A Comparative Analysis of Tourism Observatories

This paper provides a comparative evaluation of tourism observatories within the International Network of Sustainable Tourism Observatories (INSTO), focusing on regional approaches to sustainability, methodology and data focus, stakeholder engagement, and technological innovation. Using a structured and dynamic framework, qualitative data from observatory websites are quantified via Natural Language Processing (NLP) models, enabling a consistent and adaptable method for analysis. By examining observatories across continents, this study highlights how different regions prioritize various aspects of sustainable tourism, including social, economic, and environmental dimensions. The analysis further explores contrasts between Coastal/Island and Mainland observatories, revealing distinct management practices aligned with geographical and environmental contexts. This approach not only contributes to a deeper understanding of regional sustainability strategies but also offers a scalable framework for continuous, real-time monitoring and adaptation of tourism observatory practices.

Keywords: *Monitoring Sustainable Tourism, INSTO Network, Tourism Innovation, Tourism Observatories, Destination Management.*

Introduction

The United Nations 2030 Agenda for Sustainable Development and its Sustainable Development Goals (SDGs) have profoundly impacted tourism policies and sustainability initiatives (Hall, 2019). However, the political nature of the SDGs often complicates their implementation within the tourism sector (Hall et al., 2022). A fundamental obstacle is the limited understanding of underlying structural issues and a lack of critical awareness, which restricts meaningful progress toward sustainability (Boluk et al., 2019). To address these barriers, researchers advocate for an inclusive framework that incorporates both reformist and radical approaches, encompassing issues such as gender equality, Indigenous perspectives, governance, degrowth, and ethical consumption (Boluk et al., 2019). Enhancing destination quality is recognized as an effective pathway for achieving the SDGs, aligning tourism improvements with key sustainability dimensions and yielding a dual benefit of raising tourism standards while advancing sustainability (Mason et al., 2022).

Sustainable tourism development is increasingly seen as a means to balance economic growth with environmental and social responsibilities (Krabokoukis, 2023). Green innovation in the hospitality sector has been shown to enhance sustainability strategies, particularly through the adoption of green practices and branding, which contribute to business growth and policy development within the tourism industry (Chivandi et al., 2023). The 2030 Agenda, which endorses a managerial ecological approach, has a substantial influence on tourism policies (Hall, 2019). While tourism contributes significantly to economic development, especially in developing nations, it has also contributed to environmental degradation, overtourism, and situations where carrying capacity is exceeded

(Tsiotas et al., 2020; Krabokoukis et al., 2021). A more reflective understanding of sustainable tourism management is therefore essential, with a focus on community involvement and poverty alleviation through pro-poor tourism strategies (Hall, 2019).

The SDGs, established by the United Nations in 2015 as a set of 17 interlinked goals, provide a comprehensive framework for tackling global issues such as poverty, inequality, and climate change (Wadhwani and Malpani, 2023). While global in scope, these goals rely on local actions and community engagement for effective implementation (Szetey et al., 2020). Regional studies highlight the varying priorities for SDGs (Polyzos, 2019), with goals such as 4, 11, and 13 often receiving more emphasis (Salvia et al., 2019). Language use is essential in fostering genuine community participation and effective communication during development processes (Mweri, 2020). Furthermore, higher education institutions play a crucial role in promoting SDGs by embedding sustainability into curricula, especially through workshops, courses, and lectures, though such progress is skewed toward high-income countries (Amorós Molina et al., 2023).

Despite its potential, sustainable tourism as aligned with the 2030 Agenda faces substantial operational challenges (Fraguas and Lerena, 2024). The European Commission's Transition Pathway for Tourism report highlights measures to support the twin transition in tourism, yet it provides limited insight into how SMEs will navigate these challenges (European Commission, 2021; Jones, 2023). The political dynamics of the SDGs and their function in meta governance complicate their adoption in tourism (Hall et al., 2022). Although tourism is not heavily emphasized in the SDG framework, its influence is significant, primarily through a managerial ecological lens, which may inadequately address full sustainability challenges (Hall, 2019). Still, with thoughtful planning and management, sustainable tourism has the potential to benefit livelihoods, cultural heritage preservation, and natural resources (Twining-Ward et al., 2017). The UN's declaration of 2017 as the International Year of Sustainable Tourism for Development underscores tourism's role in supporting SDGs 8, 12, and 14 (Twining-Ward et al., 2017).

Tourism observatories are vital for managing sustainability at destinations, and systematically collecting and analyzing data to support decision-making within the tourism industry (Brandão & Costa, 2010). Acting as central management tools, these observatories consolidate scientific and statistical data, especially at local and regional levels where national data may be lacking (Safrida et al., 2024). Their value lies in their capacity to inform policy and strategy, though they face challenges in meeting evolving user demands and establishing effective operational models (Safrida et al., 2024). Developing conceptual frameworks and taxonomies for observatories could enhance their functionality and support the establishment of new observatories (Perinotto et al., 2022). Effective sustainable management strategies, such as aligning pricing with value, integrating sustainability in marketing, and engaging local custodians, are crucial for advancing tourism sustainability (MacKay et al., 2020). Observatories also support digital marketing strategies, which have been shown to enhance business performance and tourist satisfaction (Deb et al., 2022).

The primary objective of this paper is to conduct a comparative evaluation of tourism observatories within the INSTO network. This comparison aims to identify and analyze regional differences in approaches to sustainability, data methodologies, stakeholder engagement, and innovation and technology. Additionally, the paper examines distinctions between Coastal/Island and Mainland Tourism Observatories, providing insights into their respective management approaches and sustainability practices. This framework not only quantifies qualitative data but also offers a dynamic, adaptable method that can be continually refined in real time.

The paper is structured as follows: Section 2 provides a critical review of existing methodological approaches. Section 3 outlines the methodology developed for comparative evaluation within the INSTO network, while Section 4 presents the analysis results. Finally, Section 5 discusses the findings, limitations, and potential directions for future research.

Literature Review

Sustainable Tourism (ST) has been a central focus of academic discourse, research, and debate for several decades. Organizations and institutions have long recognized the importance of monitoring and reporting on sustainable tourism (ST), with these efforts gaining traction since the late 20th century (e.g. The World Conference of Sustainable Tourism, 1995). Prior to the development of theoretical frameworks, the emphasis was placed on establishing effective systems for tracking and assessing the sustainability of tourism practices (Hall & Lew, 2009). The lack of data and accurate information about tourism is considered as the main reason for poor sustainable destination management (Hanrahan & McLoughlin, 2023). The efforts for specific instruments that allowed tourism practitioners to operationalize the concept of sustainability resulted to some very interesting and important indicator schemes. UN Tourism Organization published one of the most complete reports (UNWTO, 2004) named “Indicators for Sustainable Tourism Development”. This report became a foundation, and other global or regional organizations followed and enriched systematically sets and categories of indicators. Now more than two decades later experts, scientists and practitioners have gained extensive experience in setting ST measurement standards (Gasparini & Mariotti, 2023) and in creating guidelines for scoping, fine-tuning, and classifying indicators (Miller & Twining-Ward, 2005). The study analyzes several of the most impactful frameworks that are currently regarded as key pillars for sustainable tourism development at the destination level, encompassing cities, islands, regions, and even entire countries.

