

# *Ecotourism In The Atsimo-Andrefana Region (Madagascar): Between Natural Resource Valorization And Sustainable Development Prospects*

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**Abstract:** The Atsimo-Andrefana region in southwestern Madagascar holds substantial yet underutilized ecotourism potential. This study examines how ecotourism can promote sustainable development while conserving natural and cultural resources. Data were collected from 70 stakeholders—including local communities, tourism operators, authorities, and conservation experts—through questionnaires, semi-structured interviews, and field observations. Findings show strong positive correlations between environmental education and site preservation ( $r = 0.82$ ) and between the promotion of ecotourism products and local incomes ( $r = 0.76$ ). Conservation of natural resources is identified as a critical driver of sustainable development. The results highlight the need for integrated strategies combining education, product valorization, and resource management, alongside strengthened local capacities and improved infrastructure to fully realize the region's ecotourism potential.

**Keywords:** Ecotourism, sustainable development, conservation, Environmental education, Atsimo-Andrefana

## 1. INTRODUCTION

Ecotourism has increasingly emerged as a central pillar of sustainable development strategies worldwide. According to the World Tourism Organization<sup>1</sup> (2022), the sector records an annual growth rate of 6.9%, reflecting the rising global demand for responsible tourism experiences that respect ecosystems. This growth aligns with the United Nations Sustainable Development Goals (SDGs), particularly SDG 15 (*Life on Land*) and SDG 8 (*Decent Work and Economic Growth*), which advocate for the sustainable use of natural resources. Successful models in countries such as Costa Rica and Bhutan demonstrate that ecotourism can generate up to 30% of local revenues while alleviating pressure on fragile ecosystems<sup>2</sup>.

<sup>1</sup> <https://www.untourism.int/unwto-2022-a-year-review> visited on 26 October 2025.

<sup>2</sup> <https://portals.iucn.org/library/sites/library/files/documents/2021-013-fr.pdf> visited on 26 October 2025.

In Madagascar, a globally recognized biodiversity hotspot, ecotourism has become a key driver of both conservation financing and local economic development. The island's exceptional endemism attracts international visitors whose expenditures directly support the management of protected areas and the improvement of rural livelihoods. Across several national parks, ecotourism provides a sustainable mechanism to reconcile environmental protection with community development, as illustrated by the Andasibe–Mantadia National Park, where 50% of park fees are allocated to local communities (Andrianambinina et al., 2023; Newsome & Hassell, 2014). In Masoala National Park, the participation of local guides exemplifies how ecotourism can foster environmental awareness while strengthening economic resilience (Ormsby & Mannle, 2006). Partnerships between local actors and international organizations further enhance these outcomes, making biodiversity—particularly iconic species such as lemurs—an ecological and economic asset (Buckley, 2014). Nonetheless, excessive dependence on tourism revenues remains a risk, particularly in times of political instability or global crises. Diversification of funding sources and robust governance frameworks are therefore essential to sustain the dual objectives of conservation and development (Andrianambinina et al., 2023). Madagascar's biological wealth, however, faces severe ecological and socio-economic pressures. Over 90% of the island's flora and fauna are endemic, including 11,516 vascular plant species (82% endemic), 69 lemur species, and very high rates of endemism among mammals and reptiles (Antonelli et al., 2022). Yet, deforestation, agricultural expansion, and overexploitation threaten approximately 62.1% of vertebrate species (Ralimanana et al., 2022). Although a protected area network exists, it covers only 10.4% of the national territory—insufficient to ensure comprehensive biodiversity protection (Ralimanana et al., 2022).

In this context, ecotourism appears as a strategic path for reconciling conservation imperatives and socio-economic needs. By generating income and raising environmental awareness, it contributes to biodiversity protection and rural livelihoods (Culbertson et al., 2022), provided that sustainable practices align local development priorities with conservation goals (Ranarijaona et al., 2022).

The Atsimo-Andrefana region in southwestern Madagascar epitomizes this ecological and developmental duality. Its exceptional biodiversity results from a combination of geological, climatic, and ecological factors. The continental rift escarpment has shaped a mosaic of habitats conducive to allopatric speciation (Liu et al., 2024), while past climatic and watershed dynamics have fostered high levels of local endemism (Pearson & Raxworthy, 2009; Wilmé et al., 2006). Variations in rainfall, vegetation structure, and microclimates further explain the remarkable microendemism observed in many taxa (Faliarivola et al., 2022; Wilmé et al., 2006). However, these fragile ecosystems are increasingly threatened by human activities and climate change, necessitating integrated conservation measures that consider both ecological complexity and socio-economic realities.

Despite these natural assets, 68% of the region's population lives below the poverty line<sup>3</sup>, and fewer than 15% of ecotourism sites have adequate infrastructure<sup>4</sup>. Local communities—particularly the Vezo fishers and Mahafaly agro-pastoralists—are highly vulnerable to resource scarcity and climate variability. Against this backdrop, this study examines how ecotourism can reconcile sustainable development with the valorization of natural resources in the Atsimo-Andrefana region. It aims to identify the conditions under which ecotourism can serve as a lever for balanced growth capable of simultaneously addressing conservation imperatives and improving local well-being.

The objectives of this article are as follows:

- To assess the impact of environmental education programs on the natural resource management practices of local actors, by measuring their contribution to reducing anthropogenic pressures (deforestation, overexploitation of coral reefs).
- To analyze the material (unique ecosystems, sustainable crafts) and immaterial (Vézo traditional knowledge, Mahafaly rituals) ecotourism potentials in order to identify economically viable and ecologically responsible valorization niches.
- To propose a framework for integrated governance involving local communities, public institutions, and technical partners, aiming to position ecotourism as a pillar of sustainable regional development, aligned with the Sustainable Development Goals.

<sup>3</sup> <https://www.worldbank.org/en/country/madagascar/publication/madagascar-afe-poverty-assessment-navigating-two-decades-of-high-poverty-and-charting-a-course-for-change> visited on 20 October 2025.

<sup>4</sup> <https://instat.mg/region/atsimo-andrefana> visited on 20 October 2025.

## 2. MATERIALS ET METHODS

The Atsimo-Andrefana region, encompassing an area of 66,502 km<sup>2</sup>, is administratively subdivided into nine districts: Toliara I, Toliara II, Morombe, Bereroha, Ankazoabo, Betioky Sud, Ampanihy, Sakaraha, and Benenitra. This spatial configuration reflects a diverse array of ecological zones and socio-cultural landscapes, providing a complex context for the study of ecotourism as a mechanism for sustainable regional development.

