Assessing Tourism Environmental Sustainability in Mediterranean Insular Destinations – Case Study Zakynthos Island

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Abstract. Attractiveness of tourist destinations relies heavily on the quality of natural/cultural resources, the maintenance of which in such destinations is fraught with difficulties. This is particularly true in Mediterranean islands, i.e., fragmented, naturally- and culturally-endowed territories and globally-acknowledged mass tourism destinations, confronted with severe threats, especially in overcrowded coastal zones. The goal of this paper is to outline a Tourism Environmental Sustainability (TES) approach as a means for assessing and regularly monitoring tourism environmental impacts on Mediterranean insular destinations. TES follows an indicator-based stream, built upon a combined top-down and bottom-up approach for guiding the selection of island-specific tourism sustainability indicators. The top-down one brings on board distributed knowledge on relevant, well-established global/European indicator systems (e.g. UNWTO, ETIS Toolkit); and sets up an enriched indicator pool for assessing tourism environmental sustainability. This is downscaled to the Mediterranean islands' context, and is further elaborated by means of a bottom-up approach, supporting indicators' prioritization on the ground of key attributes/vulnerability of each specific island under study. Implementation of TES in Zakynthos Island, Greece, namely an island currently confronted with severe tourism-related environmental impacts, demonstrates the need for well-documented, of global reach tourism sustainability assessments in alignment with place-specific peculiarities/fragility of the natural environment.

Keywords: Mediterranean islands · Sustainable Tourism · Tourism Environmental Sustainability · Environmental Indicators · Zakynthos-Greece

1 Introduction

Tourism, as a sector with a positive imprint on citizens' well-being [1] and a contributor to economic prosperity, growth and competitiveness lies among the primary developmental levers in the planning and policy discourse. However, despite the critical importance of tourism for many national and local/regional economies around the globe – including Greece – due to its capacity to generate growth, development of the sector can also jeopardize social welfare, natural integrity and economic prosperity when

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violating sustainability principles [2, 3]. Thus reaping tourism benefits takes for granted a well-established balance between economic growth on the one hand and preservation/sustainable exploitation of natural and cultural resources on the other [4]; while also maintaining quality of life and wealth of host communities [5].

The aforementioned balance has initiated the debate on the limits of growth, including the tourism sector. Actually this debate is not a new one, but dates back at least to the 60s [6]. Up to early 80s, such a debate had at its heart the concept of carrying capacity; while the focus was on identifying and properly managing the adverse effects of tourism by duly reorienting tourism policy [7]. Such an approach, however, was by early '90s replaced by the popular sustainable tourism term, perceived as a concept that fits best to all kind of tourism activities, spatial scales and distinct environmental contexts [6]. Defined by the WTO, sustainable tourism denotes a model that takes full account of its current and future economic, social and environmental impacts; while also addresses the needs of visitors, tourism industry, environment and the host communities [8]. However, as mentioned by Saarinen [6], the concept of carrying capacity occupies a key position in sustainable tourism. In fact, many of the principles of sustainable tourism are founded in the concept of carrying capacity, occasionally interpreted as an application of sustainable tourism [9].

The potential contribution of tourism to sustainability objectives is currently acknowledged at the international level, including UN Agenda 2030 and the Sustainable Development Goals (SDGs). Towards this direction, prioritization of sustainable tourism in SDGs is directly linked to [10]:

- SDG8 on 'Decent work and economic growth', and specifically in Target 8.9, aiming to "devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products by 2030";
- SDG12 on 'Sustainable production and consumption patterns', particularly in Target 12.b, aiming to "develop and implement tools to monitor sustainable development impacts for sustainable tourism that creates jobs and promotes local culture and products";
- SDG14 on 'Life below water', Target 14.7 aiming to "increase the economic benefits to Small Island Developing States (SIDS) and Least Developed Countries (LDCs) by 2030 through, among others, sustainable management of tourism".

However, attainment of sustainable tourism seems to be a tricky task. In fact, the current rapid growth and wide geographical expansion of tourist flows, coupled with developments occurring in the highly volatile external environment (climate crisis, economic and health crises, etc.) render the study of tourism and its evolution a "wicked problem'. As such, it calls for a multi- and inter-disciplinary as well as a multi-level approach. In addition, in order for a sustainable tourism outcome to be attained, its growth limits should be in alignment with social and environmental carrying capacity of destinations [11–13], rendering thus compliance with carrying capacity constraints quite critical in framing a sustainable tourism model [14].

