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EVALUATION OF SUSTAINABLE COMPETITIVENESS IN TOURISM ENTREPRENEURSHIP IN PEDERNALES, ECUADOR: AN APPROACH BASED ON THE SDGS AND THE CIRCULAR ECONOMY

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Abstract: In Ecuador's tourism MSMEs, persistent gaps remain in energy transition, certification, firm-level innovation, product internationalization, and market definition/targeting; building on this context, this study evaluates sustainable competitiveness in Pedernales using SDG-aligned, circular-economy indicators to inform destination-level action. A cross-sectional survey was conducted with n = 196 ventures (food services, lodging, transport, recreation, tour operations) applying 13 firm-level indicators mapped to SDGs 6/7/8/9/11/12/13; reliability ($\alpha = 0.878$), sampling adequacy (KMO = 0.806), and Bartlett's test ($p < 0.001$); analyses included descriptive statistics, group comparisons, and Varimax-rotated EFA. The factor solution revealed four dimensions - Environmental & Circular Practices; Perception/Training/Energy; Networks & Sustainable Mobility; Competitiveness & Local Human Capital. Key strengths include diversified supply, local hiring, and a positive environmental perception; by contrast, weaknesses persist in the adoption of renewable energy, certification and low-impact mobility. These patterns indicate partial adoption constrained by capabilities and finance at firm and destination levels. In policy terms, priority should be given to service-oriented innovation instruments, clear certification pathways, and targeted training/mentoring, alongside establishing a multi-stakeholder circular-economy lab coordinated by the Destination Management Organization (DMO). In parallel, a permanent multi-stakeholder advisory council should be established to coordinate a portfolio of demand-driven projects, search for micro-grants, and monitor indicators. Limitations include a single-destination cross-sectional design and self-reported survey data (potential desirability/recall biases); future research should consider longitudinal validation and impact evaluations via small-scale local pilot programs. The contribution consists of a replicable indicator-based diagnosis that supports decisions aligned with the SDGs in coastal destinations.

Keywords: sustainable competitiveness, tourism entrepreneurship, circular economy, sustainable development goals (SDGs), innovation ecosystem

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INTRODUCTION

Sustainable tourism has established itself as a strategic component for territorial development, especially in areas where natural and cultural heritage constitute the foundation of economic dynamism. In emerging contexts such as Pedernales (Manabí, Ecuador), tourism entrepreneurship plays a fundamental role in job creation, local innovation, and product/service diversification. However, these ventures still face structural challenges related to financing, technical assistance, infrastructure, and inter-institutional coordination (Strippoli et al., 2024).

In this context, the integration of the Sustainable Development Goals (SDGs) into business management takes on special relevance. Specifically, SDG 8 (decent work and economic growth) and SDG 12 (responsible consumption and production) act as guiding principles for sustainable practices in tourism. Furthermore, SDG 6 (clean water), SDG 13 (climate action), SDG 17 (partnerships), and SDG 4 (quality education) are gaining relevance, given their direct relationship with resource use, training, innovation, and institutional coordination (Guimarães et al., 2023; Sousa et al., 2022).

As discussed by Zorpas et al. (2021) and Matteucci (2020), tourism destinations require territorial approaches that incorporate circular economy tools, waste reduction, energy efficiency, and community participation as core components of the business model. This view is also reinforced by the closed-loop approaches in the hotel industry (e.g., material reuse, efficient resource management, and collaboration with local suppliers) that reduce environmental impacts. Similarly, Dias & Estevão (2024) argue that effective tourism innovation must be anchored in region-specific diagnostics that account for both the capability of the entrepreneurial ecosystem and the institutional factors shaping its performance. Aligned with this rationale, this study in Pedernales generates empirical evidence to inform local decision-making. This linkage enables technical diagnostics to translate into destination-specific public policies adapted to the dynamics of each region. The studies by Gabor et al. (2023) also demonstrate that the absence of circular practices places pressure on waste management

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systems and increases pollution, making it a priority to monitor such practices in developing coastal destinations. Following the approach of Kronenberg & Fuchs (2021) and Garcia (2022), this research adopts a territorial and participatory perspective, supported by operational and measurable indicators that make it possible to assess the degree of alignment of entrepreneurship with the commitments of the 2030 Agenda. Tourism entrepreneurship in emerging coastal destinations requires the integration of the SDGs with circular economy practices and an innovation-ecosystem perspective. Recent evidence shows that SDGs incorporation in enterprise strategy hinges on policy design and collaboration (moving beyond growth-only logics), while innovation and entrepreneurship act as pivotal vehicles in SDGs 8, 9, 12, 13 and 11 (e.g., open innovation, knowledge sharing, and inclusive governance) (Deep et al., 2024; Rodaro et al., 2025). Likewise, the circular economy (CE) and innovation ecosystems are mutually reinforcing: primary actors (firms, start-ups, research) and support actors (policy, finance) co-produce circular business models that strengthen competitiveness and sustainability; however, digital-innovation–CE linkages remain underexplored and require coordinated, multi-actor responses (Alka et al., 2024).

Inclusion also matters: gender differences shape digital transformation and sustainable practices in SMEs, which requires differentiated support; by actively participating in decision-making, women entrepreneurs contribute to the co-creation of rural policies and strengthen the destination's competitiveness (Belas et al., 2025; Stylianou et al., 2025). Finally, urban innovation policies can help reduce inequality by fostering employment concentration (agglomeration economies), structural upgrading toward higher-productivity activities, and greater entrepreneurial and innovation vitality; together, these dynamics create social benefits such as better jobs, higher incomes, local capabilities, and shared services that support innovation strategies relevant to the local tourism ecosystem (Li et al., 2025). This article addresses these gaps by (i) measuring sustainable competitiveness with CE- and SDG-aligned indicators at firm level; (ii) interpreting findings through an innovation-ecosystem perspective (actors, networks, capabilities); and (iii) deriving context-specific policy actions for Pedernales that translate measurement into inclusion, service-innovation instruments, and collaborative governance (Alka et al., 2024; Deep et al., 2024; Rodaro et al., 2025). In this context, this study aims to evaluate the sustainable competitiveness of tourism entrepreneurship in Pedernales, Ecuador, by applying a validated indicator-based diagnostic aligned with the SDGs and circular-economy principles; using firm-level data, adoption gaps were identified and context-specific policy actions to foster competitive, inclusive, and environmentally responsible growth were addressed.