INSTO’s Contribution to Sustainable Tourism Through Science-Policy Integration

The United Nations World Tourism Organization's International Network of Sustainable Tourism Observatories (INSTO) plays a foundational role in promoting sustainable tourism development globally, aligning its objectives with the United Nations Sustainable Development Goals (SDGs) (Ryan et al., 2019). INSTO

observatories operate as catalysts for evidence-informed destination management, helping bridge the gap between scientific research and policy implementation by facilitating the transfer of knowledge and adaptive management practices within the tourism sector (Scuttari et al., 2023). Since its establishment in the early 1990s, INSTO has systematically promoted sustainable tourism through the development of indicators that enable tourism managers to make data-driven decisions incorporating social, economic, and environmental factors (Manning, 2021). These observatories have been implemented in diverse contexts worldwide, with case studies in Mexico, Portugal, and Indonesia showcasing varied approaches to integrating evidence-based management in destination planning (Scuttari et al., 2023). Additionally, Brazil's network of 26 active observatories exemplifies how local observatories contribute valuable data for public and private managers, enhancing tourism quality and visitor experiences (Alvares et al., 2020).

INSTO's methodology fosters an adaptive transformation within tourism systems by establishing observatories at the destination level, facilitating data collection and analysis of sustainability indicators that inform responsive management cycles (Ryan et al., 2019). This adaptive management aligns with the UNWTO's vision of tourism as a lever for achieving SDGs, especially in promoting decent work and economic growth (SDG 8), responsible consumption and production (SDG 12), and life below water (SDG 14) (Twining-Ward et al., 2017). However, significant challenges remain, particularly in measuring tourism's sustainability impacts at localized levels, as data limitations hinder comprehensive regional analysis, particularly across Europe (Alfaro Navarro et al., 2020).

INSTO observatories are crucial in integrating a range of stakeholder perspectives into sustainable tourism management, fostering collaboration across local communities, public-private partnerships, and international organizations. This approach aims to ensure that tourism remains economically beneficial, socially inclusive, and environmentally responsible (Sotiriadis & Shen, 2017; Vijayanand, 2013). Stakeholder engagement is particularly important in regions where tourism must balance local needs with cultural and natural resource preservation, and INSTO's focus on public-private partnerships strengthens its impact on tourism infrastructure and heritage management, enabling equitable benefit distribution among stakeholders (Scuttari et al., 2023).

Furthermore, INSTO has expanded its focus to include technological advancements in data collection, utilizing big data and real-time analytics to address complex needs within sustainable tourism management (Krasnyuk and Elishis, 2024). The integration of big data analytics enables a more personalized approach to tourism marketing strategies, supports monitoring of visitor behavior, and allows for adjustments in management practices based on real-time insights (Manning, 2021). These technological developments position INSTO observatories to respond effectively to operational challenges and the diverse dynamics of tourism markets, particularly in developing regions facing macroeconomic constraints.

In bridging the science-policy gap and supporting sustainable tourism development, INSTO's contribution underscores its essential role in aligning tourism practices with global sustainability objectives. The network's use of sustainability indicators, stakeholder collaboration, and technology-driven

methodologies continues to enhance its capacity to support data-driven tourism policies that address both global sustainability imperatives and local needs (Ryan et al., 2019; Fraguas and Lerena, 2024; Bricker, 2018). Through these combined efforts, INSTO establishes a model for sustainable tourism monitoring and policy implementation across diverse geographic contexts, reaffirming tourism's role in advancing the 2030 Agenda for Sustainable Development.

European Tourism Indicators System for Sustainable Destination Management

The European Tourism Indicators System (ETIS), developed by the European Commission, serves as a framework for monitoring and enhancing tourism sustainability at the destination level (Modica et al., 2018; Font et al., 2023). ETIS facilitates sustainable tourism management by providing a set of indicators that can be adapted based on specific destination needs, yet its implementation has encountered significant challenges. These include issues in data collection, limited stakeholder engagement, and the difficulty of tailoring indicators to unique local contexts, which collectively limit the system's effectiveness in achieving impactful policy transformation (Tudorache et al., 2017; Modica et al., 2018). Despite these challenges, ETIS remains a valuable conceptual tool for raising awareness and promoting social learning among Destination Management Organizations (DMOs) regarding sustainable tourism practices (Gasparini and Mariotti, 2023).

The flexibility of ETIS allows DMOs to select indicators that align with available data and specific regional requirements, supporting a tailored approach to sustainability management. This adaptability is crucial given the diverse contexts within European destinations, where varied tourism patterns require locally relevant indicators to assess sustainability effectively (Krajnović et al., 2020). For example, ETIS has been applied in assessing resident satisfaction with tourism, yielding insights into host community perceptions and tourism impacts (Foroni et al., 2019). However, the European Commission's initial expectations for ETIS to drive comprehensive sustainability transformations and boost destination competitiveness may have been ambitious; while the framework has succeeded in raising awareness, it has had limited direct influence on policy change and the practical enhancement of tourism competitiveness (Font et al., 2021).

Research across several European countries, including Italy, the Netherlands, and Serbia, indicates that DMOs and stakeholders often face knowledge gaps regarding sustainable tourism indicators and struggle with implementation due to varying levels of understanding and engagement (Modica et al., 2018; Gasparini and Mariotti, 2021; Cimbaljević et al., 2023). Consequently, continuous efforts are essential to improve stakeholder knowledge and engagement, enhance data collection methodologies, and foster an adaptive management approach within the ETIS framework (Modica et al., 2018; Tudorache et al., 2017). Such initiatives would potentially increase ETIS's practical impact, supporting DMOs in creating a more substantial and measurable influence on sustainable tourism practices across European destinations.

Tourism Satellite Account (TSA) for Measuring Economic Impact in Tourism

The Tourism Satellite Account (TSA) is a globally standardized framework developed to measure the direct economic contributions of tourism to national economies. Approved by the United Nations Statistical Commission and widely promoted by the World Tourism Organization (UNWTO), the TSA provides internationally comparable estimates that highlight tourism's economic role and interconnections with other sectors (Frechtling, 2009; Baker, 2013; Paci, 1998). By capturing the direct economic effects of tourism, TSA has become a foundational tool for understanding tourism's economic structure. However, the TSA's primary focus on direct impacts may limit its applicability for more complex economic analyses. For in-depth assessments, alternative methods such as Input-Output Tables, Computable General Equilibrium (CGE) models, and Social Accounting Matrices (SAMs) offer robust frameworks. In particular, SAMs enable a more comprehensive analysis by examining the broader effects of inbound tourism expenditures on production, labor, and household consumption, facilitating assessments of tourism's long-term economic sustainability (Ferrari et al, 2022).

The TSA framework has seen significant adoption, especially in the Asia-Pacific region, where it aids regional economic planning despite ongoing challenges with data accessibility and completeness (Baker, 2013). Its adaptability has also led to the development of sub-national and regional TSAs, which allow for localized analyses of tourism’s economic impact, offering a flexible model for assessing tourism at various scales (Frechtling, 2009). As global tourism continues to expand, with international arrivals reaching 1,087 million in 2013, marking a 5% increase over the previous year, there is an ever-growing demand for reliable, standardized economic data on tourism (Kleeman, 2014). This continued expansion, coupled with the UNWTO's projected growth of 4-5% annually in international tourism, underscores TSA’s critical role in supporting informed economic and policy decision-making within the tourism sector (Kleeman, 2014).