As recognized by the WTO [8], progress towards sustainability in tourism has so far been rather slow, in addition to the sector's late start in applying monitoring procedures for assessing its impacts on destinations. Furthermore, despite the long-standing discussion and interest in sustainable tourism as well as the major advances in tourism

statistics, there is yet no standardized basis for relevant data collection at either the national or the subnational level. This is a significant *gap*, and one that limits the potential for data-enabled policy development, directed at advancing sustainable tourism goals and monitoring tourism sustainability achievements [15]. Furthermore, sustainability perception, in general, varies across diversifying community actors, grasping tourism development from different angles. Thus, applicability of international assessment toolkits can be questioned; while tailored-made approaches are considered as essential for operationalizing tourism sustainability assessments.

When downscaling at the Mediterranean level, the aforementioned knowledge/data gaps on tourism still remain of key importance and actually a main obstacle in order for policy making processes to be properly fed; and sustainable tourism models, in line with communities' expectations, to be articulated [16]. Such a gap is definitely noteworthy when considering the pivotal role of the Mediterranean world's leading destinations – about 30% of international arrivals in 2015 [17] and 41% of the European arrivals in 2019 [18] – rendering thus sustainable tourism a key driver for reaching sustainability objectives in this globally-acknowledged tourism hot spot area.

Particular significance in the Mediterranean region is gained by insular territories, i.e. fragmented land compartments and highly-rated tourism spots, as well as designated planning and management units due to insularity drawbacks [19]. The confined area of islands, the spectacular natural and cultural resources, and the small size of indigenous populations render them particularly vulnerable to tourism impacts. Thus concern is raised as to these impacts on islands' tangible and intangible identity (e.g. architecture, landscape, traditions, etc.), preservation of local ecosystems, land use change for accommodation and tourism-related infrastructure, etc.; since, in most cases, tourist development in such areas leaves aside issues of scale and surpasses carrying capacity limitations [20]. Tourist intensity and overcrowding in insular territories can undoubtedly increase both social and environmental pressures, a state already witnessed in Greek islands [19, 21]; and call for appropriate assessment tools for quantifying impacts or level of tourism sustainability performance.

Within such a context, the focus of this work is on the development of a methodological approach for assessing Tourism Environmental Sustainability (TES) in fragmented, owing fragile ecosystems, insular areas and is structured as follows: in Sect. 2 the environmental dimension of sustainable tourism is shortly discussed; Sect. 3 presents the methodological approach of this work; Sect. 4 describes the implementation of the proposed methodological framework in Zakynthos Island, Greece; finally, in Sect. 5 results are discussed and key conclusions are drawn.

2 The Environmental Dimension of Sustainable Tourism

Tourism development can definitely benefit a destination (e.g., job creation). However, when superficially planned and managed, such development can also have harmful repercussions on the destination's socio-cultural (e.g., loss of the traditional culture and identity) and natural environment (e.g., soil, air and water pollution, ecosystem degradation) [22]. Planning for sustainable tourism development, in this respect, serves the ultimate goal of providing directions towards a less resource-intensive tourist model. This implies

a wise balance among economic, social, cultural and environmental objectives, paying noteworthy attention to the integrity and adequacy of resources. The key principles of sustainable tourism include [23]:

- Environmental sustainability, promoting a tourism model that is compatible with and endorses ecological processes, biological diversity and destinations' natural resources.
- Social sustainability, supporting a tourism development form that is in alignment with and further reinforces community's traditional principles.
- Cultural sustainability, ensuring that the tourist model pursued respects community's cultural values, while also strengthening community identity itself.

When it comes to the natural environment, tourism affects in a direct and/or indirect way the environmental state of destinations, thus gradually degrading the key resources upon which the sector is founded. In order to minimize the adverse impacts of tourism on nature, careful planning is essential, bringing on board the concept of carrying capacity. This according to WTO, is defined as *"the maximum number of people that can visit a tourist destination at the same time, without causing destruction of physical, economic or sociocultural means and an unacceptable reduction in the quality of the satisfaction of visitors"* [5, 24]. That said, a need for particular focus on carrying capacity constraints of destinations is raised, with carrying capacity being tightly interwoven with the sustainable tourism perspective. In fact carrying capacity is a means for framing environmentally-acceptable thresholds up to which tourism can grow; and provides input for more informed and environmentally-solid policy decisions as well as the steady monitoring of outcomes of their implementation [14].

Speaking of insular territories as spectacular natural and cultural ensembles, the issue of carrying capacity acquires significant relevance. This is true especially in the context of tourism, being a major pillar of islands' economic profile, but also a source of severe impacts on sustainability achievements. Early studies on island tourism have mostly raised sustainability concerns, aligned with the impact assessment of tourism development. Thus, Mai and Smith [25] assessed sustainable tourism by use of a system dynamic model, fuelled by indicators as to the number of tourists, investments, tourism infrastructure, waste, pollution and attractiveness. Ng et al. [26] assessed islands' sustainable tourism by means of the Sustainable Ecotourism Indicator System (SEIS), i.e. a system grounded in social, environmental and economic dimensions. Mcelroy [27] used tourism density estimations as a critical input for assessing future scenarios and related environmental degradation, caused by tourism overcrowding. However, worth mentioning is that construction of such indicators is case-specific, depending on the particular geopolitical, climatic, cultural and social conditions [28].