CONCEPTUAL FRAMEWORK

Sustainable competitiveness and circular economy in tourism

The concept of sustainable competitiveness combines economic performance with principles of social equity and environmental responsibility. In the tourism sector, this approach involves generating shared value, diversifying products, improving the quality of services, innovating business models and minimizing negative impacts on the environment (Reinhold et al., 2017). Today, competitiveness extends beyond efficiency or profitability to integrate the capacity of organizations to actively contribute to the sustainable development of the territory (Gabor et al., 2023; Garcia, 2025). In emerging destinations such as those in coastal Ecuador, competitiveness also hinges on firm-level innovation, market development and internationalization, domains in which MSMEs show persistent gaps (Garcia, 2024, 2025).

The circular economy applied to tourism introduces a logic of regeneration and optimal use of resources through the 10R principles: rethink, redesign, reduce, reuse, repair, restore, remanufacture, recycle, recover and revalue (Strippoli et al., 2024). In sectors such as accommodation and food, this logic takes on particular relevance due to the high volumes and diversity of waste generated. Building on Juvan et al. (2023), hotels and restaurants produce more than 35 million tons of solid waste annually, with significant internal differences in generation patterns, requiring specific management strategies tailored to each segment. A critical caveat is that most CE evidence comes from Europe and large hotel chains; transfer to SME-dominated, coastal contexts requires territorial diagnostics and staged adoption pathways. In addition, recent studies have highlighted that in rural communities linked to small-scale tourism, the circular economy is not just limited to industrial processes. Instead, it also draws on cultural practices, local traditions and community relations to strengthen sustainability from a territorial and participatory approach (Siriwong et al., 2025). However, these approaches often rely on self-reported practices and short time frames, limiting causal inference and external validity in fast-changing tourism markets.

Additionally, Alves et al. (2024), point out the importance of designing assessment tools that capture perceptions, attitudes, and levels of interest in the circular economy as part of a comprehensive diagnosis of business behavior.

In this regard, Gabor et al. (2023) evidence that the adoption of circular economy indicators such as the use of renewable energy, material efficiency, and waste management systems, has a positive effect on the environmental sustainability of tourism. Their empirical study, based on advanced statistical models in 30 European countries, supports the need to incorporate these indicators in emerging destinations to avoid cumulative impacts and improve green competitiveness. Yet, indicator frameworks are rarely tailored to MSME capabilities and financing constraints; this study responds with a territory-specific, firm-level set of indicators that can be monitored and compared over time.

Likewise, Matteucci (2020) proposes that the hotel sector can act as a catalyst for the circular economy by redesigning operational processes towards cleaner systems, promoting the use of recyclable materials, and establishing more sustainable relationships with local suppliers, elements that can be integrated as key indicators in the diagnostics of sustainable competitiveness in Pedernales. A limitation of this strand is the emphasis on operational eco-efficiency over governance and ecosystem capabilities, which are necessary for durable CE transitions in small destinations. This approach not only promotes responsible production and consumption models (SDG 12), but also highlights the need for more detailed assessments that recognize the heterogeneity within the tourism sector in tourism waste management.

The incorporation of practices such as water footprint measurement, eco-design of services, and smart natural resource management enables a shift toward regenerative models beyond conventional recycling. Furthermore, as Zorpas et al.

(2021) emphasize, the adoption of environmental management systems (ISO 14001, EMAS, Green Key), staff training, and strategies such as environmental gamification and collaborative consumption strengthen the institutional and cultural capacities necessary to implement an effective circular model in tourism. Still, most studies remain cross-sectional and descriptive; rigorous evaluations of CE adoption and performance (energy, waste, revenue, jobs) in MSME settings are scarce, especially in Latin America. From a system and network perspective, the innovation ecosystem (primary actors—firms, start-ups, research; and support actors—policy, finance) interlocks with the circular economy to generate sustainable business models (waste reduction, resource efficiency, remanufacturing, regenerative design) (Alka et al., 2024). This interplay helps explain firm-level indicators already used in this study (training, certifications, participation in networks, renewable energy): they are not isolated practices but ecosystem capabilities that enable circular transition and competitiveness (Alka et al., 2024). Yet the literature flags underexplored digital-innovation–CE links and calls for collaborative, multi-actor strategies, particularly relevant to coastal, SME-dominated destinations (Alka et al., 2024).

Recent works provide complementary angles: Rodaro et al. (2025) on SDGs integration through policy design and collaboration; Deep et al. (2024) on service-oriented innovation instruments for tourism MSMEs; Belas et al. (2025) on digital transformation gaps; Li et al. (2025) on city-level innovation for inclusion. Collectively, they underscore ecosystem governance and capability-building; however, they seldom operationalize firm-level CE–innovation metrics or test them in SME-dominated coastal destinations. Evidence for coastal Ecuador is particularly scarce—an empirical gap addressed in this paper.

Tourism, SDGs and entrepreneurial ecosystem

The link between tourism and the SDGs is particularly strengthened through targets such as promoting policies for sustainable tourism that generates employment and values local culture (SDG 8.9), developing tools to monitor tourism's impacts from a sustainable perspective (SDG 12.b), climate action and resilience to environmental threats (SDG 13), and fostering strategic partnerships to implement sustainable actions in a multi-sectoral manner (SDG 17). Sustainable entrepreneurship, as proposed by Huang et al. (2023) must be understood as a sociotechnical practice that emerges from the interaction between entrepreneurs, institutions, and their territorial context, beyond mere individual economic action.

