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Monitoring Sustainability Performance of Insular Territories against SDGs – The Mediterranean Case Study Region

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Abstract: With the adoption of the United Nations' Agenda 2030, some member states of the European Union have voluntarily assessed their state as to the 17 Sustainable Development Goals (SDGs) by use of the United Nations' monitoring system for administrative bodies. However, this system does not take into account specific challenges in achieving SDGs that are faced by vulnerable geographical contexts. Among these contexts fall the emblematic case of insular regions, suffering from particular natural and geographical 'handicaps' which, in most cases, confine their efforts to SDGs' achievements. The goal of this paper is to feature a monitoring system that is capable of measuring progress of insular territorial contexts to 2030 SDGs; and is adjusted to islands' particularities. In doing so, the link between the structural problems of islands and the UN 2030 SDGs is established, feeding the design of a monitoring mechanism by means of an Islands' Sustainable Development Index (ISDI). ISDI integrates environmental, social, economic and innovation dimensions, represented by four core indicators, namely the IEND, ISD, IED and ID respectively. The

results of this research demonstrate: (i) the need to assess progress of islands towards the SDGs taking into account the "insularity" dimension, i.e. incorporating in the monitoring system respective intrinsic and extrinsic peculiarities of such territorial contexts; and (ii) how intrinsic quantitative and qualitative attributes of island regions, embedded in an integrated analytical approach, can inform strategic decision-making in order for higher levels of sustainability performance in these specific territorial entities to be achieved.

Keywords: UN Agenda 2030; Sustainable Development Goals 2030; European Islands; Islands' Sustainable Development Index; Monitoring System; Islands' Sustainability

1. Introduction

The Sustainable Development Goals (SDGs), signed on by the UN General Assembly in 2015, consist of 17 interlinked global goals and the accompanying 169 targets; and aim at inspiring Member States to focus and join efforts in order for the maximum sustainability performance in economic, social and environmental terms to be collectively attained at a global scale by 2030 (Singh et al. 2018; EU Sustainable development 2020; EU 2030 Agenda 2020). With this in mind, in 2017 the Inter-Agency and the Experts' Group on SDGs' indicators (IAEG-SDGs) established an *indicator framework* and a voluntary *monitoring system*. This framework is based on the use of 232 indicators; and aims at systematically assessing global progress, complemented by progress at the Member States' level (Leadership Council 2015; OECD 2015; Ritchi, 2018; UN General Assembly 2017; UN IAEG-SDGs 2020; UE SDG Indicators 2020a).

The cornerstone of the IAEG-SDGs' mechanism is the *national level*, where monitoring is based on a set of indicators that rest upon national priorities (Leadership Council 2015; UN SDG Indicators 2020b), further complemented by regional and global assessments. This framework of indicators is completed by a transversal level – the *thematic monitoring* –, which groups together indicators for the analysis of complex challenges in different sectors and thematic areas, such as health, education, agriculture (UN General Assembly 2015; UN General Assembly 2015; Leadership Council 2015; Ripple et al. 2017; UN General Assembly 2017). This *multi-level monitoring approach* (Costanza et al. 2016; Nilsson et al. 2016; Pradhan et al. 2017; Coscieme et al. 2020) stresses the necessity to: cope with a series of future-oriented and urgent technical priorities through the creation of partnerships at the global level; and monitor the performance of indicators to account for sustainability counterparts at the Member States' level (Leadership Council 2015; EUROSTAT Statistical Books 2017).

The monitoring system of the 2030 Agenda (or UN monitoring system) promotes not only an effective international cooperation among Member States, but also exchanges of good practices as a

mutual learning tool (UN General Assembly 2015). However, the rather large number of indicators, incorporated in this evaluation mechanism, is highlighted by the scientific community as an issue that does not facilitate the collection and real time analysis of data in order for *sustainability gaps* to be identified and targeted action to be undertaken (Hák et al. 2016; Beynen et al. 2018; Miola and Schiltz 2019; Allen et al. 2016; Allen et al. 2018; Janoušková et al. 2018; Dong et al. 2017; Smith et al. 2017). This brings forward the need to make the SDGs *concrete and operative* (Hák et al. 2016) and evaluate the relevance of indicators in order for decision-making processes and coordinated multi-level governance strategies to be favored (Lal et al. 2008; Connell 2018).

In this regard, Miola and Schiltz underline also the fact that "*differences in policy priorities between countries could exacerbate the importance of choosing a method or indicators*" (Miola and Schiltz 2019, p. 4). This, in turn, implies that the UN monitoring system could eventually disfavor the comparison among countries' performance in SDGs (Miola and Schiltz 2019), since no adequate guidance is provided by means of explaining how countries engaged can assess and measure progress towards sustainability (Beynen et al. 2018). However, potential for a comparison among similar geographical realities would not only facilitate the interpretation of the 17 SDGs, but would also support the identification of sustainability indicators that are more relevant to spatial contexts with similar characteristics (Beynen et al. 2018).

Assessments of SDGs' performance becomes even more complicated and obscure in the case of *island contexts*, mainly due to the multiple challenges these territories are confronted with. These challenges are closely related to structural problems, emerging from *insularity* and related geographical and natural handicaps (Byrne et al. 2002; Connell et al. 2002; Margaras 2016; Garau et al. 2018; Opinion of the European Economic and Social Committee 2020). In fact, islands suffer from permanent and unbeatable natural, structural or demographic handicaps, linked to their distance from mainland and the isolation emerging from their geographical location (Opinion of the European Economic and Social Committee 2017; Economic, social and territorial cohesion 2020; Koutsi and Stratigea 2021).

Insularity drawbacks, as factors that severely affect the islands' economic and social cohesion and prosperity (Official Journal of the European Union 2000) are recognized by the European Union only since 2000. However, despite the realization that these drawbacks constrain the islands' sustainable future pathways and SDGs' achievements, these have not been incorporated in the IAEG-SDGs' monitoring mechanism, built to assess the progress attained towards the 17 interlinked global goals. As a result, this monitoring mechanism *falls short* in providing valid comparisons among insular geographical contexts. Indeed, while this mechanism, described by means of Indicators and a Monitoring Framework for the SDGs (Leadership Council 2015), favors a system of indicators that fulfil assessments at several spatial contexts (e.g. local, regional, national and global ones), it fails to

address a spatial level that bears the structural, geographical and natural singularities of insular territorial ones.

Based on the aforementioned gap, the *focus* of this paper is on the development of a SDGs' monitoring system that addresses the structural particularities of islands. This is pursued by illuminating these particularities within the context of the Agenda 2030 SDGs; and, based on that, setting up the *Islands' Sustainable Development* (I_{ISD}) index (composite indicator). I_{ISD} is perceived as interpretative of the ability of an island to discern and develop proper strategic actions for handling weaknesses in the social, economic, territorial and innovation realms.

The *structure* of the paper has as follows: in *Section 2*, issues, gaps and challenges raised in evaluating and monitoring SDGs in the peculiar island contexts are discussed. *Section 3* provides an overview of the key structural inefficiencies of six major Mediterranean case study islands that are used to provide critical input to the structuring of the I_{ISD} index. These islands dispose similar structural problems, although they differ in size and administrative territorial contexts. *Section 4* builds up a theoretical framework, capable of establishing the linkage between the structural problems of island contexts and the 2030 SDGs. In *Section 5*, an islands-specific SDGs' monitoring system is presented in an effort to integrate peculiarities of island contexts in SDGs assessments; and set the ground for conducting comparisons of progress to SDGs among different insular contexts. *Section 6* elaborates on the implementation of the proposed SDGs' monitoring system in the previously mentioned Mediterranean case study islands. In *Section 7*, results obtained from this implementation are discussed. Finally, in *Section 8* key conclusions of this research work are drawn.

2. Assessing SDGs' Performance in Island Territories – Research Challenges and Gaps

The problem of identifying appropriate indicators for measuring and evaluating achievements towards SDGs becomes evident in cases that sustainable development (SD) of *island contexts*, i.e., backwards or less-favored regions, is to be analyzed; and calls for integrated planning and governance approaches (Treaty of Maastricht 1992; Treaty of Amsterdam 1997). This assessment can be accomplished not only through a careful overview of sustainability achievements at the state level (native countries) but, above all, through the study and exchange of experiences with other islands, which are confronted with the same handicaps and are disposing similar cultural, social and economic attributes (EUROISLANDS 2013; European Structural and Investment Funds Regulations 2014–2020 2015; Opinion of the European Economic and Social Committee 2017; Official Journal of the European Communities 2000; Garau et al. 2020).

In fact, *islands*, as often peripheral and rather isolated territories, need to: cope with multiple developmental drawbacks, being further intensified in an era of fierce global competition and Climate Change repercussions; and, concurrently, preserve their unique identities, culture and

traditions as well as the remarkable land- and sea-scape peculiarities (Committee on Economic Affairs and Development 2005; Spilanis et al. 2012). However, in the UN Agenda 2030, apart from some measures associated with the Small Island Developing States (SIDS), a distinctive treatment of insularity, dedicated to all those major islands that fall into the jurisdiction of the European territory, is not in place; neither are taken into account in this agenda the specific physical and socioeconomic developmental constraints of these territories (Committee on Economic Affairs and Development 2005) and respective *obstacles* to sustainability. Such a distinctive treatment would be further justified by the fact that these major islands have, over the years, established a particular developmental profile (Kerr 2005), which calls for different actions from those demarcated in their continental counterparts. This holds true, especially when one comes to identify indicators capable of highlighting the islands' inefficiencies and, subsequently, monitoring their resolution.

Due to the aforementioned arguments, evaluation of insularity's realities by means of the UN monitoring system becomes extremely problematic, since this system seems to be deficient in grasping the difficulties inherent in setting up sustainable development strategies, relevant to the limited opportunities that appear in insular contexts (Connell 2018; Kerr 2005). Hence, there is a need to build up a monitoring system that allows for the analysis of similar geographical territories, even if these do not belong to the same Territorial Unit (NUTS). Towards this end, Viola (1998) in the Report on the "Problems of island regions in the European Union" stressed the need for revising the "Nomenclature of Territorial Statistical Units" (NUTS), considering its current form as liable for overlooking the real situation of island regions, thus hindering the overall vision of the islands' context. This deficit is not highlighted by the monitoring system of the UN Agenda 2030, despite the fact that belonging to different NUTS levels leads to a very different interpretation of the indicators. In fact, in case that monitoring indicators refer to the national level, all characteristics of the island context are highlighted as the nation is the island; while in case that monitoring indicators refer to the regional level, i.e. by inserting the island context into a broader one (native country), the problems of the island are enormously broadened by means of the national indicators.