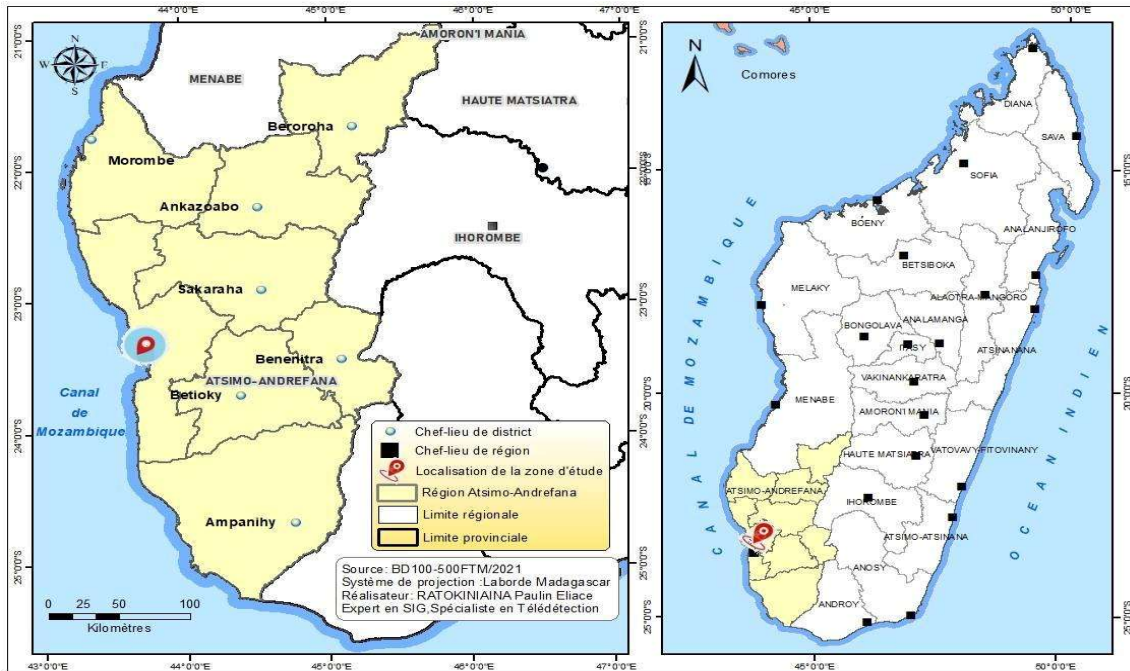


Figure 1: Delimitation of the Atsimo-Andrefana Region

Source: BD 100-500FTM

This region is geographically bounded by the following coordinates:

- Latitude: between 21°66' and 24°72' South
- Longitude: between 43°47' and 45°47' East

Table 1: Area of the Districts within the Region

District	Area in km <sup>2</sup>
Ampanihy (West)	13,253
Ankazoabo	8,834
Benenitra	4,741
Bereroha	6,723
Betioky (Sud)	10 079
Morombe	7 109
Sakaraha	8 160

Toliara I	282
Toliara II	7 321
Total région	66 502

Source : MEEI/CREAM/Monographie, 2014

## 2.1 Research Activities Conducted within the Scope of the Study

This study was structured around a rigorous methodology organized into three distinct yet complementary phases, allowing for a comprehensive approach to the ecotourism issue in the Atsimo-Andrefana region. The first phase of the research, devoted to the literature review, followed a systematic approach aimed at assembling an interdisciplinary corpus on ecotourism in the Atsimo-Andrefana region. This stage combined a critical analysis of academic and institutional literature with the utilization of geospatial and socio-economic data. The collected documents included technical reports from the World Bank and UNDP, management plans for protected areas published by Madagascar National Parks (including that of Tsimanampesotse National Park, 2021), Scopus-indexed journal articles, and doctoral theses from the University of Toliara analyzing local dynamics (2017–2022).

The analysis was guided by the *5W1H* methodological framework (*Who, What, When, Where, How, Why*), rigorously applied to each document. The “*Who*” dimension identified key actors (WWF, Madagascar National Parks, local communities), while “*What*” categorized conservation strategies in relation to the Sustainable Development Goals (*SDG 8 and 15*). The temporal aspect (“*When*”) cross-referenced historical data, such as deforestation rates between 2000 and 2023, with recent policies. The spatial dimension (“*Where*”) was specified through georeferencing of ecotourism sites using QGIS, based on the BD100 database. Methods (“*How*”) were assessed via a critical grid evaluating the representativeness of samples in previous studies, and the “*Why*” dimension highlighted research gaps, particularly regarding the role of women in ecotourism governance.

The data were integrated into a relational knowledge database (Microsoft Access), organized along three axes: thematic (biodiversity, economy, governance), geographic scale (local to national), and reliability (authors’ h-index, source type). This database was validated through three collaborative workshops with experts from CIRAD and CNRE, ensuring its robustness. Interim results included mapping of resource-use conflicts and the development of a conceptual model incorporating the sustainability triangle (*environment, economy, social*), adapted to the specific cultural context of the Mahafaly.

Methodologically, this phase was innovative in combining grounded theory for qualitative analysis with participatory mapping tools involving local communities. This approach not only anchored the research within a robust theoretical framework but also identified concrete levers for subsequent field survey phases, such as the need to examine the impact of gender inequalities on resource management.

The second phase, conducted from July to September 2023, represented a decisive stage in this study, focusing on in-depth field surveys. These investigations were carefully planned to collect qualitative data from a broad range of stakeholders, with the aim of understanding the complex dynamics and specific challenges associated with ecotourism development in the Atsimo-Andrefana region. The adopted methodology relied on a multisectoral and participatory approach, enabling the inclusion of diverse categories of stakeholders. Interviews were conducted with six main groups:

- *Representatives of the territorial and tourism administration*: Semi-structured interviews were conducted with key members of the regional offices of tourism, environment, and social affairs. These actors provided valuable insights into public policies, existing investments, and strategic priorities in ecotourism.
- *Tourism sector professionals*: Special attention was given to hotel managers, lodge operators, restaurateurs, and tour circuit managers. These discussions helped identify operational challenges they face, such as limited infrastructure, training needs, and tourist expectations.
- *Tour guides and local operators*: Their essential role in mediating between visitors and the ecosystem was examined to better understand their perceptions of current practices and opportunities for natural resource valorization.