Relevant to the above discussion is the concept of Environmental Tourism Capacity (ETC), comprising all 'fixed' and 'flexible' components of the natural and built-up environment as well as infrastructure. The 'fixed' components refer to the capacity of natural systems, expressed occasionally as ecological capacity, assimilative capacity, etc. These cannot be easily manipulated by human action and, to the extent that their limits can be estimated, they should be definitely respected as such. The 'flexible' components refer primarily to infrastructure systems, e.g. water supply, sewage, electricity, transportation. The capacity limits of these components can rise through investments,

organizational-regulatory measures, etc. Therefore, their values cannot be used as a basis for determining carrying capacity, but rather as a framework for orientating decision-making on management options [20]. Speaking of tourism destinations, including insular ones, the challenge at the local level is to maintain the 'fixed' components of ETC, i.e. ensure quantity and quality of natural resources that are vital for both the community and the visitors [29]. Of critical concern in this respect are coastal land, fresh water, agricultural land and marine resources, since the land- and sea-scape and especially the coastal part are the most harshly affected assets by widespread tourism activities and infrastructure.

The concept of TES is further elaborated in the following as a means for assessing tourism sustainability paths in insular territories.

3 Methodology

The methodological approach, developed in this work, follows a combined top-down and bottom-up stream in order for the most relevant indicators for assessing TES at the local level to be selected. The top-down approach elaborates on currently in place, well-established indicator systems for TES assessments. As such are considered the UNWTO Indicators for Sustainable Development of Tourist Destinations [30] and the European Tourism Indicator System (ETIS) [31]. The bottom-up approach indicates the distinct environmental aspects of a destination that are fragile and more vulnerable to tourism, thus significantly impacted by tourism development. The combination of top-down and bottom-up approaches aims at gathering distributed knowledge on TES indicators from the global and the European scenery; and properly downscaling this knowledge to the Mediterranean and particularly the islands' level so that environmental distinctiveness of insular destinations and vulnerability to tourism impacts to be effectively addressed by relevant indicators' selection. In particular, the proposed approach consists of four discrete steps (Fig. 1), namely:

- Step1: Exploration of the conceptual design and content (indicators) of global/European tourism indicators systems (UNWTO and ETIS), considered in the top-down stream.
- Step2: Merging of indicators of the above systems and downscaling at the Mediterranean level – especially insular territories – by highlighting those indicators that are relevant to the prevailing tourism model (hot spots of mainly mass nature) and the peculiar attributes – natural, cultural etc. – of Mediterranean islands.
- Step3: A bottom-up stream that, based on the case study specific attributes (Mediterranean island under study), highlights the most relevant of the aforementioned indicators for Mediterranean islands, thus prioritizing the most important ones for further consideration and/or data collection. Critical at this step is also exploration of objective quantitative (e.g. through legally binding rules) and/or scientifically sound (literature enunciated) thresholds for assessing carrying capacity surpass.
- Step 4: Delineation of case- and goal-specific indicators – based on indicators' prioritization of the previous step – and relevant data collection so that the assessment of the impacts of tourism activity on the environmental dimension of the destination to be accomplished.

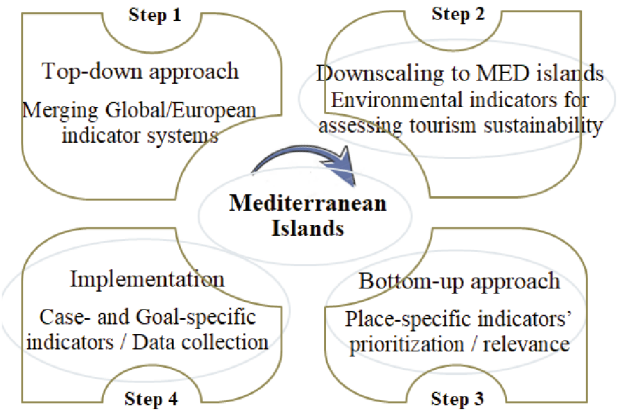


Fig. 1. Steps of the methodological approach, Source: Own elaboration

More specifically, in Step 1, the top-down stream is accomplished by elaborating on two well-documented and widely used indicators' systems, namely the UNWTO and the ETIS. More specifically, the UNWTO 2004 indicators' system is used [30] as one better oriented to planning concerns towards tourism sustainability. This system categorizes indicators into 14 issues (categories) and 42 subcategories. Within each subcategory, descriptive information on the key aspects of relevance is provided, assigning to each of them relevant indicators. The system represents a step-by-step approach, which guides the selection of operational indicators that are practically applicable to a destination. UNWTO system's architecture has formed the ground for developing the proposed, in this work, integrated indicators' system; and assessing TES as a place-based approach in Mediterranean islands.