Moreover, the tourism entrepreneurial ecosystem approach highlights the interaction between actors, institutions, markets, and support networks. From this systemic perspective, the competitiveness of tourism entrepreneurship depends not only on the individual capacity of the entrepreneur, but also on their enabling environment: public policies, institutional support, access to financing, entrepreneurial culture, and human capital (Garcia, 2022). In the same vein, Dias & Estevão (2024) highlight that the design of regional tourism innovation policies must be based on a rigorous analysis of the systemic determinants of entrepreneurship, prioritizing governance, cross-sector cooperation, and the strengthening of institutional capacities.

This allows for better articulation of actors within the entrepreneurial ecosystem, facilitating the adoption of innovative solutions adapted to the local context. Their model is especially relevant for territories such as Pedernales, where structural gaps can be addressed through territorial innovation strategies with a sustainable approach. Aligned with this approach, Sreenivasan & Suresh (2023) argue that sustainable entrepreneurship represents an effective way to advance towards the SDGs, provided it is supported by coherent public policies, cooperation networks, and educational processes that promote ethical principles and environmental awareness. Similar recent contributions include Rodaro et al. (2025), Li et al. (2025), Deep et al. (2024), Belas et al. (2025), and Alka et al. (2024), which - despite differing scales and methods—converge on the need for coordination, capabilities, and measurement. However, recent research warns that much of the academic literature on sustainable tourism omits fundamental aspects such as climate change mitigation, origin-to-destination (O/D) transport, and distance as a critical factor in tourism CO_2 emissions. According to Peeters et al. (2024), only 6.5% of articles on sustainable tourism published in scientific journals include terms associated with climate change mitigation, and many of them present weak definitions of sustainability that favor short-term economic benefits, ignoring planetary boundaries. Kronenberg & Fuchs (2021) warn that the implementation of the SDGs in tourism has been partial, with an excessive emphasis on economic goals while neglecting dimensions such as environmental justice, social equity, and participatory governance. This lag reveals a structural disconnect between tourism studies and strong sustainability approaches, due to the underestimation of transportation as a primary emitter, the lack of interest in domestic tourism, which accounts for nearly 80% of global travel, and the prevalence of analytical frameworks limited to local or temporal scales. This limits the sector's ability to formulate effective emission reduction and climate adaptation strategies. Additionally, a reductionist vision focused on economic efficiency prevails, excluding principles of environmental justice and intergenerational equity, reproducing fragmented approaches that limit structural changes in tourism.

Critically, most studies draw on cross-sectional surveys and self-reports, which weakens behavioral validity; few incorporate audits or counterfactual designs. In the light of these omissions, it is necessary to reframe analytical frameworks toward a strong sustainability approach that incorporates biophysical limits, climate justice criteria, and shared responsibility approaches between businesses, governments, and consumers. The call for attention raised by the authors highlights the urgent need to incorporate criteria such as broad geographic scope, shared responsibility between governments and businesses, and long-term scenarios into sustainable tourism research. This critique is especially pertinent for emerging destinations like Pedernales, where current decisions regarding tourism models can have significant repercussions on the territory's future ecological footprint. In this context, Khizar et al. (2023) emphasize that real progress toward the SDGs in the tourism sector depends on the coherence between business practices and sustainability principles, as well as the existence of monitoring mechanisms based on reliable data and institutional will. Anchored in this framework, the present study evaluates the sustainable competitiveness of tourism entrepreneurship in Pedernales using a validated, territory-specific set of indicators aligned with CE principles and the SDGs. Exploratory Factor Analysis (EFA) is applied to derive an interpretable structure, which enables the translation of results into potential destination-level policy actions for the DMO and local stakeholders.

MATERIALS AND METHODS

Research Approach and Study Design

This study adopts a quantitative approach, descriptive and exploratory in nature, through a case study in the city of Pedernales, province of Manabí. This approach allows for understanding behavior patterns, the level of adoption of sustainable and circular practices, and their linkage with the Sustainable Development Goals (SDGs) in local tourism enterprises (Sousa et al., 2022). The study also responds to the need to generate destination-specific empirical data on the environmental impacts of tourism and the adoption of circular strategies, as noted by Zorpas et al. (2021), and aligns with the recommendations of Dias & Estevão (2024), who emphasize the urgency of using methodologies adapted to the territorial level to identify real opportunities for sustainable innovation in Latin American regions.

Furthermore, an applied approach was considered, aimed at building useful evidence for the formulation of public policies oriented towards tourism sustainability in local contexts, in line with SDGs 8, 12 and 13. For cartographic elements, data sources, projection and software in the map caption and methods were explicitly documented.

Population and Sample

The study population consists of active tourism enterprises in the city of Pedernales that provide food, accommodation, transportation, recreation, or tourism operation services. A simple random probabilistic sampling was applied, using the formula for infinite populations. The calculation considered a confidence level of 95%, an expected population proportion of 50% (p = 0.5), its complement (q = 0.5), and a margin of error of 7% (d = 0.07), according to the procedure described by Vera et al. (2019). The estimated sample size was 196 enterprises. The surveys were conducted in the field during the second semester of 2024, at strategic points within the urban area of the city of Pedernales (Figure 1).

Geographic locations of each surveyed venture were georeferenced via the ArcGIS Survey123 questionnaire in December 2024 and processed in ArcGIS Pro 3.2 to produce the spatial distribution shown in Figure 1.