- *Local population:* Surveys conducted with fishers, artisans, and local craft vendors captured the direct and indirect impacts of ecotourism on livelihoods. For instance, artisans shared their perspectives on the valorization of cultural products, while fishers highlighted conflicts between marine conservation and subsistence needs.
- *Representatives of local and international NGOs:* These actors, involved in biodiversity conservation and community development, shared specific data on ongoing projects, their outcomes, and transferable best practices.
- *Tourists:* Although fewer in number due to seasonality, some visitors were interviewed to analyze their expectations, satisfaction, and perception of the region.

The interview modalities were adapted to ensure optimal geographic coverage across the districts of Atsimo-Andrefana. Face-to-face meetings, prioritized in rural and coastal areas (notably villages along RN9 and key sites such as Ifaty, Anakao, and Toliara), enabled direct interaction with local populations in their environment. Additionally, telephone interviews were conducted with actors who were difficult to reach or located in remote areas, to gather supplementary information.

To structure the surveys, a semi-structured interview guide was developed in advance, incorporating open-ended and thematic questions organized around four main dimensions:

- *Governance and ecotourism policies* in the region.
- *Valorization of natural and cultural resources* through ecotourism activities.
- *Socio-economic impacts* on local communities and stakeholders.
- *Environmental challenges*, particularly regarding conservation and sustainability.

The diversity of respondents and analytical contexts allowed for a holistic and multidimensional understanding of the current state of ecotourism in the region. The qualitative feedback collected was carefully transcribed, classified, and synthesized to analyze emerging trends and to code key responses.

The third and final phase, conducted from October to December 2023, was dedicated to an in-depth analysis of the collected data. This period enabled the processing, examination, and synthesis of all information gathered. The analytical work culminated in the preparation of scientific articles, facilitating the dissemination and valorization of the research findings. This phase also allowed for cross-referencing of different information sources, thereby ensuring the reliability and relevance of the conclusions drawn.

## 2.2 Rationale for the Selection of Study Sites

The selection of study sites for this project was guided by a set of scientific, practical, and socio-cultural criteria, structured to maximize the relevance of the analyses and the impact of the study's recommendations. These sites were chosen for their capacity to exemplify the unique characteristics and challenges that the Atsimo-Andrefana region presents in the domains of ecotourism and conservation.

- *Exceptional Ecological Value: Convergence of Biodiversity and Uniqueness*

The selected sites were chosen for their outstanding ecological significance, reflecting the Atsimo-Andrefana region's status as a global biodiversity hotspot with high levels of endemism. These locations harbor rare and unique species, offering invaluable opportunities for both scientific research and ecotourism development. Ecosystems such as spiny forests, mangroves, and coral reefs coexist, providing a multifaceted natural environment that can support immersive visitor experiences while serving as critical sites for conservation.

Sites like Tsimanampetsotsa National Park and the coral reefs of Ifaty exemplify living laboratories where the intricate interactions between terrestrial and marine systems can be studied. They offer unique insights into ecological resilience and the consequences of human activities, including deforestation, artisanal fishing, and reef exploitation, making them particularly relevant for research on sustainable ecotourism practices.

- *Existing Management Structures to Foster Best Practice*

A key criterion for site selection was the presence of established management structures, including those overseen by Madagascar National Parks (MNP) and various local and international non-governmental organizations. These frameworks already facilitate coordination among stakeholders, enabling more effective implementation and monitoring of ecotourism initiatives.

Moreover, the sites offer a certain degree of accessibility, a critical factor for promoting inclusive and sustainable ecotourism. Unlike entirely remote areas, these locations are served by primary or secondary transport routes which, although sometimes rudimentary, remain navigable for both adventurous domestic and international visitors. This relative accessibility, combined with nearby tourism hubs such as Toliara, ensures that the sites can simultaneously meet the needs of researchers and support local communities that rely on tourism-generated income.

- *Cultural and Traditional Significance: Heritage at the Core of Local Dynamics*

These sites extend beyond their environmental value, representing key centers of cultural identity for local communities. Traditional rites, beliefs, and practices are deeply intertwined with the natural environment, imbuing landscapes with sacred significance. For instance, sacred caves and forests preserve ancestral narratives that reflect the region's rich intangible heritage.

Including these elements in the study allows for a nuanced understanding of the interplay between biodiversity conservation and local culture. It also highlights potential models for integrating ecotourism as a means of safeguarding traditions. Collaboration with local communities, such as the Vezo and Mahafaly, provides a unique opportunity to explore how their traditional knowledge and sustainable practices can be effectively valorized within ecotourism initiatives.

- *A Living Laboratory for Socio-Economic Sustainability*

Finally, these sites serve as ideal settings for examining, within a real-world context, the dynamics between environmental conservation and socio-economic development. The juxtaposition of resource-rich ecosystems and local communities that depend directly on these resources provides a unique opportunity to study sustainable interactions. The selected sites thus function as microcosms rich in insights, enabling both a detailed analysis of current challenges and the identification of concrete strategies to foster harmonious and resilient ecotourism.

### **2.3 Sampling and Data Collection**

To thoroughly explore the ecotourism dynamics in the Atsimo-Andrefana region, a stratified sampling approach was employed, encompassing a total of 70 participants. This methodology was chosen to ensure a balanced and diverse representation of the various stakeholders involved in ecotourism, while also accounting for logistical constraints and limited resources.

The sample size was determined based on the study's objectives, which required both a detailed understanding of local actors' perceptions and sufficient representativeness to allow for conclusions generalizable across the region. The theoretical framework of data saturation—where responses begin to repeat and yield no new information—was also used to guide the determination of this sample.

Furthermore, the choice of stratified sampling was justified by the need to integrate complementary perspectives from different stakeholder groups, each playing a distinct role or having unique interactions with the ecotourism sector. Participants were therefore thoughtfully and purposefully distributed across three main categories:

- *Local Community Members (n = 40)*: Local communities form the cornerstone of ecotourism dynamics, as they live in and directly interact with the natural and cultural resources that serve as tourist attractions. Among the 40 selected participants were fishers, farmers, artisans, and local vendors. Representing over 50% of the total sample, this group reflects the emphasis placed on their daily experiences, which are often overlooked or underrepresented in tourism management policies.

