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The Italian National Strategy for Sustainable Development and the Covid-19 impact: a regional analysis

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Abstract. The Italian National Strategy for Sustainable Development plays an important role in the national implementation of the 17 Goals for sustainable development set globally through the 2030 Agenda of the United Nations. The achievement of such goals in Italy is linked to the strategic choices and objectives established at the national level. The purpose of this work is to monitor the performance of the 20 Italian regions in 4 of the 5 areas of the Agenda (People, Planet, Prosperity, Peace) over a period of time ranging from the implementation of the National Strategy to the post-pandemic. To do this, a set of representative indicators was created and a geographical sustainability assessment tool (SSAM) was used, which operates through a multicriteria analysis model perfectly integrated into a GIS environment. The results showed a strong regional variability and a radicalized North-South gap. Moreover, the monitoring between the different years (2017-2019-2021) showed the initially positive impact of the strategy, mainly due to the Planet dimension, but also the negative one that COVID-19 caused to all the regions, with different intensity depending on the dimensions considered.

Keywords: Agenda 2030, Sustainable development, Spatial MCDA, 5Ps.
JEL code: Q01.

1. INTRODUCTION

The Italian National Sustainable Development Strategy (NSDS) is the strategic reference framework for sectorial and territorial policies in Italy, having the aim of planning a vision for the future and development focused on sustainability, as a shared and essential value to face the global challenges of the country (Ministry of Ecological Transition, 2020). The National Strategy was approved by the Interministerial Committee for Economic Plan-

ning of the Italian Government, on December 22, 2017, and subsequently updated in 2022. It represents the first step to implement the principles and objectives of the 2030 Agenda for Sustainable Development at the Italian national level.

The 2030 Agenda is an action plan designed for the prosperity of people and the planet, established in 2015 by the United Nations. The Agenda promotes global peace and the eradication of poverty in all its forms and dimensions, representing the current world's greatest challenge for achieving true sustainable development (United Nations, 2015). The NSDS adopts the four guiding principles of Agenda 2030: integration, universality, transformation, and inclusion.

The process of defining the NSDS started at the beginning of 2016, with the elaboration of the "Positioning of Italy concerning the 2030 Agenda", a first attempt to verify the distance of the country from the targets set by the Agenda. In fact, the Agenda is based on 17 Sustainable Development Goals (SDGs), organized into 169 targets, identifying global sustainable development priorities through the three pillars: economic, environmental, and social (Stevens et al., 2016). On this basis, the main strengths and weaknesses of Italy have been recognized, to identify the opportunities and challenges to which the NSDS should respond.

The Italian Strategy is structured in five areas, corresponding to the so-called "5Ps" of sustainable development proposed by the 2030 Agenda: Peace, People, Planet, Prosperity, and Partnership. Each P represents a specific mission to achieve, grouping several goals and tasks along the strategy. Peace promotes peaceful but also just and inclusive societies, free of fear and violence, based on the belief that there is no sustainable development without peace and no peace without sustainable development. Behind ending poverty and hunger in all their forms and dimension, people aim to ensure that all human beings can fulfil their potential in dignity and equality. Planet

focuses on the protection of the earth from degradation, through sustainable consumption and production, sustainably managing its natural resources, and taking urgent actions on climate change, in order to support the needs of the present and future generations. The mission of Prosperity is the achievement of a satisfying and prosperous life for all human beings, not only considering economic progress but also social and technological ones. The partnership has an even broader scope because it aims to mobilize the necessary means for the implementation of the 2030 agenda through a renewed Global Partnership for Sustainable Development. In particular, it focuses on enhanced global solidarity with the participation of all countries, all stakeholders, and all people.

Each area contains some "Strategic Choices", declined in "Strategic Objectives" specific to Italy, related to the SDGs and to the targets of the 2030 Agenda (Fig. 1). A sixth area is dedicated to the "vectors for sustainability", to be considered as essential elements for the achievement of the national strategic objectives.

The strategic choices identify the priorities to which Italy is called to respond. They reflect the transversal nature of the 2030 Agenda, integrating the three dimensions of sustainability (Ministry of Environment and Land and Sea Protection, 2018). The objectives have a highly integrated nature, as the result of a process of synthesis and abstraction of the most important issues that emerged from the consultation process, dealing with multiple dimensions and areas of priority action. This framework represents a synthetic approach for expressing the complexity of the 2030 Agenda (Italian Strategy for Sustainable Development, 2017).