Comparison of assessments derived from monitoring indicators at the national level in the above mentioned first case, and those emanating by use of monitoring indicators at the regional level in the second one, seems impossible, since a sort of interconnection between the two sets of indicators is lacking. This is due to the fact that monitoring indicators at the regional level are not able to provide a complete analysis at the entire State level, but they need a peer review across countries in the same region, including also metrics not taken into consideration in Complementary National Indicators (Leadership Council 2015). Namely, whether island states (such as Cyprus) or island regions belonging to a state (such as Corsica), monitoring the islands' sustainable development performance implies the use of the same sets of variables and indicators. This would facilitate not

only the identification of political priorities, but also the choice of the most suitable indicators for monitoring progress towards the achievement of the 17 SDGs. In fact, the islands' characteristics are, in most cases, difficult to be grasped by nationally-driven monitoring indicators. The latter, by addressing a much broader spatial context such as the whole nation, lose sight of the intrinsic problems of insular contexts. Therefore, a failure to define proper, island-specific indicators does not only confine a fair comparison among similar territorial contexts. On the contrary, it can also lead to the lack of the right framework for assessing the real situation and the barriers that need to be overcome in order for desired advancements towards the 2030 SDGs to be attained by properly identifying favorable political options. This, in turn, implies the need to articulate an *island-specific monitoring system to SDGs'*, thus dealing with the gaps identified in the IAEG-SDGs indicators' framework and monitoring system.

Speaking of the island contexts, these *gaps* relate to the:

i. Lack of a monitoring system that embeds *obstacles* and *constraints* of island realities in paving sustainable pathways. Such obstacles and constraints render islands distinctly different from main land territories.
ii. Lack of specific indicators that address real problems, emanating from the "insularity" condition. These could definitely unveil the diversified economic, social and environmental attributes of island regions, compared to those of main land territories.
iii. Inability of the current IAEG-SDGs monitoring mechanism to allow an effective comparison between geographically similar contexts and enable the share of good practices among them.

To fill these gaps, this work attempts to develop a *monitoring system* that is relevant to the intrinsic attributes of the islands' contexts; and can support SD assessments through a joint interpretation of both the 17 SDGs (UN General Assembly 2015) and the structural peculiarities that are common to island regions. The *originality* of this work, therefore, lies in the elaboration of the following *research questions*:

i. Is it important to identify a SDGs' monitoring system that is tailored to certain disadvantaged geographical contexts, such as the insular ones, and why?
ii. Is it important to have a common island-specific monitoring system to SDGs, serving the needs of both the state islands and the islands belonging to a state?
iii. Is it possible to set up suitable monitoring indicators for assessing performance to SDGs with the aim to better inform policy decisions and promote the exchange of good practices to those disadvantaged island contexts?

Using as a study ground certain large Mediterranean islands that share similar structural inefficiencies, this study also aspires to make a significant contribution to the literature by featuring

a methodological approach for monitoring SDGs' achievements and guiding sustainability benchmarking among island territories.

3. The Features of the Major Mediterranean Case Study Islands

A monitoring system for handling insular contexts must be formulated, disposing certain capabilities in terms of measuring, analyzing and evaluating sustainability achievements against SDGs in such contexts. Towards this end, *quantitative and qualitative information* relevant to the islands at study is needed, illuminating characteristics of insularity, irrespective of the territorial unit level (NUTS) to which these islands belong (EUROISLANDS 2013). In this respect, sustainable development performance at different administrative levels – i.e. island state or island belonging to a state – can be assessed through a monitoring mechanism that is based on the common key attributes of islands, namely their geographical / territorial particularities and shared structural problems (European Parliament Resolution, 2003). The proposed monitoring system is tested in two sovereign states, i.e. Malta and Cyprus; and four island regions belonging to the states of Italy, Greece and France, namely Sicily and Sardinia, Crete and Corsica respectively (Figure 1).

Insert figure 1

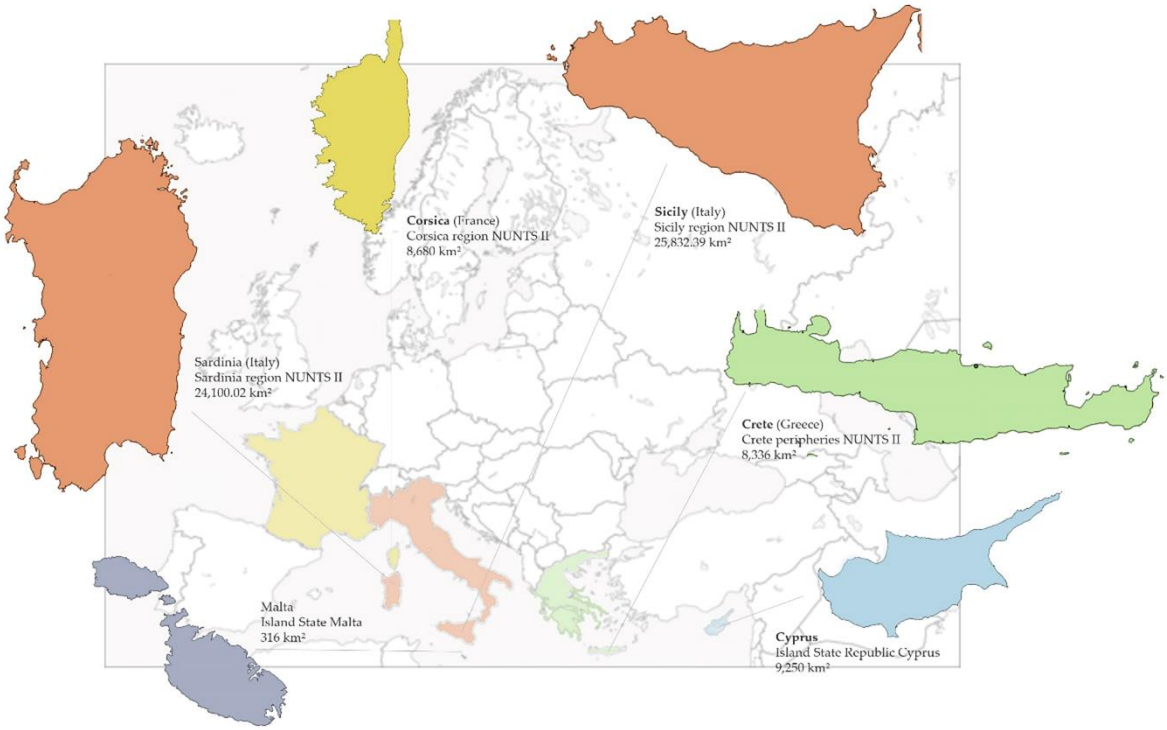

Figure 1. Major Mediterranean case study islands and territorial units, Source: own elaboration

The choice of these islands as case studies is mainly driven by the need to have a sample of administrative units that exhibit comparable attributes in terms of *geographical position*; and *similar structural problems*, as evidenced by literature review. Such a choice allows the identification of the common, most sensitive fields of application of the monitoring system in an islands' sample that is largely disposing similar sustainability objectives. It also enables assessing islands that need to improve their governance strategies towards SDGs' fulfillment; and those that represent positive showcases from a sustainability performance perspective.

As regards the *geographical position*, the selection of islands falling into the same sea basin – the Mediterranean one – was fundamental for a more effective comparison of island systems and evaluation of sustainability progress. The focus on the Mediterranean Sea Basin (European Atlas of the Seas 2020) is justified by the fact that islands (and coastal areas) falling into this Basin share common policy objectives as to the sustainable future development of their maritime and coastal parts [COM (2009) 466]. This undoubtedly facilitates a more consolidated view of issues relating to sustainability objectives – social, economic and environmental / of (coastal) land and maritime nature – in these island regions [COM (2009) 466; UE Maritime Forum 2021; COM (2012) 491 final]. Furthermore, the Member States of the Mediterranean Basin are *"encouraged to develop integrated strategies in order to face the challenges of the island regions and establish a system of exchange of best practices"* [COM (2009) 466, p. 14].

Considering *similarity of structural problems* of the islands under study, the objective was to favor a coherent policy approach to sustainable islands' development that is capable of assessing these problems and, subsequently, demarcating proper actions that will target islands' sustainability objectives and will expand solid relationships among islands concerned. The structural problems of the six islands under study can be classified into three groups, which roughly correspond to the three pillars of sustainable development (Atlas of the Islands 2013), i.e. economic efficiency, social equity, and environmental conservation (EUROISLANDS 2013; ADE 2011; SDGs Cyprus 2017).

The *obstacles towards sustainability* that need to be overcome in all six islands are easily demonstrable, taking into account the similar funding priorities these demonstrate in the EU regional and urban development contexts (European Structural and Investment Funds Regulations 2014–2020 2015; European Commission 2020). These are associated with certain weaknesses, the most important of which relate to the: lack of accessibility to European infrastructure, low investment rates in R&D, limited natural resources, confined economies of scale and constraints in social inclusion (Cohesion Policy and France 2014; Cohesion Policy and Cyprus 2014; Cohesion Policy and Malta 2014; Cohesion Policy and Italy 2014; Cohesion Policy and Greece 2014). These weaknesses raise important barriers to sustainability achievements and are associated with the

"permanent phenomenon of economic and social peripheralization that prevents islands to reach the goals of sustainable development that are reached by the mainland" (Deidda 2014, p. 1).

The Mediterranean insular territories, selected in this work, are either island states or island regions belonging to a state; and their sustainable future trajectory is particularly challenged by social, environmental, economic and adoption of innovation constraints.