ESPON Methodology for Regional Analysis and Policy Development in Europe

The European Spatial Planning Observation Network (ESPON) methodology encompasses diverse approaches to analyzing territorial dynamics and impacts across Europe, providing critical insights for regional policy and spatial planning. One of ESPON’s central tools, the Delphi method, facilitates structured engagement with stakeholders and experts, supporting concept analysis, strategy-building, and exploration of policy options for regional development (Evrard et al., 2014). This participatory approach enhances the relevance of ESPON’s outputs by integrating diverse perspectives and aligning strategies more closely with the needs of various European regions. Additionally, ESPON projects have developed sophisticated methods to classify regions into urban, rural, and intermediate territories, advancing beyond traditional urban-rural dichotomies to deliver a nuanced understanding of spatial dynamics (Cattivelli, 2023).

Another significant tool in the ESPON framework is the Territorial Impact Assessment (TIA), which serves as a multidimensional evaluation method for

assessing the effects of European Union policies on different territories, focusing on criteria such as efficiency, quality, and regional identity (Camagni, 2009). This assessment tool helps policymakers evaluate how specific EU initiatives influence territorial cohesion, sustainability, and overall regional development. In line with these objectives, ESPON's emphasis on territorial cohesion addresses the spatial distribution of economic, social, and environmental resources, supporting balanced growth and reducing disparities between regions (Prezioso, 2008).

ESPON has also contributed to cross-border collaboration and data harmonization, with projects like HARMO-DATA and BORIS focused on improving spatial data management and seismic risk assessment in the Italy-Slovenia border region. HARMO-DATA created a shared platform for spatial data management aligned with INSPIRE standards, while BORIS developed a web-based platform for harmonized seismic risk assessments, facilitating cross-border cooperation through shared data access and impact visualization (Barboric et al., 2019; Polese et al., 2023). The SLEUTH model, applied in ESPON projects, has also proven valuable in forecasting urban growth and assessing land use impacts, demonstrating how policy interventions can influence territorial development in cross-border regions such as Gorizia and Nova Gorica (Chaudhuri and Clarke, 2013).

While ESPON's methodologies provide tailored, evidence-based insights for policy and planning, some, like ESPON's specific territorial classifications, may have limited applicability outside the context of particular projects compared to more standardized frameworks such as TERCET (Cattivelli, 2023). Nevertheless, ESPON's contributions remain vital for guiding policymakers and researchers in advancing sustainable and cohesive development across Europe's diverse regions, helping to address regional challenges and enhance cross-border integration.

Tourism Carrying Capacity for Sustainable Development and Collaboration

The Tourism Carrying Capacity (TCC) concept is fundamental for sustainable tourism development, as it addresses the maximum number of tourists a destination can accommodate without causing adverse effects on its natural, social, and infrastructural systems (Zekan et al., 2022; Candia et al., 2020; Polyzos, 2019). TCC assessments are tailored to each destination type, particularly in areas such as coastal zones, where factors like tourist density, beach use, and infrastructure congestion significantly impact the environment (Maggi and Fredella, 2011).

Despite TCC's importance, calculating a single carrying capacity value remains challenging due to varying thresholds and ecological limits across regions. Consequently, recent methodologies have been developed to accommodate these differences, with approaches specific to destination needs yet adaptable across European regions facing similar sustainability concerns (Sedlacek et al., 2022). Integrating TCC assessments into Tourism Strategic Plans is recommended to better align tourism development with sustainability goals, fostering long-term environmental and social resilience (Candia et al., 2020). This integration emphasizes the role of TCC as a dynamic component of destination management strategies, reinforcing its value for sustainable tourism growth.

In addition to TCC assessments, cross-border spatial data harmonization and risk assessment are critical in fostering effective transboundary cooperation for sustainable tourism management. For instance, the HARMO-DATA project developed shared platforms and protocols for spatial data management between Italy and Slovenia, creating a collaborative structure based on INSPIRE standards to facilitate cross-border data access (Barboric et al., 2019). Similarly, the BORIS project focused on harmonizing seismic risk assessment methodologies in the Italy-Slovenia border region, which involved developing a web-based platform for data visualization and impact analysis, thus supporting cohesive regional planning (Polese et al., 2023). In the border cities of Gorizia and Nova Gorica, the SLEUTH model has been utilized to forecast urban growth and assess the implications of land use policies, underscoring the potential of coordinated land use management to influence tourism and territorial development (Chaudhuri & Clarke, 2013).

Beyond cross-border projects, TCC assessments can further benefit from local-based approaches, such as Social Accounting Matrices (SAMs) and extended multisectoral models, which analyze the economic and environmental impacts of tourism at a more granular level (Garau et al., 2022). For instance, SAMs provide insights into tourism's effects on production, labor markets, and household expenditure, highlighting how these impacts resonate within local communities. In Slovenia, TCC assessments have informed sustainable tourism strategies by identifying critical constraints, such as waste management, transportation, and water quality, required to maintain ecological balance (Jurincic, 1970). These regionally focused methodologies are instrumental in balancing tourism growth with environmental preservation and social equity.

As the risks associated with overtourism grow, researchers have increasingly emphasized the importance of composite indicators for TCC to identify areas vulnerable to environmental and social saturation, as well as regions that may still support additional tourism growth sustainably (Panousi & Petrakos, 2021). The development of these composite indicators is particularly relevant for destinations across Europe, where balancing tourism expansion with environmental protection is essential to maintaining the quality of life for residents and the visitor experience. Furthermore, TCC assessment models underscore the significance of stakeholder involvement, where frameworks that integrate stakeholder perspectives enhance sustainable outcomes by ensuring that tourism growth aligns with local community needs and ecological preservation goals (Zekan et al., 2022).

From Monitoring Frameworks to Sustainable Tourism Observatories

The study aims to present the practical applications of monitoring sustainable tourism as they are currently recognized through sustainable tourism observatories. The global platform of UN Tourism and its International Network for Sustainable Tourism Observatories (INSTO) section serves as the primary tools for analysis and research.

INSTO - Sustainable Tourism Through Regional Observatories

The International Network of Sustainable Tourism Observatories (INSTO), created by the United Nations World Tourism Organization (UNWTO), plays a pivotal role in advancing sustainable tourism development globally by enabling systematic data collection, monitoring, and policy-informed management across various regions (Scuttari et al., 2023; Lara Vásconez et al., 2024). By bridging the science-policy gap, INSTO observatories support adaptive, evidence-based destination management, helping tourism stakeholders make informed decisions (Manning, 2021). A prime example of INSTO's regional impact is in Indonesia, where Universitas Gadjah Mada (UGM), known for its rich historical and cultural assets, has recognized sustainable tourism opportunities, particularly in heritage and educational tourism. UGM's proposed tourism model centers on the "4A" framework, attraction, accessibility, amenity, and ancillary services, and aims to enhance economic welfare by empowering academics, local communities, and businesses (Munawar, 2024; Nugroho and Soeprihanto, 2016). The broader goal of sustainable tourism in Indonesia is to balance ecological, economic, and socio-cultural aspects, aligning with UNWTO's frameworks and sustainability principles (Muhammad and Prima, 2016). To evaluate these principles, Indonesia employs tools like the Global Sustainable Tourism Council (GSTC), which assess destination management, environmental protection, and risk reduction efforts, particularly in ecologically vulnerable regions, such as the slopes of Mount Merapi (Muhamad et al., 2021).