As for the 2030 Agenda, the measurement of the progress towards the achievement of the Strategic Objectives is a crucial point in the NSDS. Observation, measurement, and assessment of the strategy are essential for the successful fulfilment of the NSDS objectives. A consistent assessment allows governments to make

Figure 1. From Agenda 2030 to the National Strategy for Sustainable Development (NSDS).

evidence-based decisions, to incentive or correct specific issues, allowing citizens, at the same time, to monitor the government's activities. Monitoring progress towards SDGs is an important task that must be rigorously undertaken to evaluate the outcomes of the actions already implemented and to address the unfulfilled goals for the next decade (Carrillo, 2022).

Until now most of the effort to assess progress towards the 2030 Agenda is nation-based, because of the good quality and quantity of data at this scale and because it is possible to refer directly to the targets and goals of the Agenda. However, recently more attention has been paid to the attainment of SDGs at the local level. Sustainable development is considered achievable if it originates on the local level, following a bottom-up approach from local to supranational (Ravetz, 2000). Therefore, systems at a local level must be investigated in order to have effective and realistic evaluations of specific territorial contexts and to determine sound planning actions (Boggia et al., 2018).

However, still, few works evaluating the sustainable development of Italian Regions or municipalities concerning Agenda 2030 or NSDS are present. The importance of the diffusion of sustainable development at the local level was recognised by Farnia et al. (2019), who addressed the issue of measuring the Agenda 2030 goals at the urban level in Italy. In particular, they built a composite index for the analysis of 98 Italian municipalities, using 53 indicators representing the three dimensions of sustainability. In terms of methodology, the Spectral Value Decomposition (Farnia, 2019) was applied, clustering both indicators within each Goal and the Goals themselves for obtaining a Sustainability Index. The results showed geographical and demographic heterogeneity within the country, underlining how complex phenomena are due to the multidimensional aspects of Agenda 2030. Also D'Adamo et al. (2022) compared the sustainability of 103 Italian cities through the evaluation of 45 SDGs indicators, ranking cities based on their performance, by means of a Multicriteria Decision Analysis, in particular the Analytic Hierarchy Process (AHP) (Saaty, 2008). Results showed strong disparities across Italy with three northern cities at the top of the ranking and many southern cities at the bottom. Mascarenhas et al. (2010) emphasized how it is widely recognized that action towards sustainable development is most effective at the local scale, but that there are common resources for which efficient management occurs at a supra-municipal scale, i.e. at the regional level. Indeed, they argued that the regional scale is a good level of governance for planning, coordination, and evaluation of action towards sustainable develop-

ment. Finally, Alaimo and Maggino (2019) evaluated the sustainability of the Italian regions, using the Adjusted Mazziotta–Pareto Index (Mazziotta and Pareto, 2016) for creating a composite index for each goal considered.

As we saw, sustainability assessment can be developed using many different approaches, depending on the objectives, the scale, and the scope. The complexity of sustainability assessment requires structured, transparent, and reliable tools, and Multi Criteria Decision Analysis (MCDA) can play an important role (Cinelli et al., 2014), managing information from different indicators comprehensively within an integrated assessment approach. MCDA assumes a central role in the multidimensional evaluation process. It is used to solve complex problems by assessing all the variables, both individually and collectively, and assigning specific importance to each one (Cortina and Boggia, 2014). Thus, MCDA has been widely used to evaluate sustainability (Liu, 2007; Shmelev and Labajos- Rodrigues, 2009) and has been indicated as the appropriate tool for its assessment (Bond et al., 2012; Munda, 2005).

The approach proposed in this paper is based on Spatial Multicriteria Analysis, which demonstrated its adaptability in performing Sustainable Development Assessment (Boggia et al., 2018; Chen et al., 2010; D'Adamo et al., 2022; Massei et al., 2014; Paolotti et al., 2019; Papadopoulou-Vrynioti et al., 2013; Rahman et al., 2012;). Dealing with spatial decision problems means combining and transforming geographical data (input) into a resultant decision (output), interfacing a Geographical Information System (GIS) with MultiCriteria Decision Analysis (MCDA) methods (Massei et al., 2014). This kind of approach allows for a perfect integration between the geographical component and the multicriteria analysis, exploiting the benefits of both elements.