In general, island regions are mainly perceived as lagging behind spatial contexts (Spilanis et al. 2012), a status that is the outcome of ineffective regional development policies by the state or policies that fall short in handling peculiarities and geographical diversity of insular contexts. In *Sicily* and *Sardinia*, for example, this deficit results in lower productivity rates and competitiveness, compared to other Italian mainland regions. Furthermore, the lack of adequate transport infrastructure also weighs on the lower pace of internationalisation (Country Report Italy 2020). Islands are also marked by a significantly higher rate of *poverty risk*. In fact, in 2018 the Italian islands presented a rate of poverty risk close to 18.3%, compared to the 3.2% of the Italian northern regions (Country Report Italy 2020). *Corsica*, on the other hand, was ranked last in terms of competitiveness and investments, compared to the rest of France (Country Report France 2020). The same holds also in *Crete Island*. Actually, in Greece the economic recession that begun in 2009 has widened the already large economic and social disparities between the mainland and the island regions (Country Report Greece 2020). The situation of *Cyprus* and *Malta* is different since they, as island states, can implement policies that are capable of reducing the negative effects of insularity. Such policies contribute to the decrease of the development gap between them and the mainland regions of the European Union. However, they are still confronted with various problems, mainly related to social inclusion, income and education inequalities and mobility constraints (Country Report Cyprus 2020; Country Report Malta 2020).

Having delimited the sample of study islands and using the above assumptions as a starting point, an *island-specific monitoring system* that is based on the linkage between the 17 SDGs on the one hand, and the structural problems of the island contexts concerned on the other, is developed and tested. Towards this end, a measurable quantity of sustainability achievements is defined, by means of the *index of Islands' Sustainable Development* (I_{ISD}). On the basis of the I_{ISD} as a monitoring mechanism, are explored the: current level of sustainability achievements of the studied islands; and sectors in which more significant policy interventions are necessary in order for the gap against 2030 SDGs to be diminished.

4. The Theoretical Framework for Developing the Islands' Monitoring Mechanism

In order to develop the *Islands' Sustainable Development index* (I_{ISD}) and feature its constituents, namely the most suitable core and sub-indicators for assessing / monitoring islands' realities, it is

290 necessary to build up a *theoretical framework* that can embed, in an integrated way, all aspects related
291 to structural problems of islands' contexts. Such a framework is depicted in Figure 2, being the
292 outcome of several theoretical contributions on the structural problems commonly met in island
293 contexts; and the practical implications these have in terms of sustainability performance, as these
294 have been recently elaborated by the authors (Garau et al. 2020; Desogus et al. 2019, Garau et al.
295 2018). More specifically, the structure of the proposed framework attempts to capture the
296 interrelations between the 17 SDGs (UN General Assembly 2015), described in the 2030 Agenda; and
297 the structural problems common to island regions, derived from the Opinion of the European
298 Economic and Social Committee (Opinion of the European Economic and Social Committee 2020) as
299 well as the study that authors conducted in 2018 (Opinion of the European Economic and Social
300 Committee 2020).

301 **Insert Figure 2**

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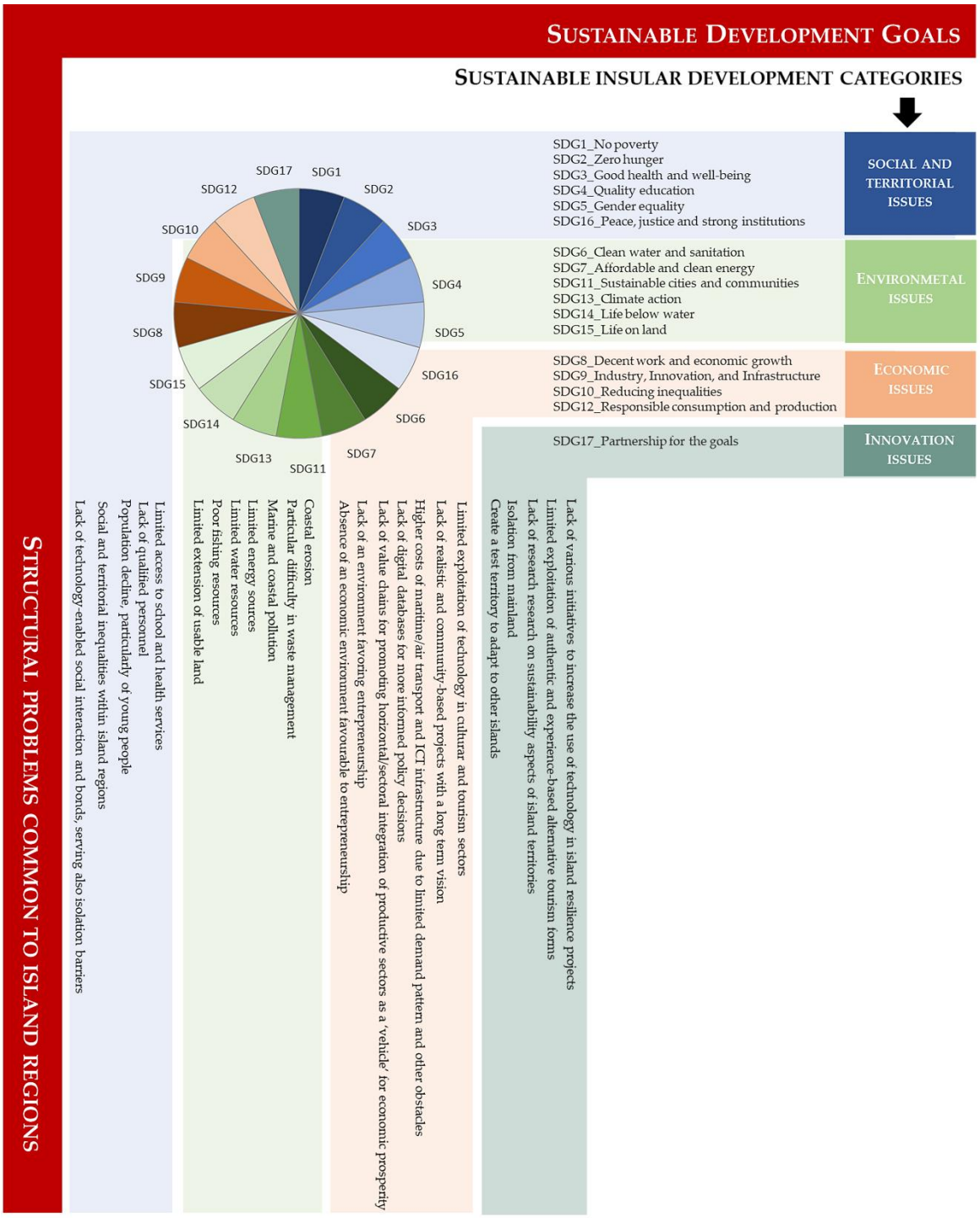

Figure 2. Theoretical framework for developing the Islands' Monitoring System, Source: own elaboration

This framework has allowed the conceptual break down of the monitoring mechanism for sustainable island development into *four categories*, namely:

i. The *social and territorial category* (line 1 in Figure 2): this links the sustainability goals addressing poverty, justice and well-being (SDGs 1 to 5 and 16) to island problems that reflect limited access to education, health and conditions of life. This category highlights the social equity imbalances, confronted by island communities in the last decade due to various internal and external factors (Opinion of the European Economic and Social Committee 2017; Stratigea et al. 2017; Stratigea and Kavroudakis 2019).

ii. The *environmental category* (line 2 in Figure 2): this interrelates the sustainability goals that define environmental conservation and sustainable use of resources (SDGs 6, 7, 11 and 13 to 15) with problems linked to the limited natural resources of islands (e.g. arable land, water and mineral resources), and the sea level rise and soil erosion (Opinion of the European Economic and Social Committee 2012). This category actually elucidates constraints embedded in the design / implementation of strategic developmental actions in island territories due to either the limited resource availability or restrictions emerging from geographical impedances as well as the high fragmentation or vulnerability of their remarkable habitats and land- and sea-scapes (Opinion of the European Economic and Social Committee 2017; Stratigea et al. 2017; Koutsi and Stratigea 2021).

iii. The *economic category* (line 3 in Figure 2): this attempts to establish the linkage between the SDGs 8, 9, 10 and 12, addressing the promotion of a strong, lasting and resource-respectful economy; and the problems inherent in island economies, mainly relating to unemployment (especially of young people), lower GDP per inhabitant, lack of entrepreneurial culture, and low competitiveness of the island economy, compared to other mainland counterparts (Chatziefstathiou et al. 2005; Koutsi and Stratigea 2021), to name a few. Most of the above mentioned weaknesses reflect the outcome of "monocultual" local economic production systems. Indeed, a number of island economies specialize in a single or quite few economic sectors (e.g. tourism and agriculture), or are condemned to do so due to size limitations (Opinion of the European Economic and Social Committee 2017; Stratigea et al. 2017; Koutsi and Stratigea 2021).

iv. The *innovation category* (line 4 in Figure 2): this intersects the 17th SDG (global partnership for sustainable development) with specific islands' structural problems, such as the digital divide, the lack of relative research and the weak diffusion of social innovations and governance models, to name a few. Handling these inefficiencies can result in the maturation of island communities on glocal (global and local) issues and challenges ahead as well as the strengthening of both horizontal and vertical interactions that can spread knowledge and broaden motivation to actively engage in the glocal endeavor (Marava et al. 2019). Of critical importance is also innovation diffusion in the *tourism sector*, the strong point of island contexts,

where value chains' creation and promotion of authentic, experience-based alternative products can become the locomotive of islands' qualitative future development pathways (Stratigea and Katsoni 2015; Katsoni and Stratigea 2016). Several islands, especially the larger ones, are well performing in the tourism sector, disposing a vibrant economic specialization in this sector (Margaras, 2016).

The above break down can illuminate the *key structural inefficiencies* of island territories in joining efforts to SDGs. At the same time, it allows the identification of those islands' attributes that need to be addressed in policy exercises so that alignment of island regions with the global SDGs struggle in equal, to mainland areas, terms to be sought. Assessing current state of these attributes, identifying targets to be reached and respective gaps, implementing relevant policies and monitoring their outcomes are all critical steps for island regions in their pathway towards the fulfillment of 2030 SDGs.