The ETIS system [31], on the other hand, is a complete tourism management tool, grounded in a set of sustainability indicators. It contains 27 core and a set 40 optional indicators, addressing destination management, social and cultural impact, economic value and environmental impact. To the benefit of this system is that destinations can choose themselves the most relevant indicators in order for their needs, stakeholders' interests and specific sustainability challenges that the destination is confronted with to be met. ETIS provides a comprehensive, flexible and tourism sectoral perspective that intends to serve the specific sustainability expectations at each local destination [31]. Selected indicators out of the ETIS are used for enriching indicators' set of the UNWTO system, by properly merging ETIS indicators into the specific categories and subcategories of UNWTO system, taking into account potential overlapping. In addition, indicators with similar meaning are codified under the same latent category.

In Step 2, a sort of downscaling of the indicators' system produced by merging UNWTO and ETIS indicators to the Mediterranean insular context is carried out. This process takes into account peculiarities of island destinations as distinct land compartments and tourism hot spots. In particular, the selection of categories and subcategories from the previously described system is accomplished so that each one of them to best reflect the range of environmental issues that may arise in a destination that displays the essential attributes of a Mediterranean island, e.g. climate change vulnerability,

tourism density and intensity, scarcity of natural resources, extraordinary fragile natural assets. This effort has resulted in a system of 50 indicators, falling into properly selected environmentally-oriented categories/subcategories shown in Table 1 (also in Table I1 in Appendix I, presenting the full list of indicators included).

Table 1. Proposed indicators' system for Mediterranean Islands – Categories and subcategories, Source: Own elaboration from [30, 31]

Category	Subcategory	Source
A. Sustaining Cultural Assets	A1. Conserving built heritage	WTO
	A2. Protecting and enhancing cultural heritage, local identity, and assets	ETIS
B. Managing Scarce Natural Resources	B1. Energy management	WTO, ETIS
	B2. Climate change and tourism	WTO, ETIS
	B3. Water availability and conservation/drinking water quality	WTO
	B4. Reducing Transport Impacts	ETIS, WTO
	B5. Water management	ETIS
C. Limiting Environmental Impacts of Tourism Activity	C1. Sewage treatment	WTO, ETIS
	C2. Solid waste management	WTO, ETIS
	C3. Air pollution	WTO
	C4. Controlling noise levels	WTO
	C5. Managing impacts of tourism & infrastructure	WTO
D. Protection of Valuable Natural Assets	D1. Protecting critical ecosystems	WTO
	D2. Sea water quality	WTO, ETIS
	D3. Beaches	ETIS, WTO
E. Controlling Tourism Activities	E1. Nr of tourists per m^2 of the site and nr of tourists per km^2 of the destination	WTO
	E2. Managing events	WTO

In Step 3, indicators of Table 1 are prioritized according to their importance as to the specific insular territory under study. This is accomplished by means of the bottom-up approach, highlighting potential environmental impacts of tourism in each specific case study context. These impacts can harm, among others, the physical – ecological state of the destination in multiple ways. Indicative impacts per distinct fields are demonstrated in Table 2; while they are also properly linked to subcategories of Table 1 and consequently to a range of respective indicators (see Table I1 for indicators' list) that can be used for assessing environmental sustainability of the tourism sector.

Work carried out in Steps 1 to 3, i.e. a combination of top-down and bottom-up approach, demarcates the necessary indicators that need to be addressed in order for

the environmental sustainability of a specific insular destination to be assessed. This is accomplished in the final Step 4, provided that the relevant indicators' information is available. That said, the proposed methodological approach can also be grasped as a means for guiding the selection of indicators and collection of essential data in order for the environmental impacts of tourism in insular destinations to be assessed; and reactive or preventive policy measures for handling these impacts to be featured.

4 Implementation of the Proposed Methodology and Results

Mass tourism development in Greek islands has, for several decades, been the prevailing model and the cornerstone of local socio-economic development. Its role in the national economy is also highly acknowledged, taking into consideration that Greece hosts almost half (50.7%) of the islands located in the Mediterranean Sea [32]; and ranks among the top five tourism destinations in the Mediterranean EU territory [33]. Despite the pivotal role of tourism in the islands and state's economy [19], however, tourist flows in island regions exceed, in most of the cases, the carrying capacity of their fragile and extraordinary natural and cultural environment [14, 19]. Assessing TES of Greek Islands, in this respect, is of high priority for properly guiding policy directions towards a sustainable, resilient and long term flourishing tourist model in these extremely vulnerable land compartments.