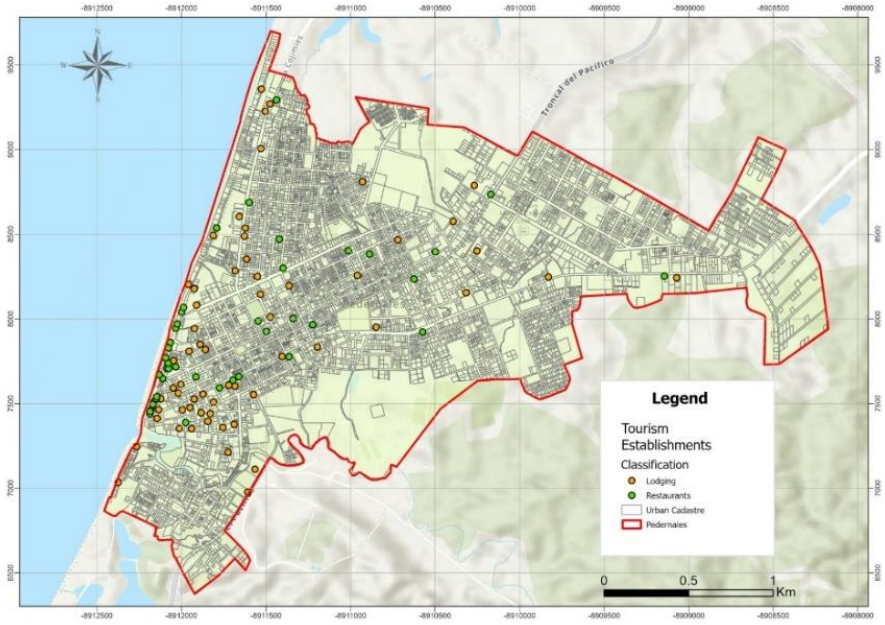

Figure 1. Map of the city of Pedernales, Manabí province, Ecuador (Source: Points—primary field survey (n = 196) collected via ArcGIS Survey123, December 2024; CRS: WGS84 / UTM 17S (EPSG:32717); Software: ArcGIS Pro 3.2. Authors' elaboration)

Study Area: City of Pedernales

The canton of Pedernales is located in the northern region of the province of Manabí, Ecuador, and forms part of the coastal corridor of the Ecuadorian Pacific. Its territory covers an approximate area of 2,456 km² and has a predominantly rural configuration, structured into five parishes: the cantonal capital Pedernales (study area) and the rural parishes of Cojimíes, Atahualpa, 10 de Agosto, and San José de Chamanga (Municipal Government of Pedernales, 2020). The canton borders the province of Esmeraldas to the north, the canton of Jama to the south, the cantons of El Carmen and Chone to the east, and the Pacific Ocean to the west, which gives it a strategic position for tourism activity and regional connectivity. All layers in Figure 1 were projected to WGS84 / UTM 17S (EPSG:32717) and processed in ArcGIS Pro 3.2; the map shows the location of Pedernales within Manabí/Ecuador, the urban core, main roads and hydrography.

From a physical-geographical perspective, Pedernales is located within the tropical Chocó biogeographic region, which provides it with significant natural wealth in terms of biodiversity, marine-coastal ecosystems, and water resources. The canton features a topography that ranges from flat coastal areas to mountainous foothills inland, with the presence of estuaries, mangroves, rainforests, and agricultural zones. The predominant climate is tropical monsoon, with average temperatures between 24°C and 27°C and an annual rainfall exceeding 2,000 mm, factors that favor the development of agricultural, fishing, and recreational activities. At the socioeconomic level, the canton presents heterogeneous conditions. Although there are local entrepreneurship initiatives, the rate of unmet basic needs is high, and informal employment

predominates in the productive sector. In demographic terms, a growing population concentration is observed in the cantonal capital, while rural areas show migration dynamics and limited access to basic services. However, the territory has a significant tourism vocation, supported by its natural attractions such as beaches, wetlands, biological reserves, and seafood cuisine, as well as local cultural expressions that have gained relevance in alternative and community tourism circuits.

The location of Pedernales on the Spondylus Route and its role as an access point to northern Manabí consolidate its potential as an emerging tourist destination. However, tourism development faces structural challenges related to territorial planning, environmental sustainability, the precariousness of basic infrastructure, and the need to strengthen the technical and management capacities of local stakeholders. These conditions justify the relevance of specific studies on the competitiveness and sustainability of its tourism entrepreneurship.

Data Collection Instrument

A structured survey composed of three sections was designed and validated:

- I. Demographic information: data on the business, age and educational level of the business owner, and type of service provided.
- II. Sustainable practices and circular economy: 13 items on a 7-point Likert-type scale (1 = Strongly disagree, 7 = Strongly agree), linked to sustainability indicators, the circular economy, renewable energy, collaborative networks, environmental perception, and sustainable mobility.
- III. Key business indicators: business life cycle, source of financing, entrepreneurial motivation, number of employees, permits, innovation, and formal records.

The questionnaire was designed to capture a comprehensive view of sustainable competitiveness, incorporating key dimensions from the outset: territorial competitiveness, waste management, water efficiency, environmental innovation, training, use of clean energy, sustainable mobility, and institutional cooperation. This structure was developed in response to limitations detected in previous studies on sustainable tourism, which, as Peeters et al. (2024), point out, tend to omit critical aspects such as tourist transport, distance between origin and destination, and shared responsibilities for climate change mitigation. The 13 indicators were grouped into seven analytical dimensions: sustainable competitiveness, circular economy, waste and water, environmental practices and innovation, perception and engagement, energy transition, partnerships and networks, and sustainable mobility. Each dimension was associated with specific indicators of SDGs 4, 6, 7, 8, 9, 11, 12, 13, and 17, covering social, environmental, energy, institutional, and governance goals. The content of the instrument was validated through expert judgment by seven specialists in sustainable tourism and the circular economy, who reviewed the items for wording and consistency, suggesting minor technical adjustments to improve their contextual appropriateness. Figure 2 shows the firm-level indicator–SDG associations used in this study, improving readability and saving space.