- *Tourism Operators (n = 10)*: This group included guides, hotel owners, and travel agency managers, who play a central role in the utilization of natural sites for tourism activities and provide economic and organizational perspectives.

- *Local and Regional Authorities (n = 14)*: These participants primarily comprised municipal leaders (mayors, fokontany chiefs) and officials responsible for tourism and environmental management. Their contributions provided insights into the implementation of public policies and perceptions of sustainable initiatives.

- *Conservation Experts (n = 6)*: Including academics, researchers, and protected area managers, this group offered expert guidance on environmental challenges and strategies for natural resource protection.

This sampling strategy ensured a diversity of perspectives, enabling a comprehensive analysis of the interactions between ecotourism, conservation, and economic development. Data collection in the field employed a mixed-methods approach, integrating qualitative and quantitative tools to capture the nuances of local perceptions and behaviors.

#### *Structured Questionnaires:*

A questionnaire was developed around the study's three main variables: Environmental Education (EE), Valorization of Ecotourism Products (VPE), and Conservation of Natural Resources (CRN). The questions were designed to collect both quantitative data (using a five-point Likert scale) and qualitative insights through open-ended responses.

#### *Semi-Structured Interviews*

Semi-structured interviews focused on participants' experiences and perceptions. They were conducted with local authorities, conservation experts, and a randomly selected subset of local community members. Each interview lasted approximately 45 minutes, allowing for in-depth exploration of topics such as the economic benefits of ecotourism and its impact on traditional practices.

#### *Direct On-Site Observations*

Field visits were organized to priority areas, including Tsimanampetsotsa National Park, the Mikea Forests, and the Nosy-Ve Marine Reserve. Observations provided factual data on the condition of ecotourism infrastructure, human impacts on ecosystems, and local practices.

#### *Variables Studied*

Three primary variables were analyzed to address the research objectives and to gain a nuanced understanding of ecotourism dynamics in Atsimo-Andrefana. These variables encompass educational, socio-economic, and environmental dimensions and were examined using precise, measurable indicators for rigorous analysis.

- *Environmental Education (EE)*

This variable measures the awareness and capacity of local communities to integrate environmental preservation principles into their daily practices. Environmental education is crucial in ecotourism projects as it promotes sustainable behavioral change among populations residing near protected natural sites. Analysis identified both barriers and enablers, including the role of community leaders, local educational structures, and external partners such as NGOs in promoting ecological knowledge.

- *Valorization of Ecotourism Products (VPE)*

This variable examines the socio-economic impact of ecotourism activities, focusing on the valorization of cultural, artisanal, and ecological products associated with tourist sites. Economic valorization extends beyond direct site use to include the promotion of local knowledge and skills as a core component of the ecotourism model. This analysis highlighted potential imbalances in economic benefits among local stakeholders and persistent challenges, such as limited infrastructure and insufficient diversification of tourist offerings.

- *Conservation of Natural Resources (CRN)*

This variable assesses conservation practices linked to ecotourism initiatives and their perceived impact by stakeholders. Findings revealed a complex interaction between environmental protection and local socio-economic interests. For example, some

conservation initiatives, while ecologically effective, generated tensions by restricting access to resources such as fishing areas or firewood. The analysis informed recommendations for more inclusive and collaborative conservation approaches.

#### Data Analysis

Collected data were processed and analyzed using XLSTAT, recognized for advanced statistical capabilities. Analytical procedures included calculating Pearson's correlation coefficient ( $r$ ), a statistical measure evaluating the strength and direction of the linear relationship between two qualitative variables.

The formula used to compute ( $r$ ) is as follows:

Formula 1 :

$$r = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum (y_i - \bar{y})^2 \sum (x_i - \bar{x})^2}}$$

Où :

- Where  $x_i$  and  $y_i$  represent the values of the variables xxx and yyy, respectively.
- Where  $\bar{x}$  and  $\bar{y}$  denote the means of xxx and yyy, respectively.

Frequency tables and statistical indicators (mean, median, standard deviation) were generated for an initial interpretation of the results. Pearson's correlation coefficient was employed to identify significant relationships between the studied variables. For instance, a strong correlation between the valorization of ecotourism products and the conservation of natural resources could indicate the positive impact of ecotourism initiatives on environmental preservation.

#### Variable testing (ANOVA)

- *Multivariate Analyses*

A multiple linear regression analysis was conducted to examine the combined impact of the variables EE and VPE on CRN outcomes.

Formula 2:  $CRN = \beta_0 + \beta_1 \cdot EE + \beta_2 \cdot VPE + \epsilon$

Where

- CRN: Dependent variable (conservation score, measured on a scale from 0 to 10).
- EE: Independent variable (environmental education score, normalized).
- VPE: Independent variable (annual ecotourism revenue in USD per capita).
- $\beta_0$ : Intercept (baseline CRN value without intervention).
- $\beta_1, \beta_2$ : Regression coefficients (marginal impact of each independent variable).
- $\epsilon$ : Random error term.

#### Data Reliability

To ensure the quality and reliability of the collected information, the following measures were implemented:

- *Cross-Verification of Information*: Survey results were compared with direct field observations and secondary data obtained from relevant documents.
- *Questionnaire Pre-Testing*: Prior to deployment, the questionnaires were validated by a pilot group of five experts to ensure clarity, relevance, and appropriateness of the questions.

### 3. FINDINGS

This section presents the findings of a comprehensive study conducted with a total of 70 participants, distributed across four key stakeholder categories: local communities, tourism operators, local authorities, and conservation experts. The primary objective of this analysis was to assess the interactions and impacts among three core variables — Environmental Education (EE), Ecotourism Product Valorization (EPV), and Natural Resource Conservation (NRC) — within the broader ecotourism context of the Atsimo-Andrefana region.