5. The Methodological Approach for Developing the Islands' Monitoring Mechanism

The focus of this section is on establishing an islands-specific monitoring system to SDGs by means of a *synthetic indicator*, i.e. a single quantitative measure, which will be suitable for integrating the peculiar components of island contexts in SDGs assessments; and conducting comparisons of performance to SDGs' among such different contexts. This synthetic indicator – *Islands Sustainable Development Index - I_{ISD}* – is developed based on the previously mentioned four categories, namely the social and territorial, environmental, economic and innovation ones (Section 4). The approach for assessing I_{ISD} and its four constituents are discussed in the following.

5.1. The Islands' Sustainable Development Index (I_{ISD})

Formula 1 shows how the four categories, reflecting social/territorial, environmental, economic and innovation issues respectively are interwoven, normalizing the parameters identified in each key category and then obtaining the Islands Sustainable Development Index (I_{ISD}) as the *geometric average* of these categories (Garau et al. 2015). Core indicators, contributing to the assessment of I_{ISD} in Formula 1, are:

- I_{SD}, representing the *social indicator* or the level of social equity achieved;
- I_{END}, identifying the *environmental indicator*, implying the range of strategic actions addressing environmental upgrading purposes;
- I_{ED}, corresponding to the *economic indicator*, reflecting the level of economic well-being; and
- I_{ID}, reflecting an *indicator linked to innovation*, interpreted as the level of research and innovation inherent in island regions.

$$I_{ISD}(\%) = [I_{SD}(\%) + I_{END}(\%) + I_{ED}(\%) + I_{ID}(\%)] \quad [1]$$

To simplify monitoring of the categories listed above, the value of each indicator is displayed as a percentage. The Islands' Sustainable Development Index (I_{SD}) is represented with a circular diagram with a maximum value equal to 100%. This is subdivided into subsets, representing the four core indicators (I_{SD}, I_{END}, I_{ED} e I_{ID}) to which an *equal value range* has been assigned, namely from a minimum of 0% to a maximum of 25% (Figure 3). The choice of an equal value range to each indicator in Formula 1 – i.e. all indicators are equally important for calculating I_{SD} –is justified by the indications of the:

- Tier Classification for Global SDG Indicators of the Inter-Agency and Experts' Group on SDGs' indicators (IAEG-SDGs, 2020); and
- European Union, which considers the indicators related to sustainability as equally weighted in order for progress in each SDG to be assessed (EUROSTAT statistical books 2017; ISPRA 2020).

Thus, the percentage disposed by each indicator demonstrates the % share or contribution of each category (social, environmental, economic and innovation) to SDGs' achievement.

Insert Figure 3

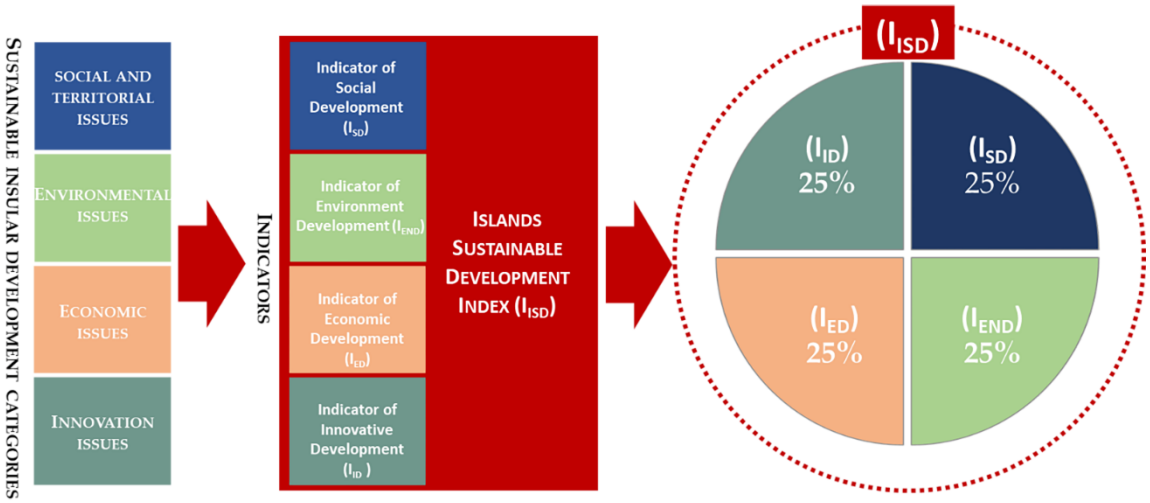

Figure 3. Schematic representation of the Islands' Sustainable Development Index (I_{SD}) and its four Core Constituents (I_{SD}, I_{END}, I_{ED} and I_{ID}) Source: own elaboration

The performance or level of sustainable development as a percentage is calculated by means of Formula 2, taking into account that each core indicator (I_{SD}, I_{END}, I_{ED} e I_{ID}) can go for a maximum sustainability percentage equal to 25% (Figure 4b).

$$100 \,/\, \text{percentage of each indicator} = 25 \,/\, X \qquad [2]$$

Figure 4b displays an interpretative circular diagram (Adenle et al. 2020), prepared by use of the core indicators that form the Islands' Sustainable Development Index (I_{ISD}). This diagram identifies the sustainability performance or state level of each category (social, environmental, economic and innovation) for each island. The circular shape provides the representation of the core indicators in the form of wedges (Figure 4a), whose size is proportional to that of the data they represent. These levels were then added together to establish the total Islands' Sustainable Development achievements (Figure 4c).

The circular diagram (Figure 4b) represents the subdivision of the Islands' Sustainable Development Index (I_{ISD}) into the four core indicators I_{SD}, I_{END}, I_{ED}, and I_{ID}, with each of them ranging from a minimum value of 0% to a maximum of 25%. It displays the maximum level that an island can reach in that particular category.

Insert Figure 4

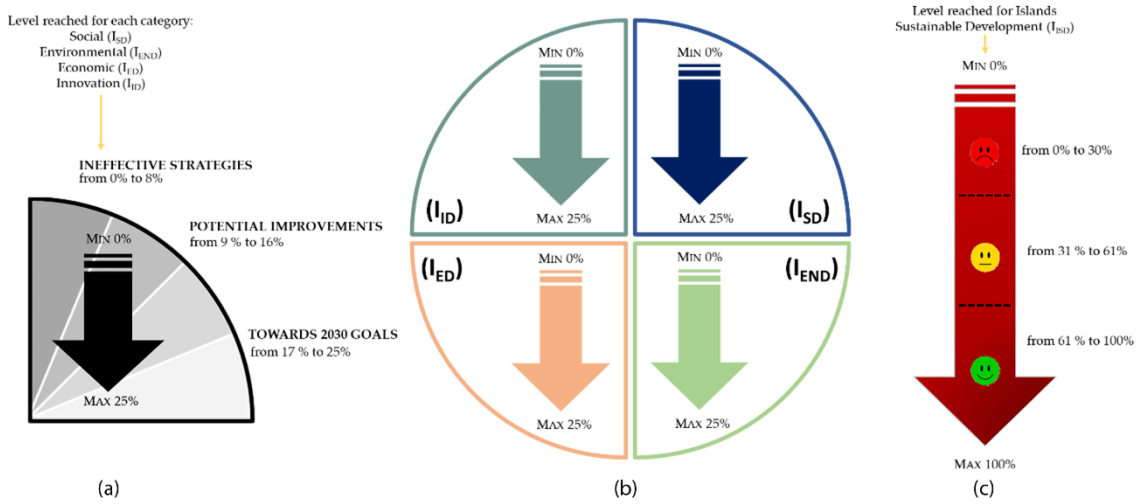

Figure 4. Representation of the thresholds of the indicators [parts (a) and (b)] and the Islands Sustainable Development Index [part (c)], Source: own elaboration

Figure 4a shows the internal threshold ranges of each core indicator's performance (I_{SD}, I_{END}, I_{ED} and I_{ID}). More specifically, the lower core indicator's performance range – from 0% to 8% – denotes poor outcomes and the need to develop more robust policies in the fields embedded in this indicator (as depicted by sub-indicators of each core indicator) in order for achievements to SDGs to be improved. The intermediate core indicator's performance range – from 9% to 16% – demonstrates that a certain level of performance is reached by the implementation of current strategies; however, internal structural problems are somehow blocking further improvements to SDGs prospects.

Finally, the higher core indicator's performance range, ranging from 17% to 25% – witnesses that current SD strategies are resulting in quite satisfactory outcomes and the islands undertake actions that can lead to 2030 Agenda SDGs' achievements.

Figure 4c demonstrates the overall level of sustainable development achievements, being the result of the sum of performances of the four core indicators I_{SD}, I_{END}, I_{ED} and I_{ID}. This consists of *three distinct threshold intervals* as well, based on respective values of the Islands Sustainable Development Index I_{ISD}, namely a(n):

- *low performance interval* – from 0% to 30% –, demonstrating difficulties of islands to implement effective policies that pave the way to the 2030 SDGs;
- *intermediate performance interval* – from 31% to 61% – displaying a situation where islands, despite the insularity constraints these are confronted with, succeed to implement policies that have positive sustainability outcomes; and
- *quite promising performance interval* – from 61% to 100% – representing an island with a governance model fully targeted to the 17 SDGs.

5.2. The core indicators as constituents of the Islands' Sustainable Development Index

The calculation of the four core indicators – I_{SD}, I_{END}, I_{ED} and I_{ID} – is conducted by use of eleven main variables (Table 1), reaped by a literature-based study of the state of the art on the analysis and development of indicators (Garau et al. 2015; Garau et al. 2020; Ciccarelli 2003; Gismondi et al. 2004; Abis et al. 2013; Mazziotta et al. 2010; Bezzi et al. 2010; Mazziotta and Pareto 2020).