In particular, the Spatial Sustainability Assessment Model (SSAM) was applied. SSAM is a powerful tool for performing sustainability analysis of different territorial areas at different scales, using a multiple criteria approach, and obtaining a sustainability index starting from environmental, social, and economic indicators.

Therefore, the aim of this work was to propose an evaluation framework for assessing the progress of the Italian regions in terms of SDGs, within the strategic borders provided by the Italian National Sustainable Development Strategy. The Italian regions were evaluated by means of the SSAM procedure, in relation to a set of indicators associated with SDGs and complying with the strategic objectives of the national strategy, for assessing the relative level of sustainable development reached by each region. It is a more local approach in comparison to other studies involving Italy (Ricciolini et

al., 2022; Rocchi et al., 2022) as it considers the regional scale, allowing for a juxtaposition across the different Italian regions, whit reference to the EU NUTS 2 classification. Moreover, the analysis includes a period that allows for a baseline (2017, the year of ratification of the NSDS), a first step of progress (2019), and some COVID-19 short-term effects on sustainable development (2021).

2. MATERIALS AND METHODS

2.1 Framework construction

2.1.1. Indicators selection

For evaluating the performance of Italian Regions on their path to sustainable development, in the framework of the national strategy, we defined a set of indicators that were methodologically in line with the goals of the strategy itself and derived from the 2030 Agenda. The indicators have been selected to cover four of the 5Ps of the Agenda, which are: People, Planet, Prosperity, Peace, and Partnership. The excluded P was Partnership since it is not covered enough at the regional level. It is more focused on a national rather than regional or local scale. Moreover, Partnership is mostly a condition for a better and faster achievement of sustainable development, mainly focused on the cooperation between Countries, to overcome disparities.

The selection of indicators is a crucial step in the study as they are a key tool for monitoring and evaluating different sectors and levels of governance. In particular, the indicators of the SDGs can be seen as a potential beacon to guide humanity on the right course towards sustainability (Lyytimäki et al., 2020). The framework proposed in this paper does not aim to define a specific method of choosing indicators, but rather to indicate a possible path for supporting the evaluation processes of regions' performance in achieving Sustainable Development Goals with the help of a geospatial tool. In addition, the construction of such a framework is subject to the availability of data for monitoring the 2030 Agenda, which is still not always adequate for the assessment of regional units, although it is rich in European countries if compared to other geographic contexts.

The selection of indicators that best fit the object of the research, which was, in this case, to evaluate the level of Sustainable Development of Italian regions regarding the NSDS, starting from the set of indicators dedicated to the SDGs made available by ISTAT (Italian National Institute of Statistics). ISTAT, like the other national statistical institutes, is called by the United Nations Statistical Commission to play an active national coordination role in the production of indicators for measuring sustainable development and monitoring its objectives. Periodically, therefore, the Institute updates and extends the breakdowns of the statistical measures useful for monitoring the sustainable development objectives of the 2030 Agenda[1].

Starting from this database, which contains all the statistical measures useful for monitoring the SDGs of the 2030 Agenda, an accurate selection was made to find the indicators that best represented the strategic choices and objectives of the NSDS. To correlate the objectives of the Strategy with the proposed indicators, an analysis with experts was conducted which allowed the creation of the final framework of indicators. The selected criteria that have been taken into account in this process are:
– representativeness of the topic;
– regional data availability;
– availability of data for the years under analysis and the possibility of updating data over the years;
– avoid the presence of redundant or overlapping indicators.

Considering the NSDS approval date (December 22, 2017) and in the light of the pandemic event, for proper monitoring of sustainability performance over time, 3 analyses were carried out with reference to 3 different years: 2017 (the year of publication of the Strategy), 2019 (two years post-release and pre-pandemic), 2021 (three years post-release and post-pandemic). In case of missing data for the reference years, those closest available were used. Punctual lack of data (i.e.: a singular missing data for a singular region) was rare: also in these cases, the first available data was traced back.

