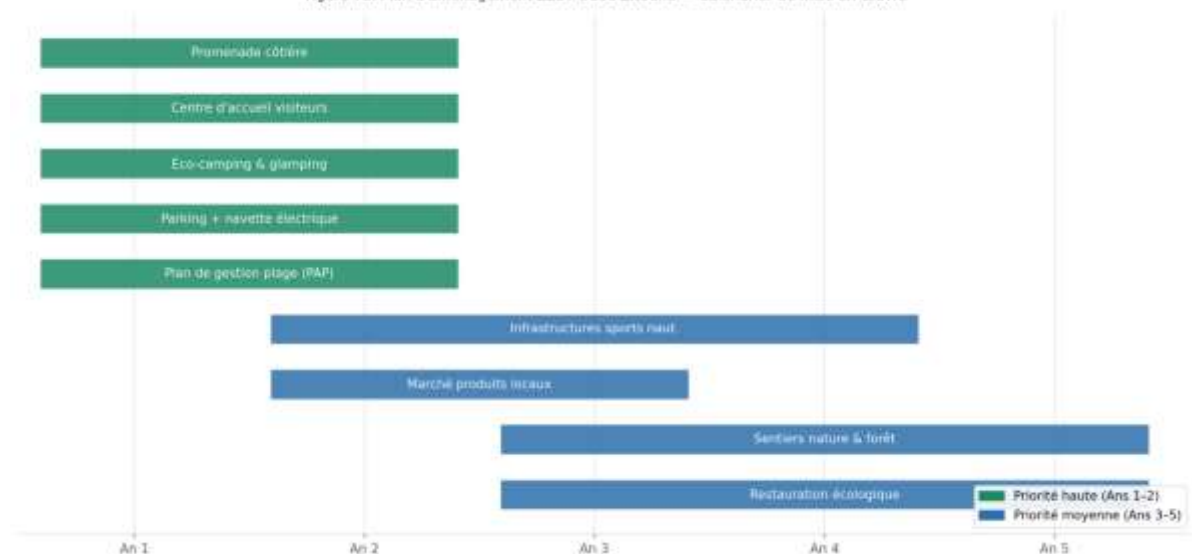


Figure 8. ZEST Oued Zitouna aménagement programme — Implementation timeline (Gantt chart). Green = high priority (Years 1–2); Blue = medium priority (Years 3–5)

Table 8. Governance Recommendations for Sustainable Tourism Development in Aokas

Institutional Measure	Actors Involved	Timeframe
Establish Local Tourism Development Committee (LTDC)	APC, Direction du Tourisme, ONAT, NGOs, private sector	Year 1
Adopt Municipal Sustainable Tourism Charter	APC, wilaya, civil society	Year 1
Implement ZEST aménagement plan (PAP, facilities)	APC, Direction du Tourisme, Conservation des Forêts	Years 1–3
Enforce 100 m coastal setback (Law 02-	APC, Direction de l'Urbanisme,	Immediate

02)	Justice	
Develop visitor monitoring system	Direction du Tourisme, ONAT	Year 2
Facilitate responsible private investment	ANDI, APC, Direction du Tourisme	Years 2–4
Integrate Aokas into Béjaïa Province tourism masterplan	Wilaya, Direction du Tourisme, Planning	Year 2

Note. APC = Assemblée Populaire Communale; ANDI = Agence Nationale de Développement de l'Investissement.



Figure 9. Proposed GIS-based land use zoning for the ZEST Oued Zitouna, Aokas. Beach zones are differentiated by use; the 100-metre coastal setback is marked per Algerian Law 02-02 [18]. Source: ArcGIS spatial analysis, 2023.

Table 9. Key Findings and Strategic Recommendations

Dimension	Key Constraint(s)	Strategic Opportunity
Tourism Resources	Inland underutilisation	Ecotourism & cultural tourism circuits
Infrastructure	Low accommodation & poor mobility	Public-private investment & regulation
Visitor Demand	Short-stay & regional focus	Convert day-trippers to overnight stays
Visitor Satisfaction	Service gaps & low leisure activities	Enhance services & environmental management
Spatial Planning (ZEST)	Lack of zoning & degraded ecosystems	GIS-based Integrated Coastal Zone Management

7. Conclusions

This paper has demonstrated that sustainable tourism development constitutes a viable and necessary strategy for reconciling environmental protection and economic development in Aokas, Béjaïa. The municipality's exceptional natural and cultural heritage provides a robust foundation for a

diversified tourism offer, yet suffers from critical governance and infrastructure deficiencies that must be urgently addressed.

The key findings indicate that: (i) tourism resources are undervalued and inadequately protected; (ii) visitor demand is structurally immature but characterised by genuine destination loyalty (84% intention to return); (iii) critical infrastructure

deficiencies — particularly parking (1.8/5), leisure facilities (2.0/5) and internal mobility (2.2/5) — limit competitiveness; and (iv) spatial planning instruments, notably the ZEST Oued Zitouna, integrated through GIS-MCDM analysis, can provide effective frameworks for sustainable development if properly implemented and enforced. For policy actors, priority actions include: adoption of a municipal sustainable tourism charter, implementation of the ZEST Oued Zitouna aménagement plan, enforcement of coastal setback legislation under Law 02-02 [18], establishment of beach carrying capacity management, and facilitation of responsible private investment in quality accommodation and eco-leisure infrastructure. Future research should incorporate longitudinal visitor monitoring, economic impact assessment and comparative GIS analysis with other Béjaïa coastal municipalities.

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