#### 3.1 Categories of Participants Based on Environmental Activities

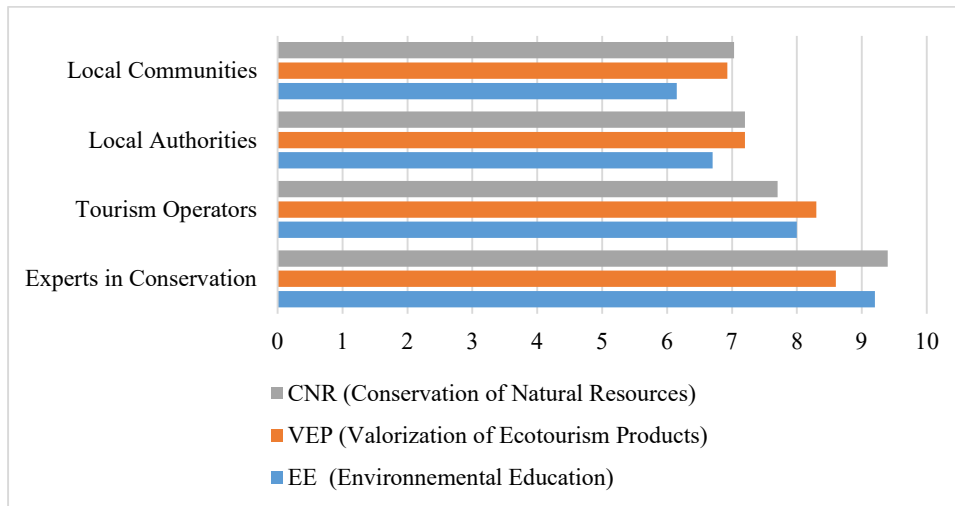


Figure 2: Participant Categories Based on Environmental Activities

Conservation experts consistently achieved the highest scores across all three dimensions (EE, VEP, and CNR), reflecting their deep understanding of environmental issues and active involvement in conservation initiatives. Tourism operators scored highly in the valorization of ecotourism products, highlighting their key role in sector development. In contrast, local authorities and community members recorded lower scores, revealing gaps in the adoption and implementation of ecotourism and conservation principles.

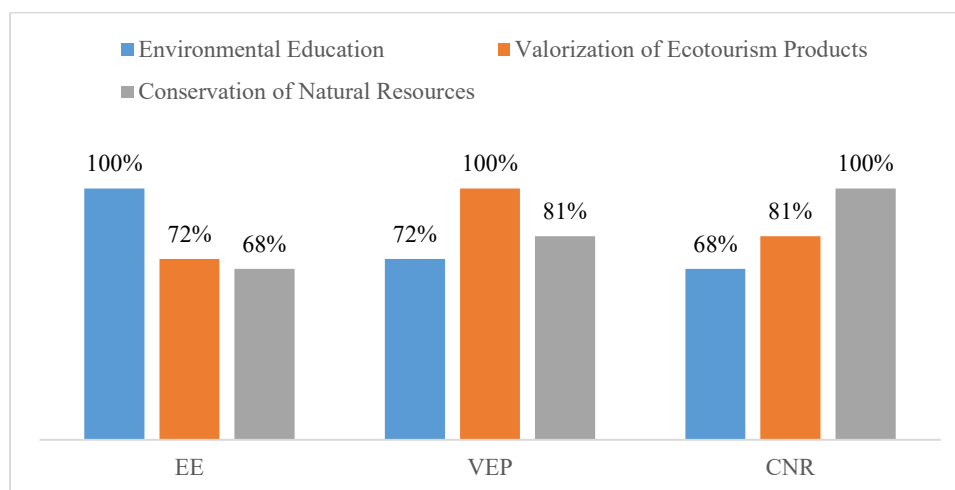


Figure 3: Correlation Matrix of Environmental Activities

All correlations are positive and highly significant. The strongest correlation is observed between VEP and CNR ( $r = 0.81$ ). EE shows a moderate to strong correlation with the other variables. These findings indicate a strong interdependence among the three dimensions.

### 3.2 Current State of Ecotourism in the Region

The Atsimo-Andrefana region, located in southwestern Madagascar, holds substantial potential for ecotourism development. However, this potential remains underutilized due to various socio-economic challenges, environmental degradation, and a lack of adequate infrastructure. Recent data (2022–2023) indicate that the main ecotourism attractions have experienced relatively low visitor engagement, reflecting a modest growth trajectory:

- *Tsimanampetsotse National Park*: Recording an annual visitation of 3,200 tourists, this park exemplifies a high-ecological-value destination. Despite its rich biodiversity, including flamingos and numerous endemic species, the park struggles to attract more visitors due to limited accessibility and insufficient promotional efforts.
- *Mikea Forest*: With only 1,800 visitors per year, Mikea Forest is a site deeply embedded in the cultural traditions of the indigenous Mikea communities. However, uncontrolled exploitation of forest resources threatens the delicate balance of its ecosystem.
- *Nosy-Ve*: This idyllic island, attracting 2,500 visitors annually, is renowned for its crystal-clear waters and marine biodiversity. Yet, initiatives to establish it as a model of sustainable ecotourism remain insufficient.

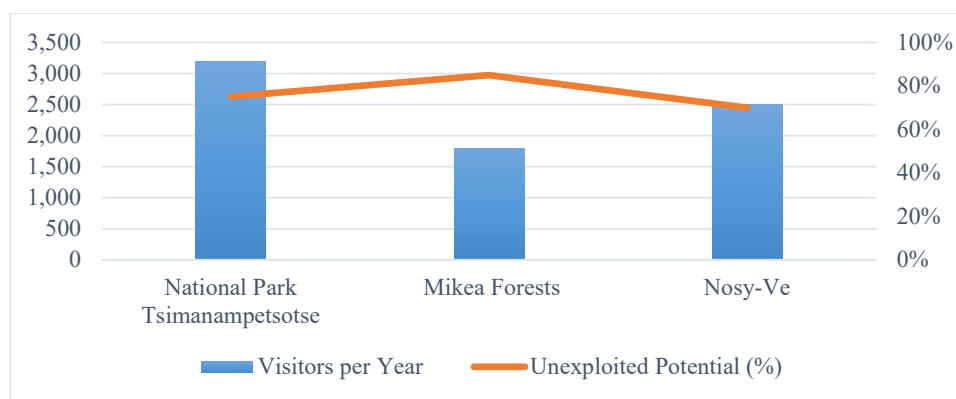


Figure 4: Current Assessment of Ecotourism

This assessment highlights the region's marginal participation in the global ecotourism market despite its unique opportunities. Fully leveraging these assets requires a concerted effort involving local communities, the enhancement of infrastructure, and the strengthening of governance frameworks.