At the end of the choosing process, the total number of selected indicators, which is 47, was divided into the 4 pillars of People, Planet, Prosperity, and Peace according to the choices and objectives of each pillar. People includes 14 indicators; Planet 8, Prosperity 15, and Peace 10. Overall, the selected criteria belong to 14 of the 17 SDGs on the Agenda. Goals 6 (Clean water and sanitation), 14 (Life below water), and 17 (Partnerships for the goals) remain outside since they are not represented by any indicator.

Tables 1, 2, 3, and 4 in Appendix A show the list of all the indicators divided by P. For each indicator, the following information is highlighted: the pertinent SDG (column 1), the reference code of the indicator (column 2), the connections with the NSDS strategic choice and the National strategic objective (columns 3-4), whether they are gains (to be maximized) or costs (to be mini-

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[1] https://www.istat.it/it/benessere-e-sostenibilità/obiettivi-di-sviluppo-sostenibile/gli-indicatori-istat (last update: 12 October 2022).

mized), the source of the data, and the relative unit of measurement.

2.1.2 Weighting phase and aggregation

In multicriteria analysis, two key phases are the definition of the weights for the criteria used and the aggregation of the weighted criteria, after their normalization. The weighting step can be carried out in two different ways: involving the experts or decision makers, who base the weighting definitions on their own experiences, knowledge, and perception of the issue; or using an objective weighting process, which is carried out independently from the subjective preferences, applying, for instance, statistical approaches (Zardari et al., 2015). This second option allows to objectify the assessment model and can be successfully applied in complex scenarios, in which the subjective weighting approach may lead to unsatisfactory results because the decision-maker(s) and/or experts are unable or unwilling to provide cohesive and exact numerical judgments for all the criteria (Boroushaki, 2017; Rocchi et al., 2022). Due to the high number of expertise areas covered by the NSDS, it seems proper to adopt an objective approach. In particular, in this work the mean weight (MW) method (Deng et al., 2000; Diakoulaki et al., 1995) has been applied. In the MW the weights were derived objectively using the following equation:

$$w_j = 1/(n_c * n) \qquad [1]$$

Where n_c is the number of pillars and n is the number of indicators within the pillar. This method assumes that indicator pillars are of equal importance. The national strategy does not discriminate between priorities to be achieved, therefore it is not correct to apply different weights among the different strategic choices identified in it. Different weights can be proposed if individual regional priorities, which may differ from each other, are evaluated; however, this aspect is not part of this analysis. As reported by Miola and Schiltz (2019), the use of unequal weights could lead to overestimating some dimensions that are growing faster, giving them greater weight, or conversely to underestimating those in which one is further behind.

The normalization and the aggregation of the criteria within each P and then into a final global score was made using the Spatial Sustainability Assessment Model (SSAM). SSAM is a powerful tool for performing sustainability analysis of different territorial areas at different scales, using a multiple criteria approach, and obtaining a sustainability index starting from environ-

mental, social, and economic indicators. This tool went through two updates, one in 2014 and another in 2021 (Boggia et al., 2018; Rocchi et al., 2022), changing also its name. The first update in 2014 was from UmbriaSUIT to GeoUmbriaSUIT, which allowed for complete integration of the multicriteria analysis with the geographical dimension since the use of GIS was introduced and the MCDA and GIS shared the same database and interface (Boggia et al., 2018). Moreover, the algorithm implemented within the procedure changed from weighting summation to TOPSIS (Hwang and Yoon in 1981). The last release in 2021 mainly included updates regarding the user experience (i.e. the input of the data or the customization of the analysis) and the typology of vector file supported.

The multicriteria algorithm used in SSAM is the TOPSIS (Technique for Order Preference by Similarity to Ideal Design) which generally defines a ranking based on the distance from the worst alternative and the proximity with the best one, represented by the lowest and highest value of each indicator, respectively, or vice versa, depending on whether it is an indicator to be maximized or minimized. The goodness of this type of approach in assessing the sustainability of countries or regions has already been demonstrated by several other authors (Bilbao-Terol et al., 2014; Boggia et al., 2018; Paolotti et al., 2016; Rocchi et al., 2022). In this study to have a more reliable comparison between the three years, we used the same worst and best points, considering the worst and best performance for each indicator over the entire period under consideration. In this way, the score achieved by a particular region is sensitive to the improvement or worsening of the remaining ones, considering the entire time horizon, i.e., we have a relative assessment. Then, the indicators representing each of the three dimensions can be treated individually, resulting in three distinct indices, for each geographic unit analyzed, i.e., environmental index, economic index, and social index. Optionally, one can also weigh the values of the three previous indices resulting in a global aggregate sustainability index (Boggia et al. 2018). The Global index is built using the weighted sum of the dimensions, therefore is useful for having a synthetic picture of the sustainability level.