Formula 3 is used for calculating the *Core Indicator of Social Development* (I_{SD}). More specifically, I_{SD} value is the outcome of three main variables, namely: I_{EL} for education, I_{HL} for health, and I_{LC} for life condition. I_{EL} represents the level of participation in primary, secondary and tertiary education. I_{HL} describes the level of general health. Finally, I_{LC} indicates the level of poverty and social exclusion. The sum of the three variables that constitute the Indicator of Social Development (I_{SD}) is divided by 11, which represents the number of sub-indicators used to describe I_{SD}.

$$I_{SD}(\%) = [I_{EL}(\%) + I_{HL}(\%) + I_{LC}(\%)]\ (1/11) \quad [3]$$

Formula 4 applies for estimating the *Core Indicator of Environmental Development* (I_{END}). I_{END} is composed of two variables, namely: I_{TR} for transport and I_{EA} for environment and agriculture. The first focuses on motorization rates and road accidents; while the second is grounded on a series of information that relate to environmental risks and business capacities in rural areas. The sum of the two variables is divided by 7 (number of sub-indicators used to describe I_{END}).

$$I_{END}(\%) = [I_{TR}(\%) + I_{EA}(\%)]\ (1/7) \quad [4]$$

Formula 5 is used for assessing the *Core Indicator of Economic Development* (I_{ED}). I_{ED} is composed of three variables, namely: I_{LM} for labour market, I_E for the economy and I_B for business. I_{LM} represents

the level of employment. I_E describes the productivity of labor. I_{LM} interprets the state of businesses in island contexts. The sum of the three variables is divided by the number of sub-indicators used to describe I_{ED} that equals to 11.

$$I_{ED}(\%) = [I_{LM}(\%) + I_E(\%) + I_B(\%)]\ (1/11) \quad [5]$$

Finally, the *Core Indicator of Innovation Development* (I_{ID}) is described by Formula 6 as the sum of three variables, namely: I_{RI} for research and innovation, I_{DS} for internet use and I_T for tourism. More specifically, I_{RI} focuses on human resources engaged in research and innovation; I_{DS} describes the use of internet by the population; and I_T represents the rate of hotel bookings. The sum of the three variables is divided by 9, which represents the number of sub-indicators used to describe I_{ID}.

$$I_{ID}(\%) = [I_{RI}(\%) + I_{DS}(\%) + I_T(\%)]\ (1/9) \quad [6]$$

Insert Table 1

Table 1. Variables, Core Indicators and Sub-indicators in Studied Insular Contexts, Source: own elaboration

Variables	Indicators	Sub-indicators	Sicily	Crete	Corsica	Cyprus	Malta	Sardinia
Indicator of Social Development (I_{SD})								
1. Educational level	I_{EL}	Participation rates in early childhood education	96	81.4	89.2	95.3	95.3	96.7
		Students enrolled in upper secondary education that followed vocational programmes	53	33.4	38.9	16.7	28.5	51.1
		People aged 25-64 years having attained at least an upper secondary level of education	51.8	72.2	66	82.5	55.2	54.2
		Tertiary educational attainment of people aged 30-34 years	20.3	33.7	21.6	58.8	37.8	21.6
		HDI Evolution of State belonging	0.88	0.87	0.9	0.87	0.88	0.88
2. Health level	I_{HL}	Standardised death rates from cancer	230.5	246.3	219.8	193.7	220.7	250.6
		Live births to mothers aged ≥ 40 years	6.7	5.7	5.1	4.6	3.6	12.4
		Number of (practising) physicians	430.4	636.1	303.9	386.8	396.4	485.3
		General health of State of belonging	0.9	0.86	0.91	0.9	0.9	0.9
3. Living Conditions	I_{LC}	People at risk of poverty or social exclusion	51.6	37	17.4	23.9	19	35
		Sustainable wellbeing of State belonging	28.1	23.6	30.4	30.7	29	28.1
Indicator of Environmental Development (I_{END})								
4. Transport	I_{TR}	Motorisation rate	661	430	550	629	608	643
		Fatal road accidents	42	84	86	57	38	64
		International Logistics Performance of State of belonging	3.74	3.20	3.84	3.15	2.81	3.74
5. Environment and Agriculture	I_{EA}	Severe soil erosion by water	43.9	23.1	18.9	6.5	10.6	12.1
		Young farm managers	8.3	9	17.3	3.3	7.1	13
		Area under organic farming	26.1	2.3	4.4	3.1	0.1	8.5
		Environmental Performance of State belonging	71	69.10	80	64.80	70.70	71
Indicator of Economic Development (I_{ED})								
6. Labour Market	I_{LM}	Employment rate	44.5	67	68.9	75.7	77.2	57.3
		Employment rate of older persons	41.6	51.2	70.4	61.1	51.6	50.4
		Youth unemployment rate	51.1	30.5	19	16.6	9.2	45
		Regional Competitiveness	-1.09	-1.26	-0.44	-0.29	-0.37	-0.97
7. Economy	I_E	Gross domestic product (GDP) per inhabitant	58.63	58.88	84.17	89.87	98.34	70.14

Variables	Indicators	Sub-indicators	Sicily	Crete	Corsica	Cyprus	Malta	Sardinia
		Labour productivity per hour worked	83.5	40.5	117.7	66.8	67.6	82.9
		Quality of Government	-1.55	-1.46	0.07	-0.11	-0.07	-1.23
8. Business	I_B	Enterprise birth rate	8.8	4.6	8.7	10.4	9.6	8.1
		Enterprise death rate	9.2	6.9	3.5	4.3	6.4	8.6
		High-growth enterprises	12.6	6.7	9.2	2.7	13.7	11
		Business extent of disclosure	7	7	8	9	3	7
Indicator of Innovation Development (I_{ID})								
9. Research and Innovation	I_{RI}	Researchers	0.38	1.02	1.12	0.28	0.43	0.38
		Human resources in science and technology	27.8	30.5	38.3	50.4	44	28.4
		Nr cross-border, transnational and interregional cooperation programmes of State of belonging	4205	1794	4764	323	222	4205
10. Digital society	I_{DS}	Daily internet users during the three months preceding the survey	69	62	76	79	82	69
		People accessing the internet away from home or work	47	67	80	79	76	80
		People buying/ordering goods or services over the internet for private use	26	67	56	39	58	38
		Innovation performance	4	7	4	5	4	4
11. Tourism	I_T	Annual rate of change for nights spent in tourist accommodation	2.9	13.9	0.8	2.3	5.6	5
		Isolation	0	2	2	2	3	3

5.3. Variables and sub-indicators

Table 1 displays the eleven variables used for calculating the Islands' Sustainable Development Index I_{SD}. Sources of relevant indicators are the EUROISLANDS project (2013), which analyzed the characteristics of islands; and the General Assembly of 2017, where the United Nations established global indicators for SDGs (UN General Assembly 2017).

For each variable and respective core indicator, several sub-indicators of SD were identified (Table 1, column 3), widely described in the literature (Bohme et al. 2011; EUROISLANDS 2013; ISPRA 2020; Leadership Council 2015; UN IAEG-SDGs 2020; UN SDGs Indicators 2020a).

The values of sub-indicators are drawn upon different databases. More specifically, the following sources are used: EUROSTAT regional yearbook Maps, 2019; HDI, 2020; HEALTH INDEX, 2021; Happy Planet Index, 2017; Global Rankings, 2018; Environmental Performance Index, 2020; Regional Competitiveness Index, 2019; EQI, 2017; Business Extent of Disclosure Index, 2019; Keep.EU, 2020; Regional Innovation Scoreboard, 2019; and Island Index, 2020. These data sources provided input at both the island state level (i.e. Malta and Cyprus) and the belonging states' level (Italy, Greece and France) in the cases of Sardinia, Sicily, Crete, and Corsica islands. The decision for using mixed indicators – regional and national ones – is justified by the fact that island policies are falling into regional ones, but are also closely linked or are parts of respective national ones. Furthermore, data on sub-indicators refers to a *five-year time span* – 2017 to 2021– making thus possible the featuring of the rate of change of specific sub-indicators in some cases (e.g. State of belonging, HIHD Evolution); and the state's performance in managing island dynamics in some other cases (e.g. International

Logistics Performance of State of belonging). This has allowed an overall five years view, in order for sustainable development estimates and subsequent possible future improvements to be assessed.

In particular, the three variables – education, health and living conditions –, which are used to define the core Indicator of Social Development (I_{SD}), are represented by sub-indicators that highlight the level of social equity. The sub-indicators that describe the two variables representing the core Indicator of Environmental Development (I_{END}) address transport in relation to natural obstacles and environmental problems of islands. The three variables, used for calculating the core Indicator of Economic Development (I_{ED}), are defined by sub-indicators that describe aspects of the economic development of island contexts. Finally, the sub-indicators associated with the three variables that are used to assess the core Indicator of Innovation Development (I_{ID}) describe the aptitude for innovation and the promotion of tourism.

The values of each single sub-indicator are reported in the EUROSTAT Regional Yearbook (2019), with the exception of the last sub-indicators of each core indicator, highlighted in bold in Table 1. The latter are obtained from specific indices, linked to the analysed variable (for example Human Development Index for the "Education level" variable).

The sub-indicators are, in most cases, expressed in percentage. However, some of them, such as "At-risk-of-poverty" rate, are not expressed this way. These are normalized by use of Formula 7, thus rendering all values in the same form (percentages).

$$\text{European average} / 100 = \text{sub indicator value} / X \quad [7]$$

The values of three sub-indicators, namely "Business extent of disclosure", "Innovation performance", and "Isolation", are represented in classes. The sub-indicator "Business extent of disclosure" considers 10 classes (from 0 = least disclosure to 10 = highest disclosure), as defined by the World Bank (Business Extent of Disclosure Index 2019; Doing Business 2020). The sub-indicator "Innovation performance" is represented by the 12 classes (from modest = 1 to leader = 12) that the European Commission determines on average for the European Union, as part of the studies on the Regional Innovation Scoreboard (Regional Innovation Scoreboard 2019). The classes representing the sub-indicator "Isolation", demonstrating the distance of an island from the mainland and other nearby islands, were taken from the United Nations Environment Programme (UNEP Environment Programme 2020; Island Inde 2020).

6. Results

The above-described methodological approach outlines a monitoring system that is dedicated to the assessment of sustainability trajectories of islands' contexts. This is accomplished by establishing bonds between the eminent structural weaknesses of these territories and the 17 SDGs (Figure 2). In fact, the variables, selected for delineating each core indicator – i.e. I_{SD}, I_{END}, I_{ED} and I_{ID} – and related

sub-indicators, all contributing to the calculation of the proposed *Islands' Sustainable Development* index I_{ISD} as an islands-specific monitoring mechanism, are falling into the European Union Directives and especially the 2030 Agenda, as the means for monitoring the Member States' progress to sustainability over the next 15 years.