Grounded in the previous discussion, the assessment of TES with a focus on the environmental dimension is carried out in this section, having as a case study the Zakynthos Island, Greece, i.e. a Mediterranean island that constitutes a typical example of an insular tourism destination, at least in the Greek context.

4.1 Main Attributes of Zakynthos Case Study Island

Zakynthos is one of the main islands of the Ionian complex (Fig. 2a), owing a surface of 407 km^2 and a coastline of 123 km. It disposes quite distinguishable and fragile natural ecosystems (Fig. 2b), coupled with environmentally-sensitive coastal parts. The island hosts the first institutionalized National Marine Park in Greece that aims at protecting the: nesting beaches of the caretta-caretta turtle, Mediterranean seal, avifauna, terrestrial and coastal flora and fauna, marine ecosystem and fishing stocks.

The island counts for 39,737 inhabitants (2021 provisional Census data). Population displays escalating trends during the last decades and a largely uneven distribution, with the city of Zakynthos – main urban area – hosting about 40% of inhabitants. In addition, the spatial pattern of economic activity follows a polarized pattern, with dominant the eastern coastal part (Fig. 2c); while western coastal settlements are gaining strength to the detriment of the mountainous ones. This polarization is closely related to the intensification of tourism and respective deployment of accommodation/transport infrastructure in the eastern part (Fig. 2d).

Traditional economic sectors – i.e. agriculture/livestock husbandry and processing of primary agricultural products – show signs of decay during the last decade; while a gradual transition towards a tertiarized economy, dominated by the tourism sector, is in

Table 2. Indicative physical – ecological impacts of tourism on islands, Source: Own elaboration from [20]

Fields	Impacts	Subcategory WTO/ETIS
Quality of life	Uncontrolled development	C5. Managing impacts of tourism and infrastructure
	Traffic and congestion	E1. Nr of tourists per m^2 of the site, per km^2 of the destination
	Noise pollution	C4. Controlling noise levels
Infrastructure	Unsustainable waste production	C2. Solid waste management
	Unsustainable pressure on sewage system	C1. Sewage Treatment
Resources	Unsustainable use of water	B3. Water availability and conservation/Drinking water quality
	Unsustainable use of energy	B1. Energy management
	Pollution of fresh water	B3. Water availability and conservation/Drinking water quality
	Marine pollution	D2. Sea water quality
	Air pollution	C3. Air pollution
Natural Environment	Visual degradation of landscape	C5. Managing impacts of tourism infrastructure
	Forest clearance	D1. Protecting critical ecosystems
	Biodiversity loss/disturbance of endangered species	D1. Protecting critical ecosystems
	Damage to natural and cultural heritage	C5. Managing impacts of tourism infrastructure A1. Conserving built heritage
	Erosion (soil/coastal)	C5. Managing impacts of tourism infrastructure
Built Environment	Wear and tear	B2. Climate change and tourism
	Incompatibility/land use conflicts	C5. Managing impacts of tourism infrastructure
	Alteration of historic settlements (urbanization, loss of architectural heritage etc.)	A1. Conserving built heritage

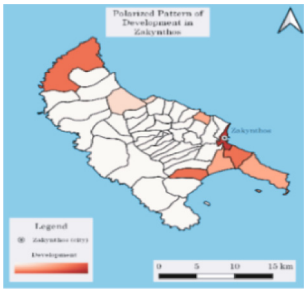
* In each subcategory a number of indicators are incorporated (see Table I1 in Appendix I)



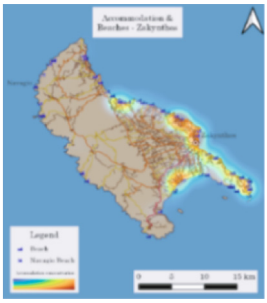
(a) Location of Zakynthos in the Ionian Islands' complex



(b) Natural/cultural resources of Zakynthos Island



(c) Polarized pattern of development



(d) Tourism accommodation/beaches

Fig. 2. Key attributes of Zakynthos Island, Source: Own elaboration

progress. Such a transition, however, increases environmental pressure on the extraordinary natural ecosystems of the island due to the rapid expansion of the built-up environment and overcrowding (inhabitants and visitors); a situation that appears more intense in the south-eastern part of the island during the peak tourist season.