After the aggregation process, the results are presented for reading and interpretation, either in the form of letters and numbers or in graphic format (maps, cartograms, and graphs). This graphical output in the form of maps illustrates the results of the multicriteria analysis for each feature that makes up the studied region, through a choropleth map, where the different colours represent the level of sustainability (Boggia et al., 2018;

Rocchi et al., 2022). Of course, because of the full integration between the MCDA and GIS, numerical outputs can be rearranged and elaborated directly into QGIS, giving more personalized results.

A major advantage over the previous version is the possibility of having more flexibility about the number of dimensions that can be included. With GeoUMBRI-ASUIT it was only possible to insert the three pillars of sustainability (environmental, social, and economic), which are usually the ones most applied. With SSAM, on the other hand, dimensions can be removed, substituted, or added, as is the case of this work, which includes four of the 5Ps into which the 2030 Agenda is organized (Rocchi et al., 2022).

3. RESULTS AND DISCUSSION

3.1 The Global Index

Figure 2 reports the Global Index, which gives us a picture of the global situation for each year, without any details about the performances for the singular P. From the geographic distribution of the index, it is possible to have a first, quick, and easy understanding of the general level of Sustainable Development (SD) of the Italian Regions, as well of their state of progress towards the Strategy priorities fulfilment. The alternatives are grouped in a 5-classes scale, from very low to very high values of the index: the darker the colour the higher the sustainable development level. The definition of the class range was established by using the maximum and minimum values of the entire three-year period as extremes

and then applying a QGIS function (equal intervals algorithm). In general, from the maps, it is possible to note a better situation in terms of SD of the North and of the Centre in comparison to the South, for all the periods examined. The passage from 2017 to 2019 highlighted a general enhancement of the sustainability performances of all the Italian regions. In 2019 none of them was in low or very low classes, and at the same time, the number of regions in the very high-class tripled, moving from 2 to 6. On the other hand, the comparison between 2019 and 2021 identified a general worsening of the SD level. Most of the regions (11 out of 21) were ranked within the Medium class, while all of them in 2019 were at least in the High class. None of the regions could be classified as Very high, denoting a worsening not only in comparison to 2019 but even to 2017, when some regions were in class Very high and the group of class High was larger. Moreover, in 2021 three regions fell into the Very low class, and for two of them, it was for the first time (Campania and Sicily).

The highlighted tendency is even clearer if we consider the aggregated data for the geographical repartitions of north, central, and south Italy (Figure 3). In 2017 and 2019 there were no differences between north and central Italy, and the south reduced its distance in terms of global sustainability between the two years. Then, the 2021 performances denoted a worsening in the three areas, which was greater for the central and south Italy.

Although the Global index is useful for a quick understanding of the general sustainability performances of the considered areas, it is not enough for deep analysis. Therefore, it was necessary to analyse the results
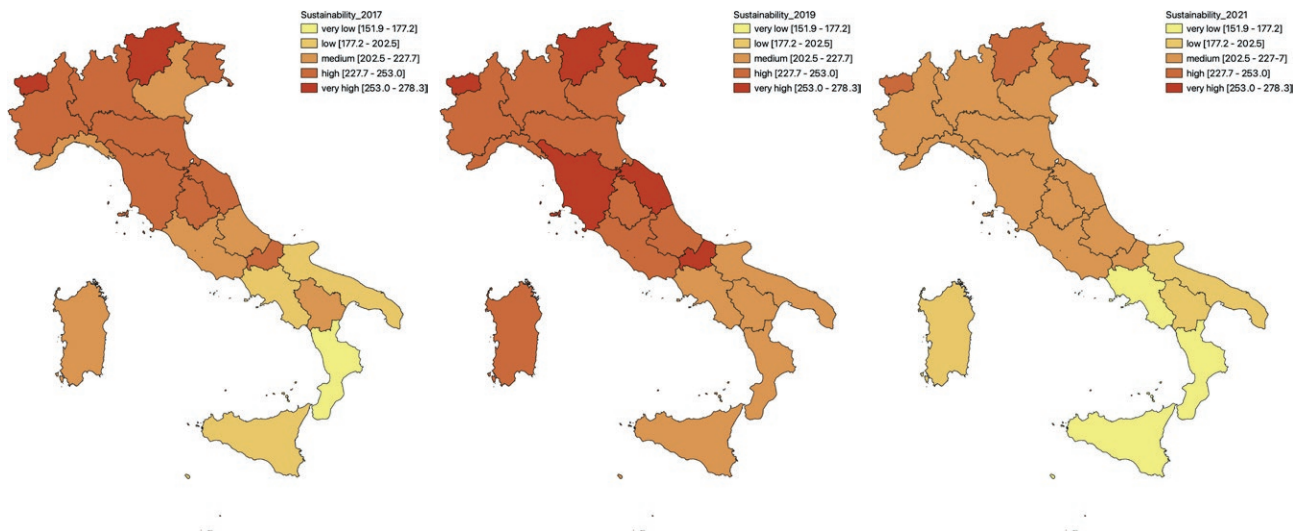