In Austria, INSTO observatories emphasize sustainable tourism in mountain regions, balancing tourism growth with environmental conservation. Research in Austria reveals that family-run tourism firms prioritize ecological and social considerations over profit once financial needs are met (Kallmuenzer et al., 2018). Sustainable tourism mobility has been another focus, especially in Tyrol, where integrated planning has examined the environmental effects of tourism-related traffic. Tyrolean research highlights innovative practices for sustainable tourism mobility, including infrastructure planning for mountain biking, wastewater surveillance for SARS-CoV-2, and avalanche disaster management strategies (Daleiden et al., 2022; Peters and Pikkemaat, 2006). A key component of Austrian research involves maintaining environmental sustainability by addressing tourism-related traffic and infrastructure impacts through adaptive management and multi-stakeholder collaboration (Scuttari et al., 2013). In Croatia, INSTO's observatory program is advancing sustainability practices in coastal areas. The Croatian Sustainable Tourism Observatory (CROSTO) has implemented environmental indicators to assess tourism's sustainability, addressing challenges such as waste management, unplanned construction, and infrastructure inadequacies in Omiš and other destinations. The EU is currently supporting sustainable tourism projects through European funds, emphasizing interdisciplinary collaboration to meet economic, environmental, and social objectives (Pavlinovic and Cosic, 2023; Kozic and Mikulic, 2011).

In addition, public-private partnerships (PPPs) are emerging as essential elements of sustainable tourism development, particularly in urban areas where collaboration is vital to manage challenges like mass tourism and sustainability. In

Japan, PPPs have been implemented across local jurisdictions, addressing broader tourism and sustainability issues through region-wide tourism management strategies (Seki, 2013). Studies in Spain indicate both the strengths and limitations of PPPs, with low stakeholder engagement and awareness in some areas posing challenges (Candrea et al., 2017). Sustainable tourism strategies in South Tyrol, Italy have also focused on mobility, emphasizing eco-friendly modes of transport and analyzing tourist behavior to guide policy. E-mobility and health-oriented tourism offer promising approaches to sustainable tourism mobility in alpine regions, though private vehicles remain the most popular transport choice among tourists (Scuttari and Isetti, 2019; Schlemmer et al., 2019).

In North America, Yukon Sustainable Tourism Observatory demonstrates how regional observatories contribute to managing tourism in natural and cultural contexts. Studies in Yukon reveal that guides and local narratives play a significant role in aligning tourism with environmental and cultural conservation goals. Yukon has developed a Sustainable Tourism Framework that integrates local knowledge with sustainability indicators, promoting sustainable practices in remote destinations (de la Barre, 2013). In Mexico, observatories monitor various sustainability indicators, covering ecological, social, and urban dimensions. The Mexican Sustainable Tourism Observatory employs business intelligence to support tourism sustainability across regions, notably in coastal attractions like the firefly sanctuary in Tlaxcala, where managing tourism growth alongside ecological preservation is crucial (Acle Mena et al., 2018). In the Yucatán Peninsula, indicators of sustainability consider economic, social, and environmental impacts, addressing the unique challenges faced by communities in balancing tourism expansion with local needs (Albornoz-Mendoza and Mainar-Causapé, 2019).

Throughout Europe, sustainable tourism indicators have been widely adopted by INSTO observatories. The Azores, for example, has established itself as a leader in sustainable tourism by implementing a comprehensive sustainability indicator system to monitor tourism's impact across economic, environmental, and social dimensions. The Azores Tourism Strategy 2030 aims to distribute tourism equitably across its islands, mitigating seasonal pressures and preserving natural resources (Cabral, 2023; Couto et al., 2021). Similarly, Algarve Sustainable Tourism Observatory (AlgSTO) in Portugal applies a set of 105 indicators covering various sustainability domains, supporting destination-level analysis and data-driven decision-making (Farinha et al., 2019). In Barcelona, Spain, tourism sustainability indicators are integrated with ETIS and local governance metrics to assess tourism's impact on local economies, environments, and social structures, with the Observatori del Turisme collaborating closely with stakeholders to apply these indicators effectively (López Palomeque et al., 2018; Bertocchi et al., 2020).

In Australia, sustainable tourism research has focused on balancing environmental protection with tourism growth. Western Australia, including areas like Rottnest Island, prioritizes stakeholder collaboration to manage tourism in sensitive natural environments, while Indigenous tourism initiatives emphasize community involvement and cultural preservation (Whitford and Ruhanen, 2010). Moreover, sustainable tourism in Colombia and Bogotá highlights regional efforts to develop ecotourism while promoting environmental protection. Colombia's

initiatives in sustainable tourism align with UNWTO standards and emphasize indicators across ecological, economic, and social domains to enhance policy efficacy and guide sustainable tourism expansion (Ines Sánchez and Jaramillo-Hurtado, 2010; Guzmán-Ramos et al., 2020).

INSTO - Sustainable Tourism Through Regional Observatories

This section critically examines a range of methodological frameworks relevant to tourism research. Table 1 presents a comparative overview of these frameworks, highlighting dimensions such as sustainability focus, stakeholder engagement, data collection methodologies, and technological integration, all of which address contemporary challenges in sustainable tourism. Several frameworks emphasize sustainability as a multidimensional construct. For instance, the International Network of Sustainable Tourism Observatories (INSTO), under the auspices of the UNWTO, integrates economic, environmental, and social dimensions into a globally applicable model. This framework underscores the importance of systematic monitoring and the localization of sustainability indicators, enabling destination-specific adaptations across regions like Mexico, Indonesia, and Europe. Likewise, the European Tourism Indicators System (ETIS), developed by the European Commission, offers a standardized tool for assessing sustainability at the destination level, promoting data transparency and stakeholder engagement across EU member states.

Table 1. *Comparative Overview of Key Methodological Frameworks*

Methodology Framework	**Reference**	**Dimensions**				
		Focus on Sustainability	Methodologies and Data	Stakeholder Engagement	Geographic Scope	Innovation and Technology
INSTO	UNWTO, 2023	Economic, environmenta, and social sustainability	Systematic monitoring and evaluation of sustainability indicators	Local communities, public/private partnerships	Local, regional, and global	Data-driven monitoring systems, evidence-based decision-making
ETIS	European Commission, 2016	Destination sustainability indicators	Indicators for sustainable tourism	DMOs, Local Governance	EU Countries	Indicator-based management system
TSA	UNWTO, 2013	Economic tourism impact	International economic indicators	International organizations	Global	Tourism Satellite Account Methodology
Carrying Capacity	Schuh et al., 2019	Overtourism prevention	Carrying capacity assessment	Local Stakeholders	EU Countries	Carrying Capacity Methodology
TIPs	UNWTO, 2023	SDGs	Sustainable Development Goals	International cooperation (UNWTO, JICA)	Global	SDG-based indicators

Circular Tourism	European Commission, 2021	Circular economy in tourism	Circular economy indicators	Public and private partnerships	EU-wide	Circular indicators and technologies
CTI (Businesses)	World Business Council for Sustainable Development, 2021	Business Circular Economy	Circular economy metrics	Business stakeholders	Global	Circular economy indicators for businesses
OECD Circular Indicators	OECD, 2021	Circular economy	Macro-level circular economy indicators	National and regional collaboration	Global	Technological and infrastructure focus
Big Data for Sustainability	Pérez Guilarte & Barreiro Quintáns, 2019	Environmental and social sustainability	Big data and real-time analytics	Public-private sector	Global	Big Data technologies
INRouTe	Massieu, 2015	Regional tourism impact	Regional tourism indicators	Local and regional institutions	Regional	Advanced regional data collection methods
ESPON	Schuh, 2019	Carrying capacity in regional destinations	Hybrid approach (qualitative and quantitative)	Local Stakeholders, government	Cross-border (Slovenia, Italy)	Data visualization and forecasting

Source: Authors' analysis, 2025

In contrast, the Tourism Satellite Account (TSA) framework, is primarily economic in focus, aiming to quantify tourism's direct economic impact. The TSA's standardized approach is particularly influential in Asia and the Pacific, providing a robust basis for comparing economic contributions across regions. Complementing TSA's economic emphasis, the European Spatial Planning Observation Network (ESPON) incorporates socio-economic indicators and stakeholder input, employing models like the Delphi and SLEUTH to enhance regional policy alignment in cross-border areas such as Slovenia and Italy.