5 Assessing Environmental Sustainability of Tourism in Zakynthos Island

Minimizing the adverse impacts of tourism on the natural environment demands careful planning, with particular focus on fragile ecosystems and carrying capacity constraints for effectively framing an environmentally-solid ground for sustainable tourism to flourish. Orientation of such a planning exercise calls for identifying potential impacts of tourism on the destination and related indicators for assessing and steadily monitoring these impacts as input to policy action. Following the discussion of previous sections, steps for assessing the TES in Zakynthos Island are presented in Fig. 3.

Speaking about the developmental polarized pattern of Zakynthos Island, the transition towards a tertiarized economy that is driven by the tourism sector and pursues a highly spatially-concentrated pattern is already mentioned (see also Fig. 2). This pattern results in a high stress – in environmental terms – exerted on respective island's compartments, especially the coastal ones. As to the tourism profile, the mass pattern is so

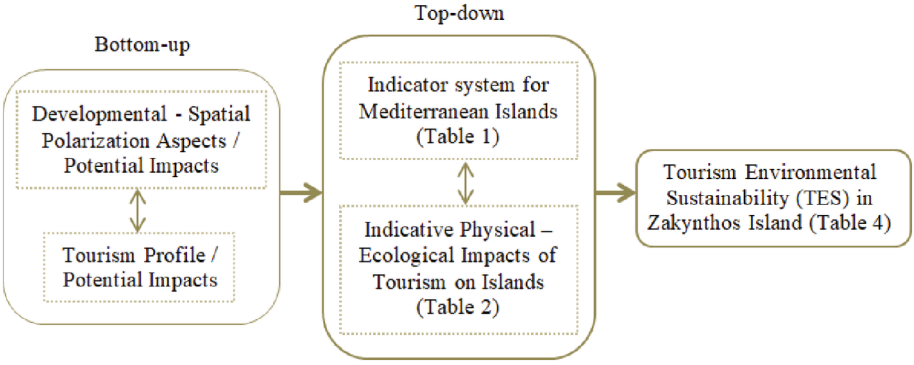


Fig. 3. Steps for assessing tourism environmental sustainability of Zakynthos Island, Source: Own elaboration

far the dominant tourism trail. This profile is sketched by a number of relevant indicators (Table 3) which, as various researchers claim, are indicative of the tourism burden in a destination [34–36].

Table 3. Key attributes of tourism activity in Zakynthos Island (2019), Source: Own elaboration from [35–38]

Indicator	Zakynthos (Ionian Islands)	Value
Tourism density (bed nights/ km^2)	10,865 (10,292 [38])	high
Tourism Intensity (bed nights/inhabitants)	111.3 (116.5 [38])	high
Number of visitors/surface of the island	1,771.34	medium
Number of visitors/local population	18.14	medium

Tourist density and intensity outcomes (Table 3) manifest the high tourist burden of the Zakynthos Island, an outcome considerably aligned with respective values for Ionian Islands as a whole. These values are classified as 'high', comparing to the ones emanating from relative studies with reference to the Greek insular context [36, 38]. Based on these studies as well, the rest two indicators of Table 3 are classified as 'medium'. Nevertheless, the spatial concentration of tourism activities (Fig. 2d), being the main source of the island's polarized developmental pattern (Fig. 3c); and the spatial distribution of natural resources (Natura 2000 regions and natural reserves) (Fig. 2b), clearly demarcate a certain risk to further degradation of natural – coastal and marine – ecosystems.

Following the steps of Fig. 3, in Table 4 the results of the qualitative assessment of the Tourism Environmental Sustainability (TES) of Zakynthos Island are displayed. Categories considered are based on those presented in Table 2, further elaborated in order to adjust to the particularities of Zakynthos Island on the one hand; and fit the categories presented in the pool of categories/subcategories/indicators presented in Table 1 on the

other. At the end of this process, TES qualitative assessment is carried out on the basis of 20 indicators (see for their description in Table I1 – Appendix I).

TES qualitative assessments, presented in Table 4, emanate from a good insight into the current state of the island, local plans, policy documents, relative studies, etc. Based on these assessments, it is evident that, despite the high performance in 6 out of the 20 indicators, the overall image can be characterized as 'satisfactory', taking into account the large number of indicators displaying a 'medium' performance.

6 Discussion and Conclusions

Mediterranean Islands are currently confronted with great challenges and dilemmas. Climate crisis, energy crisis, health crisis, economic crisis as well as already visible overtourism trends and their impacts, seem to place those regions and their future sustainable (tourism) development at stake. Most of the above crises, however, are perceived as a two-sided coin, since they carry risks but also present new opportunities ahead for: awareness raising and action undertaking by local stakeholders; assessment and valuation of the services offered by the natural ecosystems to local communities; and a more dedicated effort to the remarkable opportunities offered by the current technological advances for stepping forward towards a more smart, sustainable and resilient future pathway for both insular communities and their visitors. Technological advances, in particular, seem to present a new challenging stream, taking into account the way smart applications can offer solutions to chronic problems – environmental as well – of island regions; and the progress carried out by a number of Mediterranean islands in 'going smart' in various respects.

