THE SUSTAINABILITY CHALLENGES OF ISLANDS IN A EUROPEAN PERSPECTIVE BETWEEN MARGINALITY AND DEVELOPMENT

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1. Sustainability and sustainable development

Sustainable development is defined as « development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (United Nations General Assembly, 1987) [1].

This concept "provides a framework for the integration of environment policies and development strategies" (United Nations, 1987). However, long before the late 20th century, scholars argued that there need not be a trade-off between environmental sustainability and economic development.[2]

1.1 The Sustainable Development Goals

The Sustainable Development Goals (SDGs),[3] also known as the 2030 Agenda, aim to address a wide range of economic and social development issues and recognise the close link between human well-being, the health of natural systems and the common challenges faced by all countries, and have given a new impetus to global efforts to achieve sustainable development worldwide[4]. Each goal is linked to targets to be achieved by 2030. The goals are outlined below:

[1] United Nations General Assembly, Our Common Future Report. Oslo, 1987.
[2] Sachs (2015).
[3] According to the definition of the U.N, www.un.org.
[4] Emas (2015).

Figure 1 – *The 17 Sustainable Development Goals.*

Source: https://www.un.org.

1.2. Sustainability indicators

Three periods can be distinguished along the path towards the Sustainable Development Goals:

1. Sustainability Indicators 1.0 (1972 - 2015)

In the beginning it was like "The Quest for the Holy Grail": a search for ideal indicators; then various authors contributed to the subject, (Maureen Hart ,1999)[5]

2. Sustainability Indicators 2.0 (2016 - 2030)

From Agenda 2030 onwards, the question arises as to how different countries, cities and communities compare with each other.[6]

3. Sustainability Indicators 3.0 (2030 - ????)

There is a growing trend towards community-based indicators (tailored to the needs of communities)[7]

Statistical indicators are playing an increasing role as tools to guide decision-making processes: a community with a multitude of economic, social and environmental subsystems is too complex for a single indicator to provide proper information for all decisions to be made.

The first step in a process should therefore be to develop a vision of a sustainable society - a 'leitbild' - useful as a compass[8], with indicators to measure progress, gap from the goal and failures of plans or implementation. One wonders:

What is the link between indicators and sustainability? How appropriate sustainability indicators can be identified? How indicators can be used to measure progress towards sustainable development? What data sources are available for indicators? We try to answer these questions.

[5] Haart and Farrell (1998).
[6] Hák *et al.* (2016).
[7] Mitchell (1996).
[8] Spangenberg and Bonniot (2018).

2. Focus on Islands

Island territories, repositories of outstanding cultural and biological diversity, can be used as experimental laboratories: evolutionists were the first to use this practice: Darwin tested his evolution theories on the Galapagos, Wallace conducted further experiments on the Malay Islands.

2.1 Islands and their characteristics

Islands are highly vulnerable, highly endemic ecosystems where the pressures of human activities can have devastating effects. In fact, Islands are among the places on the planet where the effects of climate change are most evident, especially with the coming threat of sea level rise. Insularity, remoteness and consequent dependence on sea and air transport, even for basic activities, lack of economies of scale and dependence on global supply chains lay specific development challenges.

Taking into account internal and external strengths, weaknesses, opportunities and threats, the matrix shown in the following Table can be built:

Table 1 – *Strengths, Weaknesses, Opportunities and Threats for the Islands.*

	FORCES	WEAKNESSES
INTERNAL ENVELOPE	• Age structure of the young population; • Increase in the Active Population, the Activity Rate and Employment; • Natural wealth, heritage and culture; • Resistance to the crisis by the agro-food sector; • Broadband internet access; • Agri-food sector with research and innovation initiatives; • Exclusive Economic Zone of great size.	• Misalignment, in the labor market, between supply and demand for skills; • Low qualification of the active population; • Water storage capacity; • Difficulty of interconnection between research and economics; • Excessive use of some spaces by tourism, with a risk to natural resources; • Few statistical data; • Transportation.
	OPPORTUNITIES	**THREATS**
EXTERNAL ENVELOPE	• Political Stability; • Economic growth; • Growth of the Tourism Sector; • Growth of the Digital Economy; • Tax benefits on foreign investment; • Comprehensiveness of the education and training network.	• Trend of aging of the population; • Early school leaving; • Decrease in the resident population; • Desertification of smaller islands; • Geographical dispersion and diversity of inter-island economic and social contexts; • Vulnerability to climate change.