Carrying Capacity assessments, commonly applied in European destinations, prioritize the balance between tourism growth and environmental resilience, essential for mitigating over-tourism. These assessments provide adaptive insights tailored to the unique ecological constraints of coastal regions, as demonstrated in frameworks focused on Slovenia and Italy. Through synthetic indicators, these frameworks offer an operational model to manage visitor flow, thus aligning tourism activities with local sustainability objectives.

The integration of big data and real-time analytics into sustainable tourism frameworks is gaining traction. Frameworks like INSTO harness digital tools for dynamic data collection, enhancing resource management and visitor monitoring. Big Data for Sustainability allows real-time tracking and adaptive management, offering predictive insights that improve destination management strategies. Moreover, the circular economy paradigm, promoted by entities such as the OECD and European Commission, emphasizes resource efficiency through metrics and

public-private collaboration, especially in Europe, where sustainable resource use is prioritized. Tourism observatories, both global and regional, are critical in advancing sustainable tourism practices. Examples such as those in Tyrol (Austria), Azores (Portugal), and South Tyrol (Italy) illustrate the value of local governance and academic partnerships in data-driven decision-making. These frameworks facilitate a comprehensive understanding of tourism's socio-environmental impacts, guiding sustainable development at multiple administrative levels.

Methodology/Materials and Methods

To proceed in a structured comparison of tourism observatories within the INSTO network, key categories, and their respective subcategories were identified, as outlined in Table 2. This selection was based on the goal of evaluating observatories across essential operational dimensions such as Sustainability, Methodology and Data, Stakeholder Engagement, and Innovation and Technology. This framework enables a standardized and in-depth analysis, allowing for meaningful insights into observatories' strengths and improvement areas.

Table 2. *Key Dimensions and Methodological Frameworks for Evaluating Tourism Observatories*

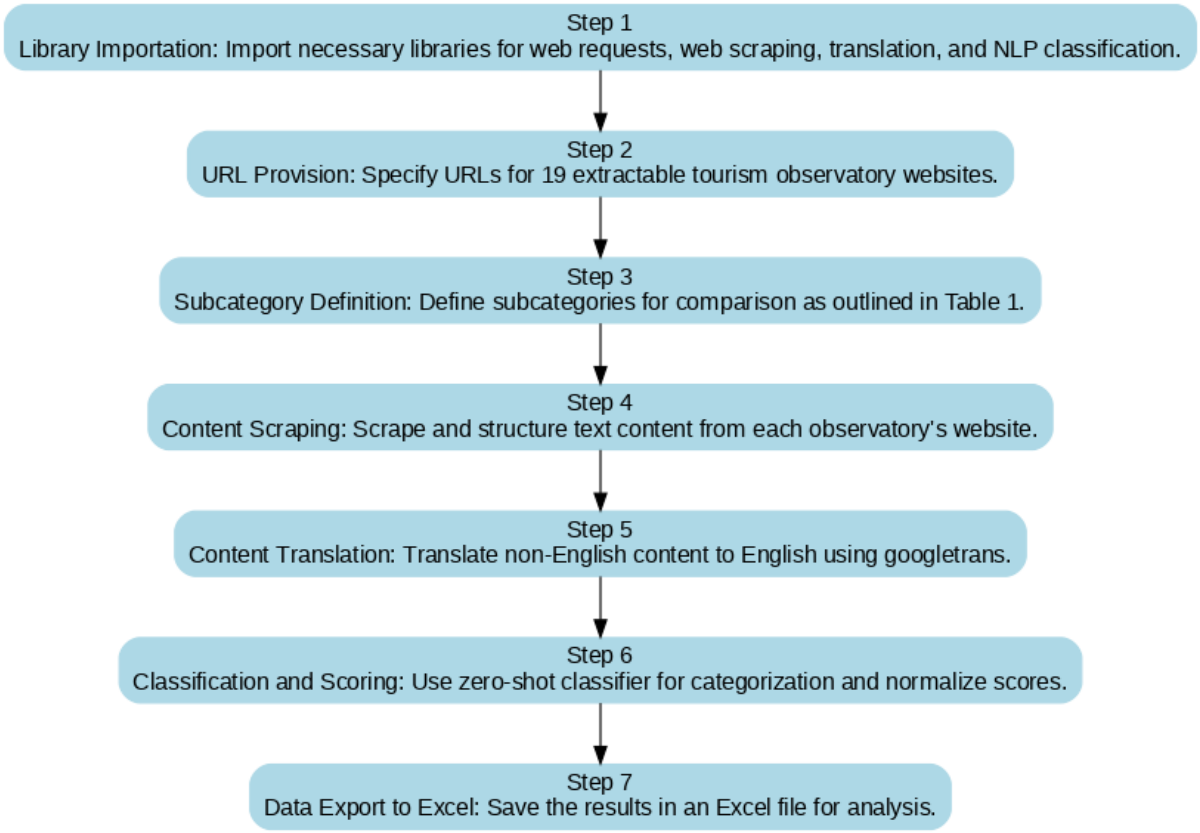
Category	Subcategory	Explanation
Sustainability	Social	Focus on social impacts, such as community well-being and local involvement in tourism initiatives.
	Economic	Focus on the economic impacts of tourism, including job creation, local business development, and revenue generation for the community.
	Environmental	Addressing environmental protection, conservation efforts, and reducing tourism's ecological impact.
Methodology and Data	Qualitative Data Collection	Includes interviews, focus groups, and observational studies to gather insights.
	Quantitative Surveys	Use of structured surveys and standardized questionnaires to collect measurable data.
	Indicator Frameworks	Specific indicators like visitor satisfaction, environmental impact, and economic benefits.
	Analytical Software and Tools	Use of tools (e.g., SPSS, GIS) for data processing, statistical analysis, and geographic mapping.

	Big Data and Social Media Analytics	Analyzing large datasets, including social media content, to identify tourism trends.
Stakeholder Engagement	Local and Regional Partnerships	Collaboration with local governments, communities, and regional organizations.
	Academic and Research Collaboration	Partnerships with universities, think tanks, and research institutions for data and insights.
	Public Policy and Governance	Coordination with national/local tourism policies and governance structures.
	Private Sector Involvement	Engagement with private businesses, including hotels, restaurants, and tour operators.
Innovation and Technology	Visitor Analytics and Flow Monitoring	Monitoring visitor flows, movement patterns, and congestion levels in tourist areas.
	Environmental Monitoring Technology	Technologies that track environmental factors, such as pollution and biodiversity.
	Forecasting Tools	Tools for predicting tourism trends, visitor numbers, and seasonal demands.
	Interactive Platforms	Platforms like mobile apps and websites that engage tourists with real-time information.
	AI and Machine Learning Tools	Use of AI for predictive analysis, trend recognition, and visitor sentiment analysis.

Source: Authors' analysis, 2025

To quantify qualitative data, a Python script was developed that utilizes Natural Language Processing (NLP) models to classify and analyze content from each observatory's website. This algorithm was applied to each category outlined in Table 1, ensuring structured and comparable analyses across observatories. The script's step-by-step procedure is shown in Figure 1. This approach was chosen to ensure a consistent and as objective as possible method for translating website information into comparable, quantifiable scores, thereby supporting a thorough comparison across the defined categories.