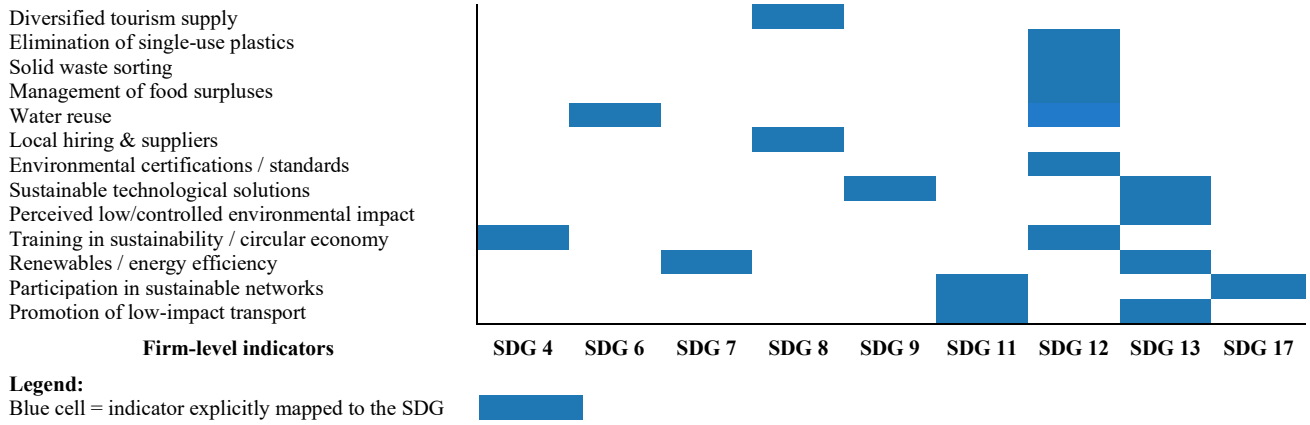

Figure 2. Indicator–SDG association matrix (Pedernales). Cells indicate whether each firm-level indicator is explicitly mapped to SDGs 4/6/7/8/9/11/12/13/17. Source: Authors' operational mapping based on official UN SDG targets

Data Processing and Analysis

The data were processed using SPSS software version 25. Descriptive statistics techniques, Cronbach's alpha reliability testing, and EFA were applied to identify latent clusters of indicators (Garcia, 2021). EFA was conducted with an orthogonal Varimax rotation; factor retention was guided by eigenvalues > 1 and inspection of the scree plot, and we report factor loadings ≥ 0.40 and cross-loading differences ≥ 0.20 for interpretability. Cross-referencing demographic variables and compliance levels by dimension was also performed to detect differential patterns based on the type of service, length of operation, and entrepreneur profile. Group comparisons followed assumption checks (Shapiro–Wilk for normality; Levene's test for homoscedasticity); One-way ANOVA with Tukey's post hoc adjustment or Kruskal–Wallis tests with Dunn–Bonferroni correction were applied, and effect sizes (e.g., η^2 or r) were reported alongside p-values.

Prior to multivariate analyses, indicator variables were z-standardized. Univariate and multivariate outliers ($|z| > 3$ and Mahalanobis distance at $p < 0.001$) were screened, and no influential cases were identified.

Missing data were handled according to pre-specified criteria: analyses were conducted using complete cases, and item nonresponse was below 5%, thus not requiring imputation. Additionally, a cluster analysis was conducted to classify the entrepreneurs according to their level of sustainability performance, which allowed for the identification of

distinct profiles within the local tourism ecosystem. Clustering was performed on factor scores using k-means (Euclidean distance); the number of clusters (k) was selected based on the elbow and silhouette criteria, and internal validity was evaluated using the mean silhouette width. The research adhered to fundamental ethical principles, ensuring voluntary participation, informed consent, and the confidentiality of the information collected.

RESULTS AND DISCUSSION

The results obtained from the survey of 196 tourism ventures located in the city of Pedernales demonstrate patterns of adoption of sustainable and circular practices, as well as differentiated levels of compliance with indicators linked to the SDGs. The main findings are presented below, organized by dimension assessed, followed by a discussion integrated with previous studies.

General Profile of Entrepreneurial Ventures

Of the total ventures surveyed, 43.4% were in food services, 29.1% in lodging, 11.7% in tourist transportation, 7.6% in recreational activities, and 8.2% in tourism operations or mixed combinations. Figure 3 summarizes this relationship, allowing for a quick comparison across categories. Small-scale family ventures with one to four employees predominate (67.9%), mostly led by women (54.1%) with secondary or higher education (73.6%). Huang et al. (2023) also reveal that personal factors such as prosocial motivation, educational level, and environmental sensitivity significantly influence the intention to undertake sustainable entrepreneurship. Regarding the business life cycle, 48.9% of ventures are in the established stage (more than 42 months of operation), while 36.2% are in the consolidation stage (more than 3 and less than 42 months). Figure 4 shows the stage distribution, including the residual "Other/Unspecified" proportion, making the ecosystem maturity structure clearly visible. These data support the idea of an ecosystem with a certain operational maturity, similar to that reported by Quintero-Ichazo & Garcia-Reinoso (2025), where business stability is related to a greater capacity to incorporate sustainable practices.