Source: Elaboration on Ocean & Coastal Management review[9].

[9] Polido *et al.* (2014).

When exogenous shocks hit the normal dynamics of local economic systems, the negative impact on Island communities is therefore more incisive than on the mainland, given their specialisation in traditional sectors of the economy, from manufacturing to tourism. This is why, even more so after the pandemic, Islands are facing a double race: towards recovery and towards sustainability, and thus, in a constantly changing world, they are a laboratory for testing models of sustainable development.

In this study, 17 European Islands have been analysed, using Eurostat data at Nuts[10] level 2[11] :Cyprus, Corsica, Guadeloupe, Mayotte, Martinique, Reunion, Kriti, Ionia Nisia, Sardinia, Sicily, Malta, Azores, Madeira, Canary Islands, Balearics, Ireland, Iceland.

3. The SDGs indicators for Islands

An attempt was made to build tailored indicators for Islands. For each SDG, the relevant indicators[12] were taken into account.

3.1 Tailored indicators for Islands

- People living in very low labour intensity households.
- People at risk of poverty or social exclusion.
- Severe material deprivation rate.
- At-risk-of-poverty rate.

- Economic accounts for agriculture.
- Organic farming: number of holdings, areas of different crops and heads of different types of animals by farm size.
- Labour force: number of persons and agricultural work, farm size.

- Infant mortality by region of residence.
- Life expectancy at birth.
- Health workforce.

[10] Official territorial statistical nomenclature.
[11] Eurostat:Regional statistics by Nuts Classification.
[12] Available at NUTS 2 level.

- Participation rate in education and training (last 4 weeks).
- Population by level of education, by gender.
- Early school leavers by gender.
- Youth neither in employment nor in education by gender.
- Employment rate of young people not in education and training.

- Regional disparities in the gender employment gap.

- Freshwater resources per river basin district.
- Water abstraction by river basin district.
- Water use by river basin district.

- Cooling and heating degree days.

- Employment rate by gender, age.
- Long-term unemployment (12 months and over) by gender, age.
- Regional disparities in the rate of Neet[13] young people.

- R&D personnel and researchers by sector and, gender.
- GERD by performing sector.
- Employment in technology and knowledge intensive sectors.

- Household income.

- Population density.

- Real growth rate of regional gross value added (GVA).

- Estimation of soil erosion by water, by level of erosion.

- Area of marine sites designated under NATURA 2000.

- Freshwater resources per river basin district.
- Land cover for FAO forest categories.

- Police recorded crime.

[13] Neither in Employment nor in Education and Training.

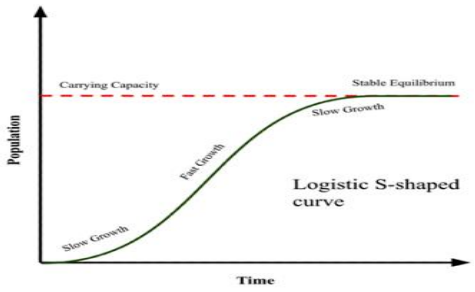
- Households with broadband access.

3.2 Island carrying capacity

Carrying capacity[14]fits, in accordance with the concept of sustainable development, into a multidimensional approach that combines several dimensions simultaneously:[15]

- Physical
- Economic
- Social
- Biophisical

Figure 2 – *Carrying capacity of the Islands.*



Source: Ecological Indicators[16].

To assess carrying capacity, an environmental and resource carrying capacity indicator (URECC) based on ecological civilisation was used in this paper, which contains 18 indicators selected from carrying capacity, water, land, air, energy and solid waste, according to the model proposed by Zang et al.(2018)[17].

[14] The maximum number of people that can visit a tourist destination at the same time, without causing destruction of the physical, economic and socio-cultural environment and an unacceptable decrease in the quality of visitor satisfaction WTO.
[15] Kostopoulou and Kyritsis (2006).
[16] Tanguay *et al.* (2010).
[17] Zhang *et al. (*2018).