Figure 1. *Step-by-Step Process of Data Extraction and Classification for Tourism Observatory Analysis Using NLP Techniques*



Source: Authors' analysis, 2025

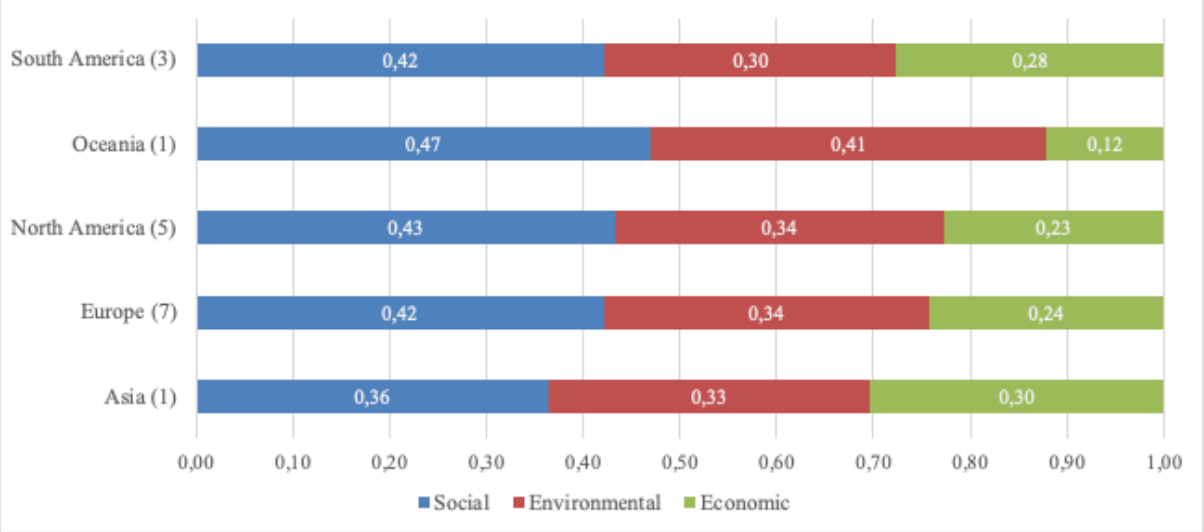
The approach begins by importing essential libraries: "requests" for handling web requests, "BeautifulSoup" for web scraping, "googletrans" for content translation, and "transformers" for text classification. Following, URLs for various tourism observatories are specified, covering a total of 42 observatories, of which only 19 had accessible websites. These websites are listed in Table 1 of the Appendix. The subcategories, as outlined in Table 1, are then defined to enable structured categorization. The "scrape_content" function is used to retrieve content from each website, converting it into a structured text format for analysis. Notably, the websites of two observatories, AlgSTO (Portugal, Europe) and Nuevo León (Mexico, North America), were unavailable for extraction and thus excluded from subsequent steps. For content not originally in English, the "googletrans" library translates the text, ensuring consistency in the data language. The translated and formatted content is then classified into predefined subcategories using a "zero-shot classifier" based on the BART model. This classifier assigns confidence scores to each category based on contextual relevance rather than keyword reliance, and these scores are subsequently normalized for consistency. Finally, the processed data, including category scores, is saved into an Excel file, providing a structured dataset for further analysis and comparison across the observatories.

Results

The following stacked bar charts (Figures 2, 3, 4, and 5) display the results for each examined category, organized by region to highlight similarities and differences across geographical areas. For Asia, the UGM (Indonesia) observatory was examined. In Europe, seven observatories were analyzed: Tyrol (Austria), CROSTO (Croatia), South Tyrol (Italy), Azores (Portugal), Barcelona (Spain), Biscay (Spain), and Navarre (Spain). North America includes five observatories: Yukon (Canada), Antigua (Guatemala), Yucatán (Mexico), OTEG (Mexico), and OTST (Mexico). Oceania is represented by Southwest Australia (Australia), and South America includes three: OTE (Brazil), CIET (Brazil), and Bogotá (Colombia).

In Figure 2, the Sustainability category results reveal regional differences. South America shows a balanced focus on social, environmental, and economic dimensions, with social to attract the greatest interest (42%). Oceania's high emphasis on social aspects (47%) suggests a strong commitment to community well-being and involvement, though economic aspects receive minimal focus (12%). North America and Europe display a similar distribution, with a stronger focus on social and environmental dimensions, indicating a commitment to both community welfare and ecological preservation. Asia, with a comparatively higher economic focus (30%), may prioritize tourism's role in economic development over other factors. These variations highlight how different regions prioritize sustainability according to their unique socio-economic contexts and tourism objectives.

Figure 2. *Regional Comparison of Sustainability Focus in the Examined Tourism Observatories*

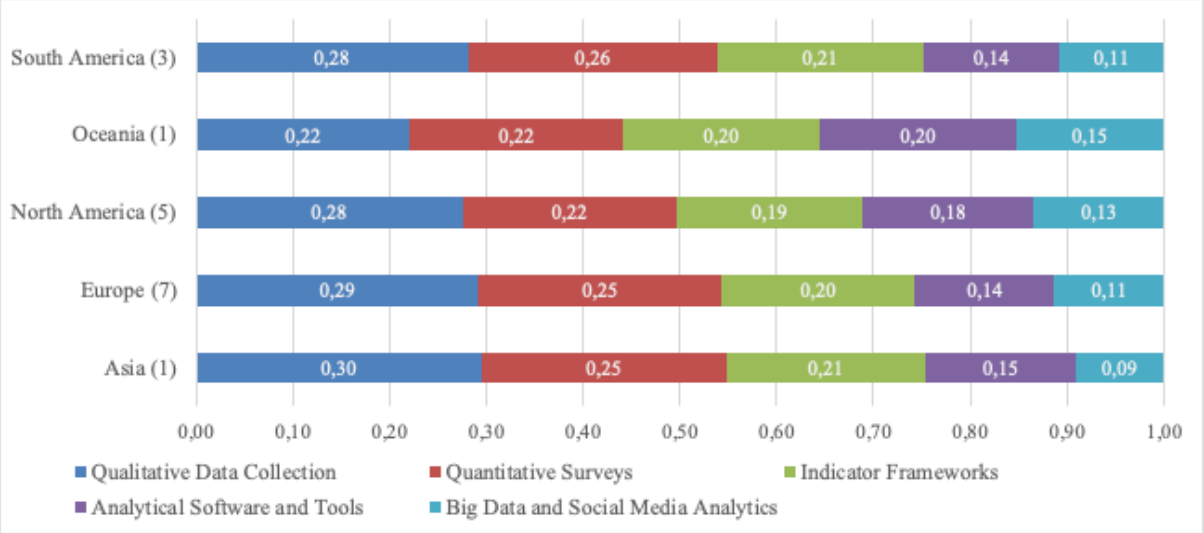


Source: Authors' analysis, 2025

In Figure 3, the results for the 'Methodology and Data' category reveal a strong emphasis on Qualitative Data Collection across all regions, indicating a general preference for detailed insights through interviews and observations. Quantitative

Surveys follow, with Indicator Frameworks, Analytical Software and Tools, and Big Data and Social Media Analytics completing the focus areas. Oceania demonstrates a particularly balanced distribution across all subcategories, suggesting a comprehensive approach. This distribution highlights the ways regional observatories adapt their methodologies to meet specific data collection and analysis needs effectively.