### 3.3 Impact of Environmental Education

Environmental education efforts in the region have led to significant progress in raising awareness about ecological issues and the conservation of natural resources. These programs have proven to be powerful levers for engaging local communities in the preservation of their natural heritage.

#### *Correlation between Education and Conservation*

The study reveals a notable correlation ( $r = 0.81$ ) between the implementation of environmental education programs and the reduction of activities detrimental to ecosystems.

The outcomes of these education initiatives indicate:

- *Understanding of Environmental Issues:* 65% of community members who participated in training reported an improved understanding of the environmental impacts of their activities.
- *Reduction of Destructive Activities:* In localities where environmental education is actively implemented, a 40% decrease in practices such as illegal logging and unregulated hunting was observed.
- *Local Conservation Initiatives:* There was a 35% increase in locally initiated conservation projects, including the establishment of nurseries, and the management of beaches and fishing areas.

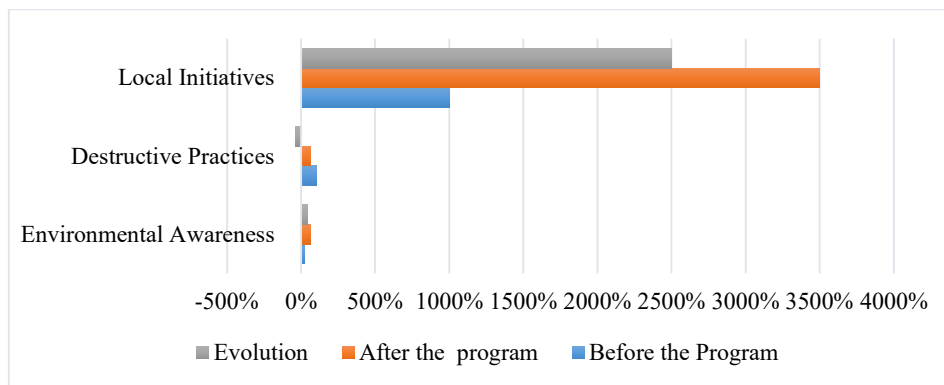


Figure 5: Depiction of the Relationship between Environmental Education and Conservation

These results underscore the critical role of education as a tool for social transformation. By raising awareness among local populations, such programs not only safeguard ecosystems but also foster a positive dynamic for sustainable socio-economic development grounded in the valorization of natural resources.

### 3.4 Valorization of Ecotourism Products

The promotion of ecotourism products plays a fundamental role in fostering local economic development while enhancing the sustainability of tourism-related activities. The analyzed data reveal a strong and significant positive correlation ( $r = 0.76$ ) between the promotion of ecotourism products and the improvement of local incomes, resulting in a tangible socio-economic impact in the Atsimo-Andrefana region.

#### Direct Economic Impacts

Initiatives aimed at promoting local products, such as handicrafts, guided excursions, and eco-friendly lodging services, have generated significant economic benefits for local communities:

- *Increase in household income:* An average increase of 45% in income was observed among households directly or indirectly involved in ecotourism-related activities. This growth highlights the sector's potential to serve as a sustainable livelihood source for local populations.
- *Job creation:* Ecotourism facilitated the creation of 200 direct jobs, ranging from trained professional guides to staff employed in lodges and local restaurants. These positions stimulate the local economy while enhancing long-term employment prospects.

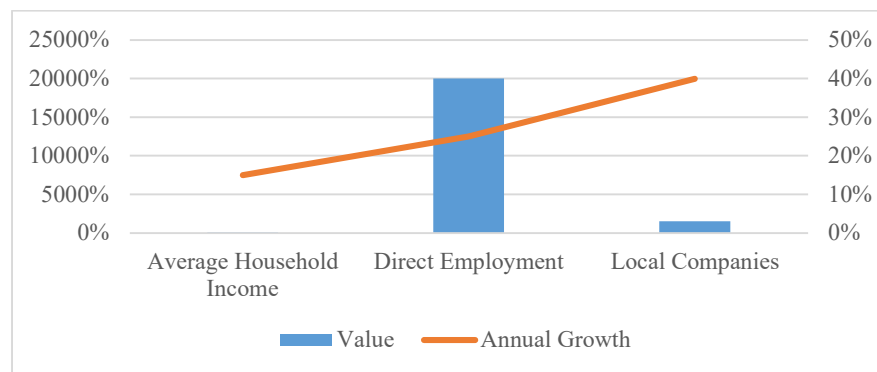


Figure 6: Economic Outcomes of Ecotourism

- *Promotion of Local Handicrafts:* The data also indicate that 15 new handicraft initiatives have emerged, highlighting products derived from traditional know-how, such as items made from sustainable materials like sisal and raffia.

### 3.5 Challenges and Recommendations for Sustainable Promotion

However, to maximize the added value of these ecotourism products, it is necessary to strengthen:

- *Promotion of local tourism circuits:* Efforts should focus on attracting more visitors interested in authentic and environmentally responsible offerings.
- *Public-private partnerships:* Collaboration with national agencies and NGOs is essential to develop programs that enhance skills within local communities.
- *Standardization of ecotourism products:* Establishing a strong regional identity for these products is crucial to ensure their competitiveness in national and international markets.

### 3.6 Conservation of Natural Resources

The sustainability of ecotourism in the region can only be ensured through sustained efforts in ecosystem conservation, particularly in protected areas and sites used for tourism activities. The study highlighted significant progress in the sustainable management of natural resources:

- *Sustainable Management Plans for Ecotourism Sites*

Data indicate that 70% of ecotourism sites in the region, such as Tsimanampetsotse National Park and the Mikea Forest, now benefit from sustainable management plans. These plans incorporate eco-responsible practices, including regulating tourist flows, preventing environmental degradation, and involving local communities in the monitoring of natural sites.

- *Reduction of Deforestation and Protection of Territories*

The combined efforts of local stakeholders, authorities, and technical partners have contributed to the following outcomes:

- *30% Reduction in Deforestation:* This decrease is primarily observed in community-managed forests and sensitive tourism areas, thanks to awareness campaigns and actively supported reforestation efforts.

- *25% Increase in Protected Areas:* The expansion of protected zones reflects a strategic commitment to preserving natural habitats, particularly for threatened endemic species, such as the marine turtles of Nosy Ve and the giant baobabs found in several sites across the region.