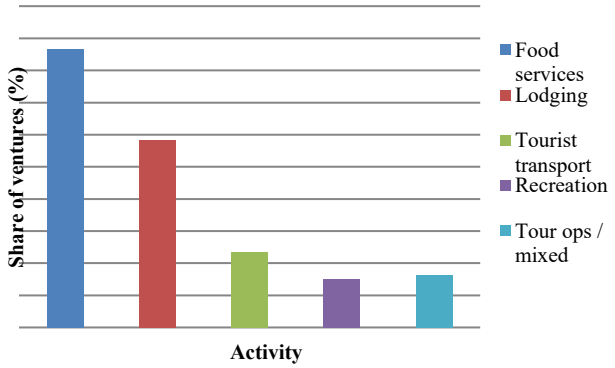

Figure 3. Distribution of surveyed ventures by activity (n = 196) (Source: Authors' survey (Pedernales MSMEs)

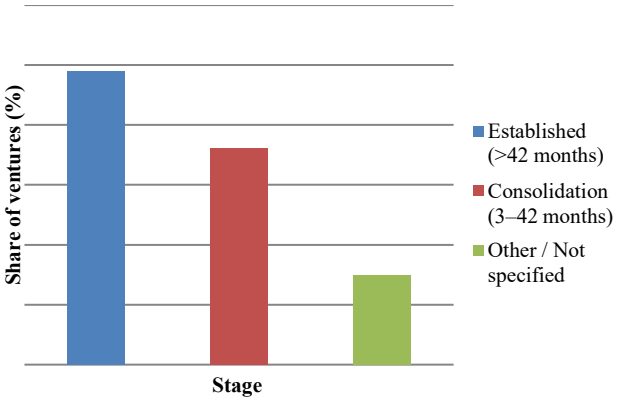

Figure 4. Business life-cycle stages (n = 196). "Other/Not specified" represents the residual share not detailed in the text

Instrument Reliability and Factor Structure

The instrument showed high internal consistency, with a Cronbach's alpha coefficient of 0.878 for all items, which supports its reliability for assessing sustainable and circular practices in tourism entrepreneurship. By dimension, the values ranged from 0.74 (for *Partnerships and Networks*) to 0.89 (for *Circular Economy - Waste and Water*), falling within acceptable ranges (Garcia, 2021; Ramirez-Anormaliza et al., 2017). The EFA with Varimax rotation identified four factors that explain 72.3% of the total variance. The Kaiser-Meyer-Olkin (KMO) test was 0.806, and Bartlett's test of sphericity was significant (χ^2=865.72, df=78, p<0.001), which supports the factorial structure. Table 1 indicates the factor loadings (indicators × factors). The four factors found were: (1) Environmental practices and circular economy (items 2, 3, 4, 5, 7, 8); (2) Environmental perception, training and energy (items 9, 10, 11); (3) Networks, mobility, and sustainable alliances (items 12, 13); and (4) Competitiveness and local human capital (items 1 and 6) (Table 1).

Table 1. Factor loadings by indicator (Varimax EFA), Pedernales tourism ventures (n = 196)
Cells show standardized loadings for components 1–4 (Source: Authors' analysis (SPSS v25)

Indicator	Comp. 1	Comp. 2	Comp. 3	Comp. 4
Single-use plastic reduction (item 2)	**0.78**	0.18	0.17	0.19
Waste sorting (item 3)	**0.74**	0.2	0.16	0.2
Food reuse (item 4)	**0.71**	0.21	0.18	0.18
Water reuse (item 5)	**0.69**	0.23	0.16	0.17
Environmental certifications/standards (item 7)	**0.73**	0.2	0.15	0.21
Low-impact innovation (item 8)	**0.7**	0.19	0.18	0.19
Perceived low/controlled impact (item 9)	0.18	**0.76**	0.21	0.22
Training in sustainability/CE (item 10)	0.22	**0.74**	0.2	0.18
Renewables / energy efficiency (item 11)	0.19	**0.65**	0.22	0.2
Participation in networks (item 12)	0.17	0.22	**0.74**	0.16
Sustainable transport promotion (item 13)	0.16	0.2	**0.71**	0.17

Diversified tourism supply (item 1)	0.12	0.19	0.15	**0.71**
Local hiring & suppliers (item 6)	0.2	0.17	0.14	**0.68**
Eigenvalues	4.26	2.23	1.58	1.18
Explained variance (%)	32.8	17.8	12.2	9.5
Cumulative variance (%)	32.8	50.6	62.8	72.3
Cronbach's Alpha	0.842	0.803	0.785	0.752
KMO (Kaiser-Meyer-Olkin)	0.806			
Bartlett's Test of Sphericity	χ^2=865.72		df=78	p<0.001

The first factor groups six items related to waste management, plastic reduction, water reuse, certifications, and sustainable technologies. It alone explains 32.8% of the total variance, with a Cronbach's $\alpha = 0.842$. The second factor, linked to environmental perceptions, sustainability training, and the use of clean energy, explains 17.8% of the variance ($\alpha = 0.803$). The third factor relates to participation in networks and the promotion of low-impact transportation, and accounts for 12.2% of the variance ($\alpha = 0.785$). The fourth factor, which addresses diverse tourism offerings and the hiring of local staff and suppliers, explains 9.5% of the variance, with $\alpha = 0.752$. Primary loadings were ≥ 0.65 and cross-loadings ≤ 0.23, indicating a clear simple structure. This empirical grouping validates the conceptual structure of the instrument and reinforces the coherence between the proposed analytical dimensions and observed field behavior.

Cross-Analyses and Group Differences

Cross-analyses were conducted to identify variations in the implementation of sustainable practices according to the characteristics of the venture. Group comparisons were performed using independent-samples t-tests or one-way ANOVA, after checking assumptions (Shapiro–Wilk for normality; Levene's Test for homogeneity). When assumptions were violated, nonparametric tests were applied (Mann–Whitney/Wilcoxon). Exact p-values (three decimals) and effect sizes (Cohen's d or η^2) were reported.