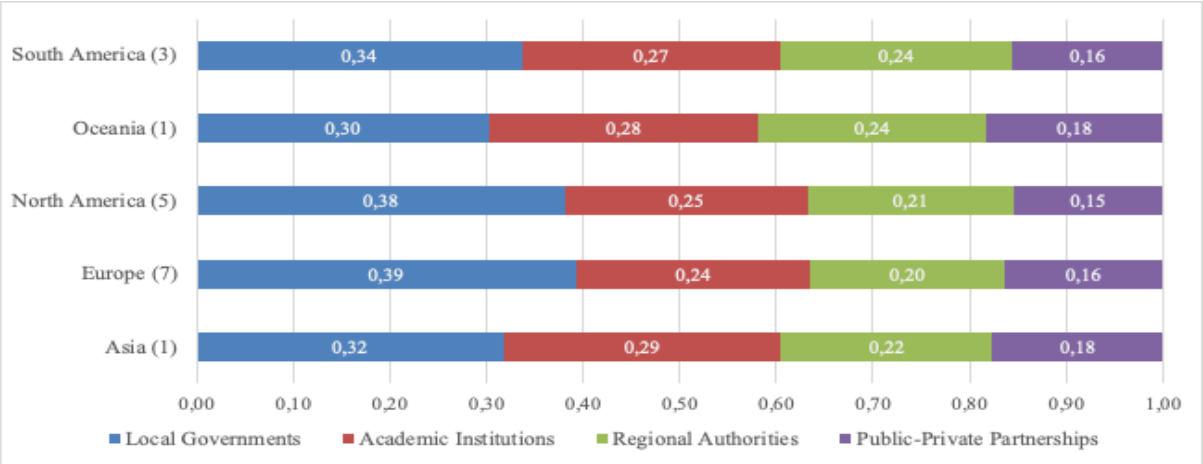
Figure 3. *Regional Comparison of Methodology and Data Focus in the Examined Tourism Observatories*



Source: Authors' analysis, 2025

In Figure 4, the results for "Stakeholder Engagement" show the involvement level of various stakeholder types across regions. Local governments play a prominent role in all regions, with particularly high emphasis in Europe (39%) and North America (38%), reflecting strong local governance in tourism management. Academic institutions follow, especially notable in Asia (29%), suggesting a research-focused approach. Regional authorities and public-private partnerships are more balanced across regions, indicating collaborative efforts in governance structures. Oceania exhibits a more balanced approach across all stakeholder types, possibly reflecting a comprehensive governance model.

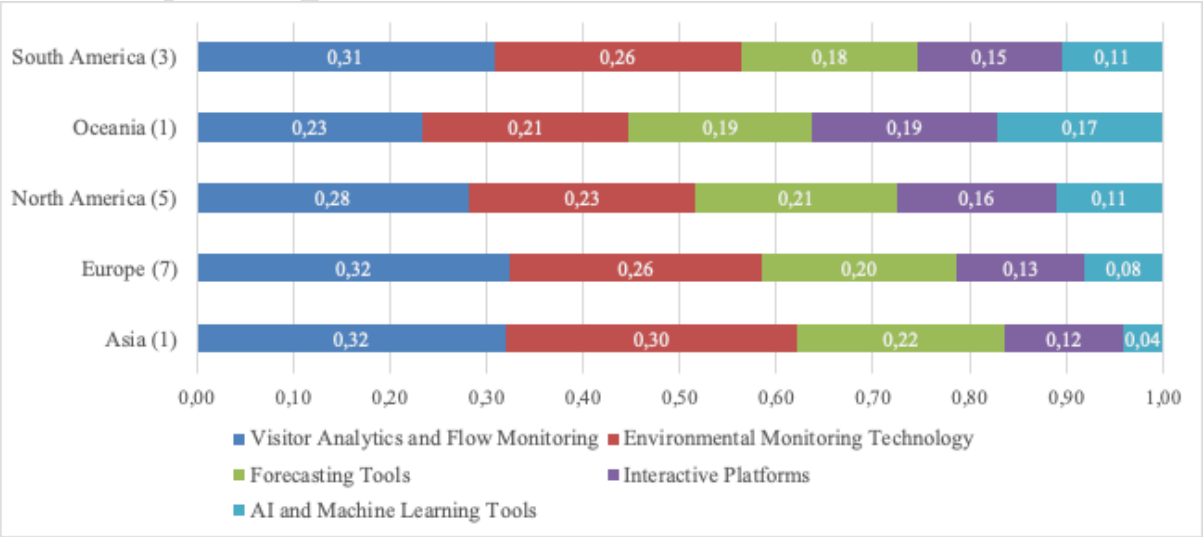
Figure 4. *Regional Comparison of Stakeholder Engagement Focus in the Examined Tourism Observatories*



Source: Authors' analysis, 2025

In Figure 5, the results for the "Innovation and Technology" category reveal significant regional differences in technological focus across tourism observatories. Visitor Analytics and Flow Monitoring emerge as the most emphasized technology across regions, particularly in Europe (32%) and Asia (32%), suggesting a priority in understanding visitor movements and managing crowd flows. Environmental Monitoring Technology follows closely, especially in Asia (30%), reflecting heightened environmental concerns. Forecasting Tools are consistently integrated, with Asia (22%), North America (21%), and Europe (20%) using them for predicting trends. Notably, AI and Machine Learning Tools have lower integration across regions, with the highest adoption in Oceania (17%), indicating a growing but still modest reliance on advanced analytics.

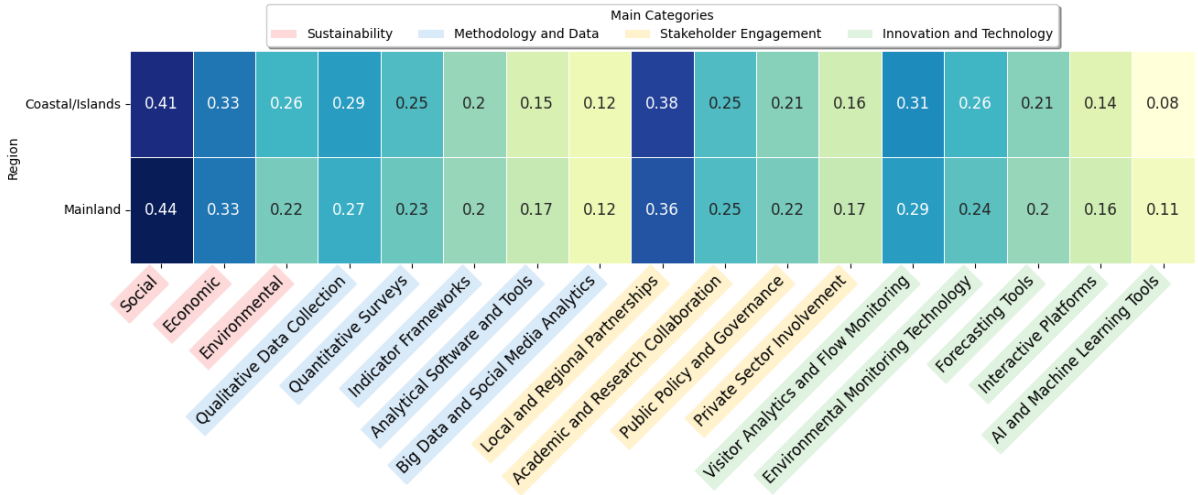
Figure 5. *Regional Comparison of Innovation and Technology Focus in the Examined Tourism Observatories*



Source: Authors' analysis, 2025

In Figure 6, a heatmap compares the performance of Coastal/Island and Mainland observatories across various categories. The Coastal/Island group includes the UGM (Indonesia, Asia), CROSTO (Croatia, Europe), Azores (Portugal, Europe), Barcelona (Spain, Europe), Biscay (Spain, Europe), Antigua (Guatemala, North America), Yucatán (Mexico, North America), Southwest Australia (Australia, Oceania) και OTE (Brazil, South America). The mainland group includes Tyrol (Austria, Europe), South Tyrol (Italy, Europe), Navarre (Spain, Europe), Yukon (Canada, North America), OTEG (Mexico, North America), OTST (Mexico, North America), CIET (Brazil, South America) και Bogotá (Colombia, South America).