3.3. How to build a sustainability Indicator

The steps to calculating indicators are[18] :

a. Data acquisition
b. Normalization and aggregation of the normalised indicators
c. Data synthesis and validation of the composite indicator.

The proposed composite indicator[19] seeks to provide as complete as possible a representation of the sustainable development of Islands.

To build a composite indicator, a subset of elementary indicators that tend to have the same theoretical relevance (the same weight) and that are available for all Islands was selected.

The composite indicator was calculated using the AMPI[20] formula, developed by ISTAT and based on normalization with the MIN-MAX method.

The synthesis of the normalized values is based on an arithmetic mean corrected with a variability function that penalizes the Islands in proportion to the variability of the indicators.The basic idea is that all Islands should tend to be optimal, i.e. they all have high indicator values. If this condition is not met the Island is penalized.

The synthetic index chosen can be written, in generalized form, as follows**:**

$$MPI_i^{+/-} = M_{r_i} \pm S_{r_i} cv_i$$

Where, M is the mean of the matrix of r observations, S is the variance and cv is the coefficient of variation.

In the Normalization phase, given the matrix X={xij} with n rows (units) and m columns (elementary indicators), the normalization matrix R={rij} is calculated as follows :

$$r_{ij} = \frac{x_{ij} - Min_{x_j}}{Max_{x_j} - Min_{x_j}} 60 + 70 \qquad (1)$$

Where xij is the value of indicator j for unit i, Min_{x_j} and Max_{x_j} are the poles of the indicator. If indicator j has a negative polarity, the complement to (1) is calculated at 200. In the Aggregation phase, if M_{r_i} and S_{r_i} are the mean and variance respectively of the normalized values on units i, the generalized formula for the fitted MPI function is given by:

[18] OECD (2008).
[19] Mazziotta and Pareto (2016).
[20] Adjusted Mazziotta Pareto Index.

$$MPI_i^{+/-} = M_{r_i} \pm S_{r_i} cv_i \quad (2)$$

Where $cv_i = \frac{S_{r_i}}{M_{r_i}}$ is the coefficient of variation for unit i and the sign ± depends on the nature of the phenomenon being analyzed[21].

For a positive synthetic index, we have the MPI +, for a negative index, the MPI -.

In the calculation of the synthesis index, in addition to the summary value obtained for each of the 17 goals[22], the corresponding carrying capacity value[23].

3.4. Results

The Islands have been classified according to their degree of sustainable development: in the following graph : upper quadrants contain those that have a higher value of the sustainable development indicator, while in the lower quadrants the synthetic index provides values corresponding to a low degree of sustainable development. Islands are found in the 'Marginality' or 'Development' quadrant based on the number of economic activities in marginal or innovative sectors and the number of innovative projects developed or under development[24].

The graph refers to the synthetic indicators calculated for each Island on the basis of the Sdg indicators for the last available year. By extending the calculation to the historical series of the recent years, each Island's detailed path towards sustainable development over the years can be drawn.

This can also be relevant, for example, in political decision making.

Figure 3 – *Classification of the Islands according to their sustainable development.*

[21] Mazziotta and Pareto (2012).
[22] De Muro *et al.* (2011).
[23] Obtained as described in Pamungkas *et al.* (2018).
[24] According to data provided by local Chambers of commerce.

Source: Elaboration on Eurostat data.

4. Will the theory be verified in everyday life on the Islands?

This section presents the results of the research carried out on the top 5 ranked Islands, with the purpose of checking in the real life the reliability of the built indicators and thus ensuring that these Islands are truly engaged in sustainable development.

4.1. The Azores

The Azores are involved in two projects that work for sustainable development. The first project: *Life Ip Azores Natura* make a valuable contribution to the conservation of species and habitats. In February 2020, a true hybrid renewable power plant was inaugurated on the Island of Graciosa (60.65 kmc, 4,400 inhabitants). The "Graciólica" solution reduces dependence on imported liquid fuels and reduces greenhouse gas emissions; it has the potential to eliminate approximately 190,000 liters of diesel per month.

Ife Ip Climaz is the second integrated project will encourage local communities to get involved in developing roadmaps to adapt to climate change and promote its adaptation measures in other areas, such as energy, forestry, and tourism.