6.1. Calculation of percentage values

Table 2 shows all values of sub-indicators in percentages, calculated by use of Formula 7. In fact, this Formula is used for re-calculating those sub-indicators' values that were not given as a percentage from the databases used (see subsection 5.3).

Insert Table 2

Table 2. Variables, indicators and sub-indicators in studied insular contexts – Values of sub-indicators in percentage, calculated by use of Formula 7 (changes from values of Table 1 in bold), Source: own elaboration

Variables	Indicators	Sub-indicators	Sicily	Crete	Corsica	Cyprus	Malta	Sardinia
Indicator of Social Development (I_{SD})								
1. Educational level	I_{EL}	Participation rates in early childhood education	96	81.4	89.2	95.3	95.3	96.7
		Students enrolled in upper secondary education that followed vocational programmes	53	33.4	38.9	16.7	28.5	51.1
		Population aged 25-64 years having attained at least an upper secondary level of education	51.8	72.2	66	82.5	55.2	54.2
		Tertiary educational attainment of people aged 30-34 years	20.3	33.7	21.6	58.8	37.8	21.6
		HDI Evolution of State belonging	0.88	0.87	0.9	0.87	0.88	0.88
2. Health level	I_{HL}	***Standardised death rates from cancer***	***0.2305***	***0.2463***	***0.2198***	***0.1937***	***0.2207***	***0.2506***
		Live births to mothers aged ≥ 40 years	6.7	5.7	5.1	4.6	3.6	12.4
		Number of (practising) physicians	**0.4304**	**0.6361**	**0.3039**	**0.3868**	**0.3964**	**0.4853**
		General health of State of belonging	0.9	0.86	0.91	0.9	0.9	0.9
3. Living Conditions	I_{LC}	*People at risk of poverty or social exclusion*	*51.6*	*37*	*17.4*	*23.9*	*19*	*35*
		State of belonging sustainable wellbeing	28.1	23.6	30.4	30.7	29	28.1
Indicator of Environment Development (I_{END})								
4. Transport	I_{TR}	**Motorisation rate**	**66.1**	**43**	**55**	**62.9**	**60.8**	**64.3**
		Fatal road accidents	**0.0042**	**0.0084**	**0.0086**	**0.0057**	**0.0038**	**0.0064**
		Environmental Performance of State belonging	**28.1**	**23.6**	**30.4**	**30.7**	**29**	**28.1**
5. Environ-ment and Agriculture	I_{EA}	Severe soil erosion by water	43.9	23.1	18.9	6.5	10.6	12.1
		Young farm managers	8.3	9	17.3	3.3	7.1	13
		Area under organic farming	26.1	2.3	4.4	3.1	0.1	8.5
		State of belonging Environmental Performance	71	69.10	80	64.80	70.70	71
Indicator of Economic Development (I_{ED})								
6. Labour Market	I_{LM}	Employment rate	44.5	67	68.9	75.7	77.2	57.3
		Employment rate of older persons	41.6	51.2	70.4	61.1	51.6	50.4
		Youth unemployment rate	*51.1*	*30.5*	*19*	*16.6*	*9.2*	*45*
		Regional Competitiveness	-1.09	-1.26	-0.44	-0.29	-0.37	-0.97
7. Economy	I_{E}	Gross domestic product (GDP) per inhabitant	58.63	58.88	84.17	89.87	98.34	70.14
		Labour productivity per hour worked	83.5	40.5	117.7	66.8	67.6	82.9
		Quality of Government	-1.55	-1.46	0.07	-0.11	-0.07	-1.23
8. Business	I_{B}	Enterprise birth rate	8.8	4.6	8.7	10.4	9.6	8.1
		Enterprise death rate	*9.2*	*6.9*	*3.5*	*4.3*	*6.4*	*8.6*
		High-growth enterprises	12.6	6.7	9.2	2.7	13.7	11
		Business extent of disclosure	7	7	8	9	3	7
Indicator of Innovative Development (I_{ID})								
	I_{RI}	Researchers	0.38	1.02	1.12	0.28	0.43	0.38

Variables	Indicators	Sub-indicators	Sicily	Crete	Corsica	Cyprus	Malta	Sardinia
9. Research and Innovation		Human resources in science and technology	27.8	30.5	38.3	50.4	44	28.4
		Nr cross-border, transnational and interregional cooperation programmes of State of belonging	**17.2**	**7.3**	**19.5**	**1.3**	**0.9**	**17.2**
10. Digital society	I_{DS}	Daily internet users during the three months preceding the survey	69	62	76	79	82	69
		People accessing the internet away from home or work	47	67	80	79	76	80
		People buying/ordering goods or services over the internet for private use	26	67	56	39	58	38
		Innovation performance	4	7	4	5	4	4
11. Tourism	I_T	Annual rate of change for nights spent in tourist accommodation	2.9	13.9	0.8	2.3	5.6	5
		Isolation	*0*	*2*	*2*	*2*	*3*	*3*

** Note: values marked in italics express negative dimensions of island contexts, e.g. 'Standardized death rates from cancer' or 'Isolation"*

Table 3 demonstrates the sum of percentages for each core indicator, calculated by use of the: Formula 3 for the Indicator of Social Development (I_{SD}); Formula 4 for the Indicator of Environment Development (I_{END}); Formula 5 for the Indicator of Economic Development (I_{ED}); and Formula 6 for the Indicator of Innovative Development (I_{ID}) respectively (columns 2, 3, 4, 5 in Table 3). In cases that an indicator expresses a negative islands' dimension (marked in italics in Table 2), then the respective value of the class is subtracted and not added in the general calculation.

Insert Table 3

Table 3. Partial and overall SD performance of major Mediterranean case study islands, Source: own elaboration

	Formula 3	*Formula 4*	*Formula 5*	*Formula 6*	*Formula 2*				*Formula 1*
	I_{SD} (%)	**I_{END}** (%)	**I_{ED}** (%)	**I_{ID}** (%)	**I_{SD}** (%)	**I_{END}** (%)	**I_{ED}** (%)	**I_{ID}** (%)	**I_{SD}** (%)
Sicily	18.8	34.8	17.6	21.6	**4.7**	**8.7**	**4.4**	**5.4**	23
Crete	19.6	24.3	17.8	28.2	**4.9**	**6.1**	**4.4**	**7**	22
Corsica	21.5	29.4	31.3	30.4	**5.4**	**7.4**	**7.8**	**7.6**	28
Cyprus	24.3	24.5	26.8	28.3	**6.1**	**6.1**	**6.7**	**7.1**	26
Malta	21.2	25.5	27.7	29.8	**5.3**	**6.4**	**6.9**	**7.4**	26
Sardinia	21.1	28.1	21	26.6	**5.3**	**7**	**5.3**	**6.6**	24

6.2. Calculation of the Islands Sustainable Development Index (I_{ISD}) and performance of core indicators

Each core indicator value of columns 2, 3, 4 and 5 in Table 3, representing SD achievements (performance) of studied islands in relevant fields, is traced to the range 0% to 25 % (maximum threshold of 25% for each single core indicator). This reduction is carried out by use of Formula 2 and results in the scores presented in Table 3, columns 6, 7, 8, 9 respectively (in bold). Finally, column

10 of Table 3 displays the overall performance of studied islands in terms of SD achievements, calculated by use of Formula 1 (values in a percentage form).

Figure 5 shows the sustainable development performance for each core indicator and the overall performance of each studied island, using the results displayed in Table 3. These results are obtained by use of the proposed monitoring system that aims at establishing linkages between the structural problems of island contexts and their sustainable development perspectives on the one hand; and the SDGs on the other.