- Lodging businesses showed greater compliance with the use of renewable energy and environmental standards (mean: 4.1) compared to food businesses (mean: 3.5), with statistically significant differences ($p<0.05$).
- Businesses in an established stage (more than 42 months old) showed higher levels of waste management and environmental perception (mean: 5.3) than those in the consolidation stage (mean: 4.7).
- Female venture leaders achieved higher averages in environmental training and sustainable partnerships (mean: 5.2 versus 4.6 for men), although these differences did not reach statistical significance ($p>0.05$).

Multiple indicators were tested in parallel by a Holm–Bonferroni adjustment to control the familywise error rate; adjusted p-values led to the same substantive conclusions. These findings confirm that the length of operation and type of service are key variables in the adoption of sustainable practices, which is consistent with recent studies in emerging tourism contexts (Guimarães et al., 2023; Sousa et al., 2022). This highlights the need for differentiated policies by type of actor and stage of the venture, which integrate technical support programs with a gender and sustainability focus. Along these lines, the results are also enriched by the findings of Alves et al. (2024), who show that sociodemographic variables, such as educational level, age, and gender, significantly influence individuals' circular behavior, reinforcing the importance of considering such factors when designing interventions for the tourism sector.

Adoption of Sustainable and Circular Practices

With the aim of assessing the effective integration of sustainability into the operations of the tourism entrepreneurship located in the city of Pedernales, thirteen key practices linked to the SDGs were evaluated (Figure 5).

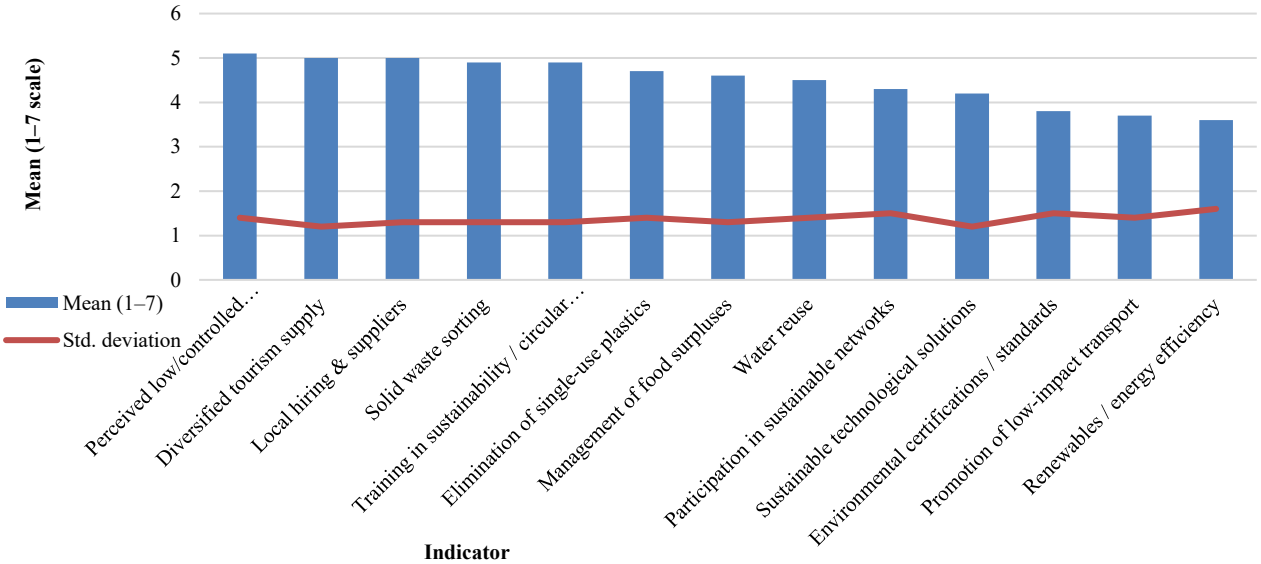

Figure 5. Item means with standard deviations (1–7 scale), Pedernales tourism MSMEs (n = 196)
Higher values indicate greater reported implementation (Source: Authors' survey)

These were measured using a scale of 1 to 7, which allowed for the identification of different levels of progress and the detection of gaps in the implementation of circular and environmentally responsible strategies. The following table summarizes the averages for each item evaluated (scale of 1 to 7). For readability, Figure 5 displays item means with standard deviations (1–7 scale), enabling quick comparison across practices. The evaluated ventures show moderate levels of implementation of circular practices, with higher levels of diversification of supply, community involvement, and environmental perception, while actions linked to renewable energy, environmental certification, and sustainable mobility remain limited. This pattern is consistent with the bar chart ranking in Figure 5 (top: diversified supply, local hiring, environmental perception; bottom: renewables, certification, low-impact mobility).

This pattern of partial adoption is also observed in other contexts, such as the study by Alves et al. (2024), which reports that, despite a positive attitude toward the circular economy, the most common actions are conventional (recycling, waste reduction), while more advanced practices such as collaborative consumption, remanufactured products, or shared mobility remain marginal. In comparison with findings of similar regional studies (Guimarães et al., 2023; Matteucci, 2020; Sousa et al., 2022), the results obtained in the city of Pedernales reflect a partial appropriation of sustainability strategies, although with clear opportunities for improvement through targeted policies and technical training programs. As indicated by Alves et al. (2024), there is a positive correlation between the level of knowledge about the circular economy and the willingness to adopt sustainable behaviors, which suggests that improving technical training in sustainability could have a direct effect on environmental action in tourism entrepreneurship.

However, as warned by Siriwong et al. (2025), rural communities face structural challenges in adopting circular models due to limitations in infrastructure, low stakeholder awareness, and limited technical capacity. Overcoming these barriers requires strengthening local collaboration, promoting community values, and fostering a conscious mindset among tourism entrepreneurs. According to Huang et al. (2023), the adoption of sustainable practices is closely linked to social capital and access to collaborative networks, reinforcing the need to strengthen local alliances to scale up good practices. A comparable situation is observed in the case of Villa de Leyva, Colombia, where, despite being certified as a sustainable destination, gaps persist between formal recognition and the effective implementation of responsible practices, especially in waste management, pressure on local resources, and the participation of community stakeholders, highlighting the need for more inclusive and coherent governance (Fonseca et al., 2025).