Tourism, as a major lever for islands' development and a sector that can make a significant contribution to all three sustainable development pillars, needs also to steadily commit to this sustainability journey. The example of Zakynthos Island – being a rather typical one of tourist developed Greek islands – clearly demonstrates the outcome of an irrational, resource-intensive trajectory brought about by the development of tourism; leading also to severe structural changes and a monocultural economic orientation of the local economy. In addition, the currently unsustainable mass tourism model definitely results in a certain overcrowding of the coastal parts, as clearly demarcated in the island's spatial developmental pattern. Concurrently, this pattern places at risk the valuable and abundant land and marine resources. This, in turn, leads to loss of the comparative advantage, upon which tourism attractiveness and related products of the island are built upon. Qualitative assessment of Tourism Environmental Sustainability in Zakynthos Island clearly displays the outcomes of a rather unsustainable model, a situation that is expected to worsen, given the exponential rising of tourist flows around the globe and the position of Mediterranean islands and particularly the Greek ones as important spots in the tourism arena.

Overturning this unsustainable tourism development model calls for a place-based, multi- and inter-disciplinary planning approach, seeking to achieve consensus on well-documented desired future end states and related policy action for their implementation. The proposed TES approach can be a useful tool in this respect, combining well-established, of global reach, tourism indicators' systems – top-down stream – with local

Table 4. Qualitative assessment of Tourism Environmental Sustainability of Zakynthos Island, Source: Own elaboration [estimations by use of 2019 data (before COVID-19 outburst)]

Indicators' Categories and Subcategories		Ranking Indicator	Source	TES qualitative assessment*		
Category	Subcategory / Subvariables			1	2	3
A, Sustaining Cultural Assets	A1. Conserving Built Heritage	I.1	WTO			
	A2. Protecting and enhancing cultural heritage, local identity, and assets	I.5	ETIS			
B. Managing Scarce Natural Resources	B1. Energy Management	I.6	WTO			
		I.7	WTO/ETIS			
		I.8	WTO/ETIS			
	B2. Climate Change and Tourism	I.11	WTO/ETIS			
		I.14	ETIS			
	B3. Water Availability and Conservation	I.15	WTO			
	B5. Reducing Transport Impact	I.17	ETIS			
	B6. Water Management	I.20	ETIS			
C. Limiting Environmental Impacts of Tourism Activity	C1. Sewage Treatment	I.23	WTO			
	C2. Solid Waste Management	I.25	WTO			
		I.28	WTO			
	C5.Managing Impacts of Tourism and Infrastructure	I.38	WTO			
D. Protection of Valuable Natural Assets	D1. Extent of protected area(s)	I.40	WTO			
	D2. Sea Water Quality	I.41	WTO			
		I.42	WTO/ETIS			
	D3. Beaches	I.43	ETIS			
		I.46	WTO/ETIS			
E. Controlling Tourist Activities	E1. Nr of tourists per m^2 of the site, per km^2 of the destination	I.47	WTO			

* Note: 1 - High (Best performance); 2 - Medium (Medium performance); 3 - Low (Worst performance)

specificities – bottom-up stream – that highlight particular conditions and fragility of natural resources at each specific island studied. Thus a more focused selection of relevant indicators for assessing and monitoring the impacts of tourism on distinct environmental assets is conducted; and the necessary data collection fields for serving the planning effort are displayed. Provided that the necessary data is available and thresholds related to these assets are given, operationalization of respective indicators; quantification of TES qualitative assessment; regular monitoring/reporting of assessment outcomes; and articulation of relevant proactive and/or remediating policy interventions will be possible for 'filling the gap' of 'nature mistreating'.

Appendix I

See Table I1.

Table I1. Categories and subcategories of global (UNWTO) and European (ETIS) tourism indicator systems used in this work, Source: Own elaboration from WTO, WTO/ETIS, and ETIS