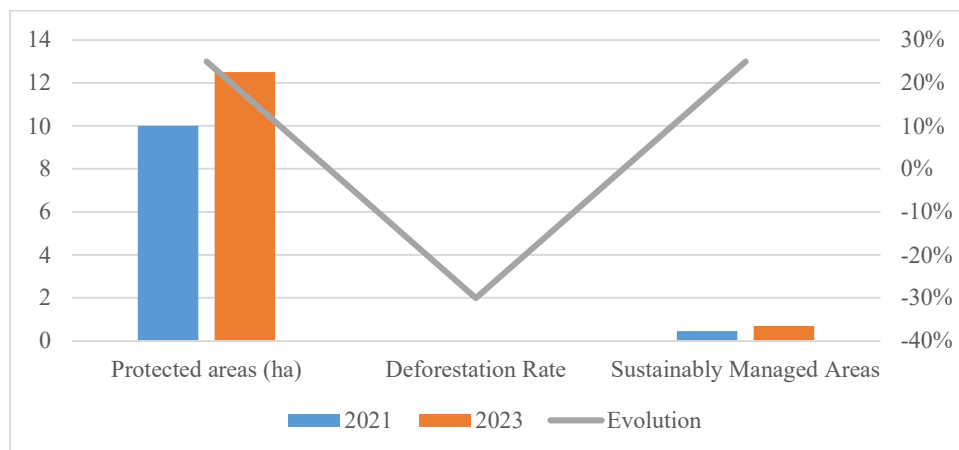


Figure 7: Conservation Indicators (2021-2023)

#### Towards Harmonizing Ecotourism and Conservation

The conservation of natural resources must be regarded as the foundation upon which ecotourism in the Atsimo-Andrefana region is built. To achieve this, sector stakeholders should:

- *Maintain community education programs:* Facilitate the dissemination of best practices in sustainable resource management.
- *Establish technological partnerships:* Implement monitoring of critical areas, including the use of drones to oversee deforestation and poaching activities.
- *Promote a participatory approach:* Involve local communities in all stages of management, from the development of plans to their implementation.

#### 4. DISCUSSION

The analysis of data collected during this research provides crucial insights into the underlying mechanisms driving ecotourism development in the Atsimo-Andrefana region. These findings corroborate previous studies while offering new perspectives on the interrelationship between education, conservation, and economic development.

##### 4.1 Synergy between Environmental Education and Natural Resource Conservation

A strong statistical correlation ( $r = 0.82$ ) was observed between environmental education and conservation initiatives, indicating that awareness plays a central role in the sustainable management of natural areas. The results demonstrate that better-informed communities, particularly regarding ecological management practices, are more likely to adopt responsible behaviors that promote ecosystem preservation.

The implementation of educational programs, including regular training on natural resource protection and the engagement of younger generations in environmental issues, proves to be pivotal. These findings align with Culbertson et al. (2022) and Ranarijaona et al. (2022), who demonstrated that targeted educational initiatives can significantly enhance community participation in conservation efforts. Moreover, local initiatives, such as those conducted within protected areas in the Atsimo-Andrefana region, exemplify the positive impact of education on mitigating the adverse effects of human activities (Wilmé et al., 2006; Faliarivola et al., 2022).

Nevertheless, these educational efforts face notable challenges. Limited access to teaching resources and logistical means sometimes constrains the effectiveness of educational actions. Therefore, it is imperative to strengthen partnerships among NGOs, local

institutions, and government bodies to develop didactic tools tailored to the local context. Special attention should also be given to ensuring the sustainability of these programs, particularly in ecologically vulnerable areas.

The analysis of economic data reveals a significant upward trend: household incomes in regions actively engaged in ecotourism initiatives increased by an average of 45%. This figure highlights the potential of ecotourism as a driver of local economic development. These findings corroborate the conclusions of Ormsby & Mannle (2006) and Newsome & Hassell (2014), who emphasized ecotourism's role in supporting local livelihoods and stimulating economic activity in communities with limited traditional income sources.

The economic impacts extend beyond mere income growth. Field observations indicate:

- *Creation of direct and indirect employment:* Ecotourism has generated job opportunities ranging from lodging management and visitor reception to artisanal production of local crafts for tourists. On average, over 200 positions were recorded in these complementary sectors within the Atsimo-Andrefana region.
- *Diversification of economic activities:* The growing importance of ecotourism encourages local entrepreneurs to diversify their offerings (e.g., ecological tours, unique accommodations) and motivates rural populations to participate in the value chain, as evidenced by various community projects in the area.

However, these economic developments are accompanied by notable challenges. Fluctuations in tourist arrivals—often influenced by factors such as Madagascar's political instability or global health crises—can affect the sustainability of income gains. Additionally, ensuring equitable revenue distribution remains critical to prevent the sector's benefits from being captured by external investors at the expense of local communities.

#### **4.2 Ecotourism as a Lever for Conservation and Socio-Economic Development**

The findings confirm that ecotourism in the Atsimo-Andrefana region serves as a dual mechanism, simultaneously supporting biodiversity conservation and local socio-economic development. Tourism revenues contribute to the management of protected areas while offering economic incentives that encourage communities to engage in sustainable practices (Andrianambinina et al., 2023; Newsome & Hassell, 2014). Similar trends have been observed in other biodiversity hotspots, such as Madagascar's eastern rainforests and Costa Rica's Monteverde Reserve, where ecotourism fosters community participation and generates alternative livelihoods (Buckley, 2014).

Local engagement in guiding, hospitality, and site management enhances environmental stewardship by creating tangible benefits for those directly interacting with ecosystems (Ormsby & Mannle, 2006). In addition, the participation of diverse stakeholders—ranging from local authorities to NGOs—ensures a multidimensional approach to ecotourism governance, which aligns with global best practices for sustainable tourism development (Thomas & Mefalopulos, 2009). The results highlight that ecotourism acts as an economic driver and a social catalyst, fostering collaboration, equity, and long-term ecological protection.