4.2. Reunion Island

The Island of Reunion (2,511 kmc, 840,974 inhabitants) has set itself the ambitious goal of becoming a zero-energy Island by 2025, a particularly ambitious objective given its high population density. Several virtuous experiments are already underway on the Island, such as the « *Agrienergie 5* » project, which combines organic agriculture and solar energy.

4.3. Balearic Islands

Mallorca is the first destination certified by the « *Unwto Quest »* program, a quality certification for tourism destination management organizations.

Ibiza is a signatory of the « *Green Energy Islands Deal »* to initiate the energy transition of the Island and work to gradual elimination of single-use plastic by 2023. Another project relates to the protection of the Posidonia. It also aims to better inform people about its crucial role, in the hope of preserving it for more years.

Menorca is a United Nations Biosphere Reserve.

Formentera is a true laboratory of sustainable mobility. The number of vehicles allowed to access the Island has been limited and a digital mobility monitoring process has been implemented.

4.4 Crete

The Island of Crete (8,300 kmc, 600,000 inhabitants) has identified key actions to become a zero-emission Island by 2030.

In terms of energy supply, the Island has an isolated system and all its consumption is produced locally. A new project will work to support the increase of renewable energy. Energy efficiency solutions for hotels, buildings and street lights will be improved and an information campaign will be planned to increase the acceptance of renewable energy by the population.For water management, innovative desalination plants and systems to increase the efficiency of the water network will be studied, taking into account seasonal fluctuations in demand due to tourism.

4.5. Guadeloupe

The archipelago of Guadeloupe (1,628 kmc, 405,739 inhabitants) is partially decarbonized. In addition to the wind farm scattered throughout the archipelago on the Island of Désirade, a fleet of six electrically powered vehicles has been set up, which has also created jobs for the inhabitants.

5. Conclusion

To sum up, the Sustainable Development Goals are increasingly becoming a benchmark for national and local policies. It is therefore crucial to build appropriate tools to measure progress not only at country level, but also at a more detailed territorial level.

Statistical indicators are tools to guide decisions and can measure goals achieved towards sustainable development.

There are many indicators on sustainable communities that can be used as sources of 'inspiration', but each community is individual and the development of indicators at the local level offers an opportunity "to see" individuality in the choice of indicators,

As evolutionists teach us, Islands can be considered as test laboratories for sustainable development. Therefore, by using Eurostat data at the Nuts 2 level, we can build sustainable development indicators tailored to the specific needs of Islands that preserve their local identity,

They can not only measure their path towards sustainability but also their transition from a 'traditional' to a more innovative dimension, related to the nature of the economic-social activities on the territory.

The work has shown how the results obtained from the indicators are checked in the day-to-day reality of Islands, but practical evidence suggests that any sustainable development project cannot succeed without the full involvement of local communities.

This study is still ongoing and aims to refine the analysis on the specific needs of Islands, the indicators could be applied in other territories and contexts.

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SUMMARY

Islands, repositories of great cultural and biological diversity, have historically provided situations of excellence for measuring and studying evolutionary pathways (Darwin, 1856), i.e. laboratories. These places, blending both urban and rural elements, are highly vulnerable ecosystems with high degree of endemism where pressures from human activities can have devastating effects. In fact, Islands are among the places on the planet where the effects of climate change are most evident, especially with the upcoming threat of sea level rise.

Island economies also have their own characteristics that make them vulnerable to external shocks: their insularity, remoteness and associated dependence on sea and air transport, even for basic activities, lack of economies of scale and dependence on global supply chains pose very specific development challenges. Moreover, they can be a real test case for sustainable development models.

This work, based on official statistical data, aims, on the one hand, to monitor the degree of achievement of sustainable development goals in 17 European Islands and, on the other hand, to build a system of indicators tailored to the needs of these highly specific territories.

Thanks to these indicators, Islands that had achieved some significant goals, either by taking the path of tradition or the path of innovation, will be identified. Finally, with a look at the daily life of the Islands, the correspondence of the theoretical models developed will be checked and the actions carried out on the way to sustainability will be observed. The aim is to build a tool that can be used in different contexts to measure well-being, environmental quality, the green economy and other aspects in the view of sustainable development and that can provide an integrated framework of internationally comparable quantitative information.

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