Category	Subcategory	Indicator	Source
A. Sustaining cultural assets	A1. Conserving Built Heritage	I.1 Number and type of new legislation introduced to preserve structures at local, regional, or national level	WTO
		I.2 Number and type of designation under which historic structures, monuments and districts are recognized	WTO
		I.3 Amount of funds allocated to the restoration, preservation, and maintenance of cultural assets on a yearly basis	WTO
		I.4 Percentage/change in the development of the surrounding area to a cultural asset	WTO
	A2. Protecting and enhancing cultural heritage, local identity, and assets	I.5 Percentage of the destination's events that are focused on traditional/local culture and heritage	ETIS
B. Managing scarce natural resources	B1. Energy Management	I.6 Per capita consumption of energy (overall, by tourist sector – per person day)	WTO
		I.7 Percentage of businesses participating in energy conservation programs, or applying energy saving policy and techniques	WTO/ETIS
		I.8 Percentage of energy consumption from renewable resources (at destinations, establishments)	WTO/ETIS
		I.9 Energy consumption per tourist night, compared to general population energy consumption per resident night	ETIS

(*continued*)

Table I1. (*continued*)

Category	Subcategory	Indicator	Source
	B2. Climate Change and Tourism	1.10 Frequency of extreme climate events	WTO
		1.11 Percentage of tourist infrastructure located in vulnerable zones	WTO/ETIS
		1.12 Total CO_2 produced due to the community's energy consumption	WTO
		I.13 Percentage of natural area coverage in the territory of the destination	WTO
		I.14 Percentage of tourism enterprises involved in climate change mitigation schemes, such as CO_2 offset, low energy systems, etc. and adaption responses/actions	ETIS
	B3. Water Availability and Conservation	1.15 Water price per litter or cubic meter	WTO
	Drinking Water Quality	1.16 Percentage of tourism establishments with water treated to international potable standards	WTO
	B4. Reducing Transport Impact	1.17 Percentage of tourists and same-day visitors using different modes of transport to arrive at the destination	ETIS
		I.18 Percentage of tourists and same-day visitors using local/soft mobility/public transport services to get around the destination	WTO/ETIS
		I.19 Average carbon footprint of tourists and same-day visitors travelling from home to the destination	ETIS
	B5. Water Management	I.20 Water consumption per tourist night compared to general population water per resident night	ETIS
		I.21 Percentage of tourism enterprises taking actions to reduce water consumption	ETIS

(*continued*)

Table I1. (*continued*)

Category	Subcategory	Indicator	Source
		I.22 Percentage of tourism enterprises using recycled water	ETIS
C. Limiting environmental impacts of tourism activity	C1. Sewage Treatment	I.23 Percentage of sewage from the destination receiving treated to at least secondary level prior to discharge	WTO
		I.24 Percentage of total waste recycled per tourist compared to total waste recycled per resident per year	ETIS
	C2. Solid Waste Management	I.25 Waste volume produced by the destination (tons)	WTO
		I.26 Percentage of tourism establishments collecting waste separately	WTO/ETIS
		I.27 Percentage of employees informed and trained in the use and disposal of the substances they use	WTO
		I.28 Waste production per tourist night compared to general population waste production per person (kg)	WTO
		I.29 Percentage of total waste recycled per tourist compared to total waste recycled per resident per year	ETIS
	C3. Air pollution	I.30 Number of days exceeding standards	WTO
		I.31 Number of health problems reported by tourists	WTO
		I.32 Cost of repair to buildings and cultural sites	WTO
	C4. Controlling Noise Levels	I.33 Noise levels at site in decibels	WTO
	C5. Managing Impacts of Tourism and Infrastructure	I.34 Total length of roads	WTO
		I.35 Total run of overhead electrical cables	WTO
		I.36 Height of buildings (average and maximum)	WTO

(*continued*)

Table I1. (*continued*)

Category	Subcategory	Indicator	Source
		I.37 Density of buildings per square kilometer	WTO
		I.38 Ridgeline or coastline continuity (percentage of intrusion on ridge and coastline)	WTO
D. Protection of valuable natural assets	D1. Protecting Critical Ecosystems	I.39 Existence of protected areas at the destination	WTO
		I.40 Extent of protected area(s)	WTO
	D2. Sea Water Quality	I.41 Turbidity of water	WTO
		I.42 Level of pollution in seawater per 100 ml (fecal coliforms, campylobacter)	WTO/ETIS
	D3. Beaches	I.43 Percentage of beaches awarded with Blue Flag	ETIS
		I.44 Total km of free beaches relative to total km of beaches	ETIS
		I.45 Percentage of beaches accessible to all	ETIS
		I.46 Number of days per year the beach/shore is closed due to contamination	ETIS/WTO
E. Controlling Tourist Activities	E1. Nr of tourists per m^2 of the site and km^2 of the destination	I.47 Nr of tourists per square meter of the site, per square kilometre of the destination	WTO
	E2. Managing Events	I.48 Number of waste bins (bins/spectators) and number of recycle bins for plastic, aluminium, paper, organic waste	WTO
		I.49 Number of security personnel (as % of spectators), number of incidents (arrests, complaints), number of medical/first aid posts	WTO
		I.50 Area for parking	WTO

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