Insert Figure 5

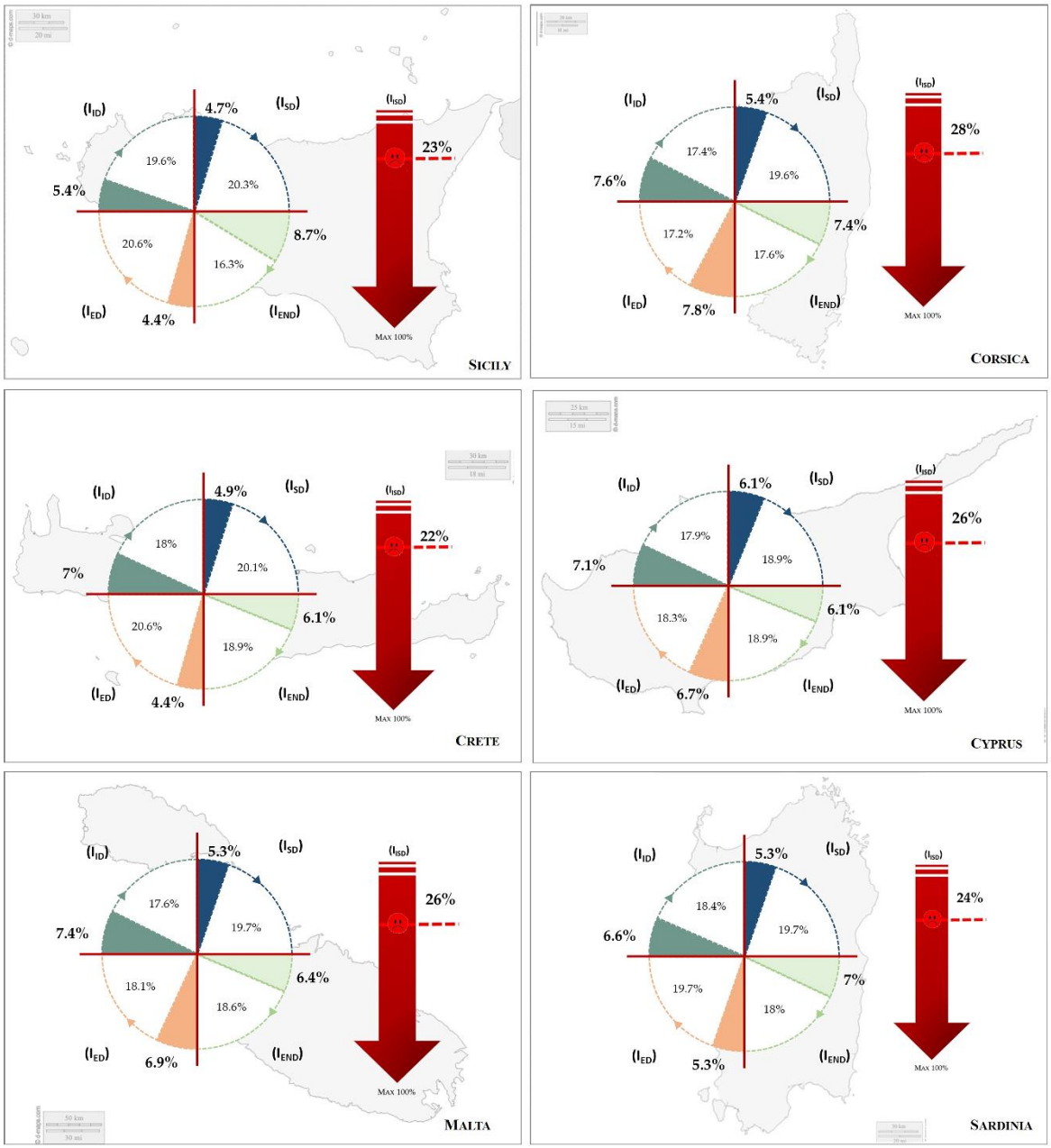

Figure 5. Performance of each island under study in terms of sustainability achievements, Source: own elaboration

576

577 *6.3. The Islands' Sustainable Development Index (I_{ISD}) in major Mediterranean islands*

578 Deeper insight into the results of Figure 5 reveals the low sustainability performance of the
579 studied islands; and the need for implementing more targeted policies for reaching convergence to
580 the 17 SDGs, i.e. an obligation of all EU member states by 2030. As stated in Sections 2 and 3,
581 however, these results need be linked to the flexibility or autonomy of individual islands to articulate
582 their own policies, i.e. the understanding of related administrative contexts is necessary. This allows
583 for the realization of whether and how sustainable development can be facilitated by policies
584 implemented in each single island context.

585

586 **Insert Table 4**

587

588 **Table 4.** Comparative performance of the major Mediterranean case study islands, Source: own elaboration

	(I_{ISD})%	**Administrative levels**	**Policies**	**Region Policies**	**Major criticality**	**Minor criticality**
Sicily	23%	island regions	associated with a Country	autonomous region	I_{ED}	I_{END}
Crete	22%	island regions	associated with a Country	semi-autonomous region	I_{ED}	I_{ID}
Corsica	28%	island regions	associated with a Country	semi-autonomous region	I_{SD}	I_{ED}
Cyprus	26%	sovereign states	Independent		I_{SD}-I_{END}	I_{ID}
Malta	26%	sovereign states	Independent		I_{SD}	I_{ID}
Sardinia	24%	island regions	associated with a Country	autonomous region	I_{SD}-I_{ED}	I_{END}

589

590

591 More specifically, as Table 4 shows, the Islands' Sustainable Development Index (I_{ISD}) for all
592 studied islands is extremely low, compared to the European average. Among these islands, *Corsica*
593 is the one that shows the highest level in the Islands' Sustainable Development Index (I_{ISD}), especially
594 due to the excellent performance in the Indicator of Economic Development (I_{ED}) and the Indicator
595 of Innovation Development (I_{ID}). These indicators, owing a percentage of 7.8% and 7.6% respectively,
596 show a good scoreboard, linked basically to the quality of administrative actions (the only positive
597 ones among the analysed islands); and the number of cross-border, transnational and interregional
598 cooperation programmes implemented in this island. The *main strength* of Corsica is, therefore, the
599 interplay between innovation and local economic development, the successful outcomes of which
600 demonstrate the proper functioning of dedicated policies. As an example, can be mentioned the
601 innovation pact "U pattu innuvazione" (U Pattu Innuvazione 2020; The Innovation Pact 2017) that
602 was signed in 2017; and aimed at facilitating and accelerating innovation in the region through
603 various financial support measures from the European Union. In fact, Corsica, although not an
604 autonomous state, is a semi-autonomous region (Collectivité Territoriale Corse - CTC) with specific

605 governance structure and status that allow implementation of specific policies. These, properly
606 integrated into or complemented by policies at the national level, can effectively address and
607 ameliorate the negative effects of insularity, as depicted by the sub-indicator "Regional
608 Competitiveness", gaining actually the highest score among all studied islands.
609 The same holds for *Malta* and *Cyprus* which, as island states, can put into force policies that are
610 better adjusted to islands' structural weaknesses. The analysis conducted leads to the conclusion that
611 these two islands rate equally with regard to the Islands' Sustainable Development Index (I_{ISD}) (same
612 percentage of 26%). Same as in the Corsica Island, the performance noticed in Malta and Cyprus is
613 mainly linked to the economic and innovation dimension. In fact, study of the respective
614 Commission Staff Working Documents of Cyprus and Malta (Country Report Cyprus, 2020; Country
615 Report Malta 2020) reveals that policy actions are focused on innovation investments, targeting
616 economic growth and taking into account both the spatial and resource constraints. These
617 investments have a specific focus on improving *innovation and productivity rates* which, in turn, could
618 positively impact environmental sustainability and social inclusion in these islands, i.e. fields that
619 rate rather low as shown by the Indicator of Social Development (I_{SD}) and the Indicator of
620 Environmental Development (I_{END}) (Figure 5).
621 The case of *Sardinia and Sicily* (both Italian islands) is different. In fact, although both have a
622 special status and therefore enjoy particular norms and flexibility that allow all local and territorial
623 entities to have administrative and financial autonomy, they display a low performance in terms of
624 the Islands' Sustainable Development Index (I_{ISD}). This is mainly due to very low achievements in
625 the Economic Development (I_{ED}) and Social Development (I_{SD}) indicators. Furthermore, the
626 Innovation Development indicator (I_{ID}) does not show a good progress. In fact, it was expected that
627 Sicily, due to geographical proximity to the Italian peninsula, could witness insularity condition in
628 a milder way and display better performance rates in terms of research and innovation. However,
629 inspection of the innovation performance and isolation sub-indicators unveil that the first remains
630 unchanged (4%), while the second increases.
631 Finally, the lowest Islands' Sustainable Development Index (I_{ISD}) is noticed in the case of *Crete*
632 *Island* (22%). In fact, Crete disposes some of the lowest performance rates in the three out of four core
633 indicators – namely the I_{SD}, I_{END} and I_{ED} –, reflecting a skew development model, based on a spatially
634 concentrated mass tourism and a resource-intensive agricultural pattern, both following innovation-
635 poor traces. However, low performance in the previously mentioned core indicators actually
636 contradicts with the presence of the high quality and of global reach institutions and research centers,
637 located in the Crete Island. The latter is evident from the high performance in the I_{ID} core indicator.
638 This contradiction demonstrates the lack of effective policies that can: establish relevant knowledge
639 diffusion channels and robust bonds between the society, the environment and the economy on the

640 one hand and innovation on the other; and lead to more informed regional and national policies in
641 order for the current centrifugal spatial development and economic model to be reversed.

642 **7. Discussion**

643 In the previous sections, a monitoring mechanism for assessing sustainable development of
644 island territories and its implementation in a number of major Mediterranean islands were analyzed.
645 This mechanism was grounded on the structural weaknesses of these territories, as defined by the
646 European Union; and attempted to explore the potential for achieving the 2030 Agenda SDGs in such
647 handicapped insular regions. Results obtained reveal a strong criticality in the four core indicators
648 used in this respect, i.e. the social (I_{SD}), environmental (I_{END}), economic (I_{ED}) and innovation (I_{ID}). In
649 particular, these indicators, obtained from the conceptual break down of SD in island territories
650 (Figure 2), unveil the poor performance of all studied islands with respect to the 2030 SDGs.
651 In fact, while in this monitoring mechanism each core indicator analyzed can range up to a
652 maximum threshold of 25%, only the Indicator of Environmental Development (I_{END}) for Sicily
653 slightly exceeds the 8% threshold, as shown in Figure 5. This indicates the rather ineffective SD
654 strategies implemented so far in all studied islands that fall short in coping with insularity
655 drawbacks and positively affecting the progress of islands towards SDGs. This poor performance of
656 policies is revealed by the overview provided through the calculation of the Islands' Sustainable
657 Development Index (I_{ISD}).
658 Furthermore, as highlighted also in the introduction, the literature shows that island regions in
659 the Mediterranean constitute remarkable social, economic, physical and cultural ecosystems and
660 *"ideal 'laboratories' for studying and measuring sustainability, with easily discernible limits and defined flow"*
661 (Spilanis et al. 2009, p. 179). However, they are also marked by a range of drawbacks due to insularity
662 constraints (Spilanis et al. 2009 and 2012; Koutsi and Stratigea 2019 and 2021). These drawbacks, as
663 stated by various researchers, are largely overlooked in policy design. Indeed, both European and
664 national policies are so far lacking an "insular dimension" (Margaras 2016). This jeopardizes
665 effectiveness of such policies in insular territories, while places sustainable future pathways of these
666 particular spatial contexts at stake. Furthermore, it is crystal clear that sustainability objectives in
667 insular regions have to be treated through the 'lens' of insularity repercussions, since experience
668 shows that "business as usual" policies, although effective in handling mainland regions'
669 inefficiencies, they fall short when applied to island regions.
670 Therefore, as highlighted in the literature, the current SDGs monitoring system cannot illustrate
671 the real situation of island regions. Such regions, due to their geographical connotation, are marked
672 by the repercussions of isolation, which cannot be grasped by generic indicators measured over an
673 entire nation. In this regard, the proposed methodology can shed light on three fundamental factors

in support of sustainable development of insular regions, namely the policy context, social equity and degree of innovation, briefly discussed in the following.