Figure 6. *Comparison of Key Focus Areas in Coastal/Island vs. Mainland Tourism Observatories*



Source: Authors' analysis, 2025

The heatmap highlights key similarities between Coastal/Island and Mainland observatories, particularly in Social Sustainability (41% for both) and Local and Regional Partnerships under Stakeholder Engagement (38% for Coastal/Islands and 36% for Mainland). These high scores suggest that both types of observatories prioritize the social well-being of communities and foster strong local partnerships, which are crucial for effective stakeholder collaboration. Both regions also place a shared emphasis on Economic Sustainability (33%) and Visitor Analytics and Flow Monitoring within Innovation and Technology (31% for Coastal/Islands and 29% for Mainland). The common focus on economic sustainability underscores the economic benefits tourism brings to local communities, while visitor monitoring reflects a priority for managing tourist flows efficiently to prevent overcrowding and ensure a sustainable tourism experience.

The Social subcategory in Sustainability shows a slightly higher score for Mainland observatories (44%) compared to Coastal/Islands (41%). This may reflect Mainland observatories' stronger focus on community engagement and social impacts, possibly due to the larger, often more diverse communities that Mainland regions support. Additionally, for Environmental Monitoring Technology within Innovation and Technology, Coastal/Islands score slightly higher (26%) than the

mainland (24%). This heightened focus among Coastal/Island observatories could be due to the environmental sensitivity of these regions, where close monitoring of biodiversity and pollution is crucial to preserve fragile ecosystems. These findings highlight that while both groups share common priorities, Coastal/Island observatories tend to emphasize monitoring environmental factors more, likely to address unique challenges faced by their sensitive and often smaller-scale environments.

Discussion

The findings highlight how tourism observatories approach sustainability monitoring and stakeholder collaboration, aligning with previous research on regional differences in tourism management (Hall, 2019; Scuttari et al., 2023). The focus on social sustainability across observatories reflects the broader global trend of promoting community-centered tourism (Boluk et al., 2019). Additionally, the emphasis of coastal and island observatories on environmental monitoring supports previous findings regarding the ecological vulnerabilities of these regions, further reinforcing the need for targeted conservation efforts (Twining-Ward et al., 2017).

Differences in methodological approaches reflect regional disparities in data availability and technological infrastructure. The extensive use of big data analytics in Asian, European, North, and South American observatories suggests a more mature data ecosystem that facilitates data-driven decision-making and predictive modeling (Gasparini & Mariotti, 2023). In contrast, observatories in regions with less technological infrastructure continue to rely on traditional survey-based methods and qualitative approaches, which, while valuable, may limit scalability and real-time adaptability. Another critical aspect is the strong involvement of local governments in European and North American observatories, highlighting the presence of well-established institutional frameworks that support structured tourism governance (Sotiriadis & Shen, 2017). These frameworks contribute to more effective policy implementation and long-term sustainability strategies.

Finally, technological adoption trends underscore the role of innovation in enhancing sustainability monitoring. AI-driven forecasting tools and visitor analytics are increasingly integrated into observatory operations in technologically advanced regions, demonstrating their potential to support adaptive management practices. As the tourism sector continues to evolve, innovative technologies are expected to play a pivotal role in optimizing sustainability outcomes and improving the overall effectiveness of tourism observatories.

Conclusions

This study offers a comparative evaluation of tourism observatories affiliated with the International Network of Sustainable Tourism Observatories (INSTO), revealing critical insights into the diverse regional approaches toward sustainable tourism management. The analysis underscores variation in observatory practices

across continents, with each region prioritizing different aspects of sustainability, methodological focus, stakeholder engagement, and technological application.

A key finding is that social sustainability consistently emerges as a focal concern across observatories, in both Coastal/Island and Mainland contexts. This reflects the increasing emphasis on community well-being and active engagement in tourism management. Economic sustainability also scores highly, underscoring the recognition among tourism observatories of the vital role that local economic development and job creation play in achieving sustainable tourism objectives. Notably, Coastal/Island observatories demonstrate a heightened focus on environmental monitoring, likely due to the unique ecological sensitivities and vulnerabilities of these areas. Conversely, Mainland observatories place a relatively greater emphasis on social impacts, possibly driven by the diverse and more extensive populations they serve.

Moreover, the consistent use of both qualitative and quantitative data collection methods across all observatories highlights a shared preference for comprehensive insights into tourism impacts, further supporting robust, evidence-based decision-making processes. This research demonstrates the potential of a data-driven framework that facilitates dynamic, continuous monitoring of sustainable tourism practices. By leveraging NLP and zero-shot classification models to quantify qualitative data, this approach enables a scalable, adaptable solution that can support real-time analysis and monitoring of tourism observatories worldwide.

Future research could expand upon this framework by including additional observatories within and beyond the INSTO network, providing a richer understanding of region-specific and cultural nuances in sustainable tourism management. Furthermore, the framework could benefit from integrating advanced machine learning capabilities to refine classification accuracy over time and improve adaptability to shifting tourism dynamics. Additionally, exploring the impact of emerging technologies, such as AI and blockchain, on sustainable tourism observatories offers significant potential for enhancing data reliability, transparency, and scalability.

This approach, through the comparative evaluation of online qualitative data, enables the identification of evolving dynamics, opportunities, and challenges in sustainable tourism management. By offering a robust, real-time analysis framework, this methodology supports informed decision-making that aligns with regional priorities and advances global sustainability goals in tourism.

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Appendix

Table 1. *List of Accessible Tourism Observatory Websites Used in the Analysis*

Tourism Observatory	URL
UGM	https://www.pasca.ugm.ac.id/v3.0/
Tyrol	https://www.unwto.org/observatories/tyrol
CROSTO	https://www.iztzg.hr/
South Tyrol	https://insto.unwto.org/observatories/south-tyrol-italy/
Azores	https://otacores.com/
AlgSTO	https://www.turismodoalgarve.pt/pt/default.aspx
Barcelona	https://www.observatoriturisme.barcelona/
Biscay	https://www.visitbiscay.eus/es/inicio
Navarre	"http://www.turismo.navarra.es/esp/profesionales/Observatorio-turistico/Informes-coyuntura/2018/
Yukon	https://insto.unwto.org/observatories/yukon-canada/
Antigua	https://insto.unwto.org/observatories/antigua-guatemala-guatemala/
Yucatan	https://observaturyucatan.org.mx/
Nuevo Leon	https://www.nl.gob.mx
OTEG	https://www.observatorioturistico.org/
OTST	https://www.observatorioturisticodetlaxcala.com.mx/wp/
Southest Australia	https://insto.unwto.org/observatories/southwest-australia/
OTE	https://observatoriodeturismo.com.br/
CIET	https://www.turismo.sp.gov.br/ciet
Bogota	https://insto.unwto.org/observatories/bogota-colombia/

Source: Authors' analysis, 2025