Consistently, Del-Aguila-Arcentales et al. (2022) highlight that the alignment of entrepreneurship with the SDGs depends largely on the existence of enabling environments, where effective public policies, committed local actors, and a territorial vision of sustainability converge. Finally, Gupta et al. (2024) emphasize that sustainable entrepreneurship requires simultaneously integrating economic, environmental, and social objectives from the design of the business model, promoting solutions that respond to global and local challenges.

It is observed that knowledge about sustainability does not always translate into concrete actions. For example, although 73% of respondents claim to be familiar with the SDGs, actions related to clean energy or waste management continue to show weaknesses, which is consistent with Peeters et al. (2024) diagnosis regarding the weak integration of climate change in tourism. This gap between discourse and practice reflects the need to strengthen technical capacities, access to financing, and contextualized training processes. Without these elements, sustainable commitments run the risk of remaining at a declarative level without any real impact on business operations.

Consequently, the study confirms the need to improve the articulation of local initiatives with multisectoral cooperation networks (SDG 17), implement environmental monitoring tools, and strengthen the provision of specific training on circular practices. Furthermore, the poor performance in energy indicators suggests a priority line of intervention to reduce the ecological footprint of local tourism, as indicated by Gabor et al. (2023). The findings of Alves et al. (2024) also support the idea that environmental education should focus not only on conceptual knowledge, but also on the generation of practical skills and sustainable behavior changes, which is essential to strengthen the circular culture in the tourism ecosystem.

Policy and managerial implications

Service-oriented innovation instruments are more effective in tourism than traditional R&D mechanisms. Policy mixes (coordinated bundles of instruments) should prioritize licensing and certification to assure quality, strategic public procurement, and training/mentoring for SMEs; and they should broker knowledge flows across trade, technology, infrastructure, and regulation systems (Deep et al., 2024).

Public–private collaboration and social entrepreneurship strengthen sustainability outcomes and competitiveness (Deep et al., 2024). At the local level, innovation-oriented strategies can further support inclusive development. Evidence from city-level pilot programs indicates reductions in inequality through labor agglomeration, structural upgrading, and enhanced entrepreneurial vitality. While contexts differ, these mechanisms are transferable to tourism ecosystems (Li et al., 2025).

In Pedernales, these findings align with the measured weaknesses (energy transition, certifications, sustainable mobility) as evidenced by the lower-ranked items in Figure 5 (Alka et al., 2024). Accordingly, the DMO and sector stakeholders should: (i) prioritize energy efficiency and renewables (SDGs 7/13); (ii) accelerate the adoption of environmental certifications; and (iii) establish a multi-stakeholder circular-economy lab focused on waste minimization and circular design (Alka et al., 2024). Concurrently, the DMO should establish a permanent, multi-stakeholder advisory council at the destination level for the tourism, hospitality, and gastronomy sectors to institutionalize co-creation, coordinate a portfolio of demand-driven projects, and mobilize micro-grants, technical assistance, and mentoring across the value chain (Deep et al., 2024; Li et al., 2025). To ensure effective implementation, a 12–18-month roadmap with SDG-aligned KPIs (7, 12, 13) and quarterly reviews is recommended. The council should also facilitate partnerships with

municipal utilities (energy, water, waste), training centers and universities, and financial institutions, while overseeing monitoring and periodic evaluations to support learning and scaling.

CONCLUSION

The study enabled a comprehensive characterization of the degree of sustainable practices adoption and circular economy principles in tourism entrepreneurship in the city of Pedernales. It revealed significant progress in areas such as tourism supply diversification, local hiring, and positive environmental perception, but also identified structural weaknesses in energy transition, environmental certifications, and sustainable mobility. Using a territory-tailored, indicator-based approach (n = 196), the study offers a granular snapshot of the local entrepreneurial ecosystem and actionable inputs for the formulation of public and private strategies aimed at sustainable development. The findings underscore the need for greater coordination between institutional actors, businesses, academia, and communities, as well as for public policies that promote training, innovation, and multisector cooperation. In addition, the tested indicator framework - covering sustainable competitiveness, circular economy, and perception/engagement - is a valid and replicable tool for other tourist destinations with similar characteristics. Overall, evaluating practical, contextualized, and measurable indicators enables the clear identification of gaps and opportunities in the entrepreneurial ecosystem, favoring evidence-based decisions aligned with the SDGs. As a practical next step, the DMO must adopt this indicator dashboard for annual monitoring and SDG-aligned reviews.

Limitations & Future Research. This is a cross-sectional, single-destination study relying on self-reported survey data from owners and managers; while useful to capture perceptions and practices, these data may be subjected to social desirability and recall biases; longitudinal and behavioral evidence is needed to assess persistence and causality. The instrument did not analyze gender or digital-divide dynamics; future work should examine how these factors shape sustainable practice adoption and participation in local innovation ecosystems.

Future lines of research could include: (1) conducting longitudinal studies to track the evolution of indicators over time; (2) applying comparative methodologies across tourist cities or cantons in the province of Manabí; (3) incorporating mixed-methods/qualitative analyses on perceptions and barriers to sustainable adoption; and (4) assessing the impact of circular-economy and sustainability policies through small-scale local pilot programs, using rigorous impact-evaluation methods with appropriate comparison groups (e.g., difference-in-differences, matched comparisons, or randomized pilots when feasible). However, these advances would strengthen the destination's adaptive capacity to confront climate change, biodiversity loss, and structural inequalities.

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