7.1. Islands' policy context

The proposed methodology highlighted that island policies are strongly conditioned by national laws and governance. These factors have positive repercussions in cases where island-specific policies, designed and implemented by the state, are properly adjusted to peculiarities and structural problems of that type of, handicapped by insularity, regions. If this is not the case, then this factor can become a *barrier* to sustainable future development of island regions, largely ignoring geographical connotations and intrinsic issues this type of regions implies (Figure 2). The successful outcome of matching SD policies to particularities of island systems is nicely depicted in case of island states, such as Malta and Cyprus, where insularity peculiarities in fact are inherent in the state policies. Similar, however, is the case of the largely autonomous island of Corsica which, by use of direct European funding, designs and implements SD policies that have at their heart innovation and economic growth objectives; and use these two dimensions as the 'vehicles' for social and environmental purposes as well.

7.2. Social equity under the insularity condition

The research has uncovered the social equity imbalances raised by the insularity condition. In fact, social equity performance of island regions is extremely lower than the European average; and is an issue that seems hard to be beat due to the distinct geographical handicap of the sea barrier. The islands' geographical position has strong socio-cultural impacts, linked above all to the distance from the mainland (Spilanis et al. 2012). The latter mortgages a fair socio-economic balance, which in turn favors dynamics of depopulation and place abandonment. The typically 'closed systems' represented by the island regions, their geography, remoteness and environmental vulnerability constitute the main sources of problems related to social equity and the risk of poverty. However, by systematizing the various sub-indicators of the proposed monitoring system, described in Section 5, it is feasible to improve the level of social equity (Indicator of Social Development), by implementing policies that reinforce performance in other core indicators, such as the Indicator of Innovation Development (I_{ID}) and, most importantly, the sub-indicator linked to tourism. The latter can, based on the remarkable islands' natural and cultural assets, play a decisive role in the socio-economic development of the island territories.

7.3. Innovation as the core of islands' sustainable strategies

Inspection of results presented in Section 6 highlights the emphasis placed by the studied islands on innovation, as this is shown by the Indicator of Innovation Development (I_{ID}), gaining the highest values with respect to the rest of core indicators analysed. This makes clear that innovation lies at the heart of islands' strategies as a means to bridge the *insularity 'gap'* currently noticed between islands and mainland regions, especially in the economic realm. In fact, as shown by the results presented in Table 3, in all studied island regions apart from Sicily, the higher the Indicator of Innovation Development (I_{ID}) is, the better the achievements of the Economic Development (I_{ED}) indicator are.

In general, the proposed monitoring system highlights the *sectors* that display a low performance, thus providing guidance to policy makers as to the diversified or more robust policies that need to be in place in these structurally and physically weak insular environments when seeking to improve sustainability achievements. In this respect, it can lead to more informed policy making for handling sustainability objectives in such environments. Furthermore, it stresses the importance of *linkages* among the four core areas (social, environmental, economic and innovation). More specifically, the joint reading of the structural problems of island regions and the 17 SDGs allows for the realization of those linkages that are necessary or need to be enhanced. For example, by understanding the critical role of innovation for improving the performance of other sectors, decisive strategies can be designed and implemented, bridging innovation with e.g. environmental or societal objectives on the way to a more sector- and spatially-balanced and converging to 2030 SDGs island development.

8. Conclusions

The UN Agenda 2030 and related SDGs bring to the forefront new challenges and policy targets for both the society and the political system global wide. The highly vulnerable and usually lagging behind insular territories are, among other regions, confronted with additional efforts, emerging from the structural inefficiencies the context of insularity implies.

In support of these efforts, this study proposes a *monitoring mechanism* for assessing sustainable development performance with respect to the 2030 SDGs that is properly adjusted to insular peculiarities. The proposed mechanism aspires to advocate islands' endeavours to SDGs by assessing current sustainability state; identifying sectors of low sustainability performance; and shedding light on sectoral 'missing links' that need to be established in support of improving overall sustainability outcomes. It is based on a *theoretical framework*, which attempts to establish linkages between the concept of *sustainable islands* on the one hand, taking into account the structural problems common to the majority of island regions; and the *17 SDGs*, as defined by the European Union in the 2030 Agenda, on the other (Figure 2).

Out of this framework, *four critical fields* of sustainable development in island contexts are identified. These form the ground for articulating *four core indicators* – namely the I_{SD}, I_{END}, I_{ED} and I_{ID}. These address four pillars of sustainability in this type of regions, associated with the social, environmental, economic and innovation dimensions (Figure 3); and underline the distinctiveness of the *"insular dimension"* when assessing performance towards SDGs. The proposed *Islands' Sustainable Development Index (I_{ISD})* (Section 5) is the amalgam of these four core indicators; and demonstrates that islands' progress to SDGs has to be approached and assessed in ways adjusted to the insular context, i.e. by use of island-specific indicators, embedding peculiarities linked to the insularity condition.

The proposed monitoring mechanism can be fed by raw data on sub-indicators, leading to calculations of both the core indicators and the respective Islands' Sustainable Development Index. These offer decision makers *robust assessment and monitoring tools* for realizing sustainability deficits and gaps to be filled towards the 2030 SDGs. In addition, this mechanism is dynamic and scalable, i.e. it can be enriched with new variables and respective indicators; and can be replicated to both national and international state islands and islands belonging to states or regions. It can also be used for setting up island sustainability thresholds, proposed by standardization bodies; as well as for profiling and assessing sustainability performance of other islands' typologies.

However, it is necessary to highlight some *limitations* of the proposed methodological approach as follows:

- *Contribution of core indexes (I_{SD}, I_{END}, I_{ED} and I_{ID}) to the calculation of the main index I_{ISD}*. The proposed monitoring system assumes an equal contribution of all four partial core indicators (I_{SD}, I_{END}, I_{ED} and I_{ID}) to the calculation of the main Islands' Sustainable Development Index (I_{ISD}). As previously noticed, this keeps track with the indications provided by the IAEG-SDGs (2020) and the European Union. This choice, however, can jeopardize outcomes of the monitoring system, lowering its potential to grasp the real context of each studied island. It should be kept in mind, though, that even in case certain island case studies may present a slightly different image that the one sketched by the commonly accepted islands' peculiarities, used for building up the proposed monitoring system, it is necessary to establish a common approach for each indicator in order for sectors/fields with the greater problems, both within the island itself and in comparison, with other islands, to be grasped.
- *Production, availability and aggregation of data*. Data production is currently almost never aligned among islands. This holds especially true in case of a state island and an island belonging to a state. Therefore, it is important to downscale data at the island level in order for SD assessments and monitoring to be accomplished at this territorial context.

- *Data availability*. Current data production pattern impedes uninterrupted access to regularly collected data. This makes data availability discontinuous and partial, to the detriment of the scope of the monitoring system, i.e. evaluation of islands' sustainability achievements towards SDGs at certain time intervals. For the effective use of the proposed monitoring system, disaggregation of data at the island level and collection at specific time intervals is fundamental, serving assessment / monitoring of sustainability achievements towards SDGs and benchmarking of progress in different islands' contexts.

The experience gained by studying Mediterranean islands that fall into different administrative contexts – i.e. state islands and islands belonging to a state – allows answering the initial research questions. More specifically:

- Both administrative contexts have to deal with similar challenges that are due to insularity, verifying the concept of *''Mediterraneanity"*, defined by Spilanis *et al.* (2009) and reflecting the shared problems and commonalities of the Mediterranean insular regions.
- Policies implemented by state islands are, as expected, better oriented to insularity drawbacks as opposed to islands belonging to a state, where policies being put forward are more general and fall short in effectively handling peculiarities of insular regions.
- The proposed monitoring mechanism performs well in both insular administrative contexts – state islands and islands belonging to a state – unveiling, in both cases, fields in which more dedicated policy action, in support of insular regions to pave their way to SDGs, is needed; and revealing also potential linkages among sectors that could thrust mutual sustainability improvements.
- From the pool of studied islands some good practises, leading to more sustainable outcomes in an island environment, could come into light, featuring thus the need for islands' networking and collaboration in order for the benefits of a broader coalition towards the 2030 SDGs to be reaped.
- The role of *innovation* as a key driver and an enabler of sustainability achievements is revealed in several of the studied islands. For instance, in case of Malta, Cyprus and Corsica, performance demonstrated by the core Indicator of Innovation Development (I_{ID}) goes hand in hand with the one displayed by the Indicator of Economic Development (I_{ED}). This underlines a shift or a certain focus of internal policies of these island contexts on innovation, in order for the shortcomings of insularity to be compensated and effective ways to SDGs to be sought. Innovation could also exert a catalytic role in pushing forward developments in the social and environmental realms, which demonstrate a rather weak performance in terms of sustainability achievements. Thus innovation-oriented interventions could be well suited for abrogating relevant inefficiencies in these fields.

The above inferences, as a qualitative outcome of the proposed monitoring mechanism, are quite helpful for guiding effective and more targeted policy decisions that are capable of tackling insularity weaknesses and supporting insular regions to sustain their own way to 2030 SDGs.

In addition, the studied monitoring system establishes an approach that is replicable to any island, since this is built upon the ground of commonly shared island problems, already recognised for years by the European Union. This system has also considerable practical advantages for policy makers due to its capability to: establish international standards that reflect island contexts; spread good practices for SD by introducing indicators relevant to these specific territorial contexts; inform on data requirements, i.e. what kind of data needs to be regularly produced in order to keep track with a constantly updated database and be in line with other islands; and promote cooperation agreements among islands for serving mutual goals towards the SDGs.

Additionally, the proposed methodological approach could eventually be adopted by other places that the European Union defines as geographically disadvantageous, e.g. mountainous or peripheral areas, provided that relevant indicators are accordingly adjusted to reflect the specific peculiarities of these areas. Indeed, this approach could be tested in other geographically-confined or handicapped territorial contexts as well, thus stressing the value of monitoring sustainability achievements towards SDGs in alignment with geographical constraints or similarity of problems, mainly dictated by the geography of relevant places. Furthermore, another future direction of this research and the proposed monitoring mechanism could focus on the steady monitoring of islands' sustainability achievements and distance from SDGs in regular intervals, so that relevant progress to be assessed and policy decisions to be properly informed and adjusted.

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Data Availability Statement:

a. Some or all data, models, or code that support the findings of this study are available from the corresponding author upon reasonable request.

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