#### **4.3 Environmental Education and Conservation Behavior**

Environmental education emerged as a significant predictor of conservation outcomes in the region. The study revealed a strong positive correlation ( $r = 0.81$ ) between environmental education programs and reductions in destructive practices such as illegal logging, overfishing, and unregulated hunting. Approximately 65% of trained community members reported a better understanding of environmental impacts, while 35% initiated local conservation projects, including nurseries and community-managed protected areas (Culbertson et al., 2022; Ranarijaona et al., 2022). These findings are consistent with previous research indicating that targeted educational interventions can transform local behavior, enhance ecological literacy, and reinforce the long-term sustainability of natural resource management (Chambers, 1994; Pearson & Raxworthy, 2009). In regions like Atsimo-Andrefana, characterized by high endemism and micro endemism, education not only raises awareness but also equips communities with the knowledge and skills to mitigate human-induced threats, particularly in fragile ecosystems such as spiny forests, mangroves, and coral reefs (Wilmé et al., 2006; Liu et al., 2024).

#### 4.4 Valorization of Ecotourism Products and Local Livelihoods

The promotion of ecotourism products significantly contributes to household income, job creation, and local entrepreneurship. The study documented a 45% average income increase among households involved in tourism-related activities, alongside the creation of 200 direct jobs in guiding, eco-lodges, and handicraft production. Additionally, the emergence of 15 new artisanal initiatives illustrates the potential of ecotourism to integrate traditional knowledge and cultural heritage into sustainable economic development (Ormsby & Mannle, 2006; Antonelli et al., 2022).

The positive correlation observed between product valorization and income ( $r = 0.76$ ) is in line with global evidence showing that well-managed tourism products can stimulate economic diversification while preserving cultural identity (Ashley & Roe, 2001; Spenceley, 2010). However, the results also indicate that the distribution of benefits remains uneven; highlighting the need for targeted interventions such as capacity building, market access enhancement, and standardization of ecotourism products to ensure inclusivity and equitable growth (Scheyvens, 2002).

#### 4.5 Conservation of Natural Resources

Sustainable management of ecotourism sites is critical for maintaining biodiversity and ecosystem integrity. Approximately 70% of priority sites—including Tsimanampetsotse National Park, Mikea Forest, and Nosy-Be—now implement formal management plans encompassing eco-responsible practices, tourist flow regulation, and community participation (Faliarivola et al., 2022; Wilmé et al., 2006). These measures have led to a 30% reduction in deforestation in community-managed forests and a 25% increase in protected zones.

This demonstrates that ecotourism can be effectively aligned with conservation objectives when underpinned by strong governance and participatory approaches (Buckley, 2014; Newsome & Hassell, 2014; Souther et al., 2023). Integration of traditional ecological knowledge and adaptive management practices further strengthens site resilience against anthropogenic pressures and climate variability (Pretty et al., 2009; Pearson & Raxworthy, 2009). Overall, the data support the concept that conservation and economic development can be mutually reinforcing when local communities are active participants in management processes.

#### 4.6 Challenges and Opportunities for Sustainable Ecotourism

Despite the ecological and economic potential, significant barriers remain. About 68% of the population lives below the poverty line, and less than 15% of ecotourism sites have adequate infrastructure, which constrains visitor engagement and limits socio-economic benefits (Antonelli et al., 2022; Ralimanana et al., 2022). In addition, climate change, habitat degradation, and overexploitation pose ongoing risks to both tourism sustainability and biodiversity conservation (Faliarivola et al., 2022; Liu et al., 2024).

Addressing these challenges requires integrated strategies, including diversification of income sources, capacity-building programs, and improved monitoring technologies such as remote sensing and drone surveillance (Thomas & Mefalopulos, 2009; Scheyvens, 2002). Collaborative partnerships among local communities, governmental agencies, NGOs, and private operators are essential to create resilient ecotourism systems capable of sustaining both livelihoods and ecological integrity.

#### 4.7 Towards Integrated and Inclusive Ecotourism

The findings underscore that ecotourism in Atsimo-Andrefana can serve as a model for integrated natural resource valorization and sustainable development. Combining environmental education, cultural heritage valorization, participatory governance, and robust conservation strategies provides a pathway to balance ecological preservation with socio-economic growth (Andrianambinina et al., 2023; Buckley, 2014; Culbertson et al., 2022). To maximize impact, stakeholders should adopt multi-level approaches that integrate scientific research, local knowledge, and policy frameworks. This includes strengthening institutional coordination, promoting equitable benefit-sharing, and developing standardized ecotourism products that appeal to both domestic and international tourists (Souther et al., 2023; Scheyvens, 2002). When effectively implemented, these strategies can transform ecotourism into a powerful lever for inclusive and resilient development in Atsimo-Andrefana.

## 5. CONCLUSION

This research highlights the structuring role that ecotourism can play in the Atsimo-Andrefana region. Not only does it represent a promising pathway toward sustainable development, but it also offers a viable solution for enhancing natural resource value while improving the living conditions of local populations. This duality—combining economic development with environmental preservation—requires integrated strategies, rigorous planning, and the active involvement of multiple stakeholders.

The study reaffirms that environmental education is a fundamental pillar in the development of sustainable ecotourism. By raising community awareness of the importance of conserving natural resources, environmental education fosters responsible behaviors and contributes to the sustainable management of ecosystems. The collected data demonstrate that areas benefiting from structured educational programs display stronger indicators of ecological preservation and community participation.

The integration of local communities into the valorization of ecotourism products—such as eco-guiding, handicrafts, and other income-generating activities—is essential to improving their economic well-being. Our findings show that the diversification of ecotourism offers not only strengthens the income of vulnerable populations but also reduces pressures on natural resources caused by unsustainable practices such as land overuse and deforestation.

The active engagement of local stakeholders in the design and implementation of ecotourism projects has emerged as a key factor for long-term success. Participatory governance ensures that projects are better aligned with the actual needs of communities while promoting their ownership of the initiatives. This approach helps establish a balance between the economic valorization of resources and their long-term preservation. From this perspective, one critical question remains open: *how can institutional and educational mechanisms be further strengthened to enhance the effective participation of local communities, thereby consolidating a sustainable model of ecotourism in the Atsimo-Andrefana region?*

Future studies should explore longitudinal approaches to better capture the long-term impacts of ecotourism on both ecosystems and local livelihoods. Comparative analyses between different regions of Madagascar would also provide valuable insights into the contextual factors influencing the success or limitations of community-based ecotourism. Additionally, integrating social network analysis could help understand how institutional actors, NGOs, and local leaders interact within governance frameworks.

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