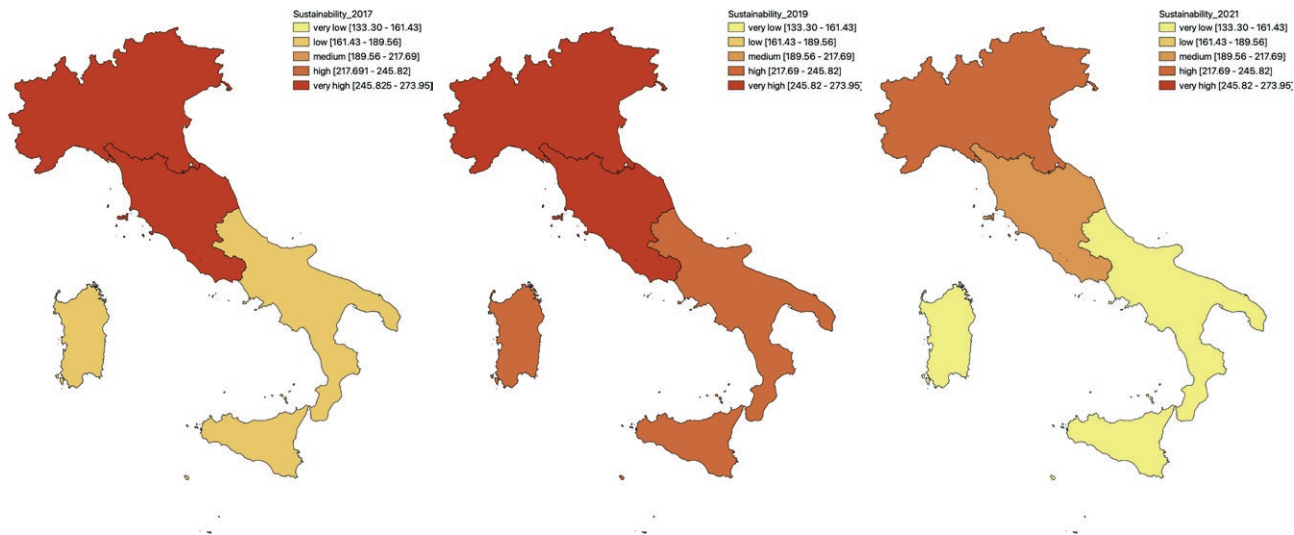**Figure 2.** Global index – regions distribution.

Figure 3. Global index- geographical repartitions distribution.

of the 4 Ps, which contribute to the composition of the overall index.

3.2 The Ps Indices

The Global Index is built on four indices, one for P (Peace, People, Planet, Prosperity): each of these dimensions contributes differently in the composition of the overall index. Figure 4 reports for each Ps Index the range of the values and the median, represented by the dot, for the Italian regions. Starting from the left there are the four Ps indices, and for each index there are the three years, one next to the other. The first index on the left (Peace) showed a general decrease between 2017 and 2019, while in 2021 there was a reduction of the range between the top and bottom because of an improvement of the lowest values and also a deterioration of the best ones. This trend was due to the complex combination of the Peace indicators which do not have too many affinities both in the trend over the years and in the geographical distribution. To explain the decrease in the general performance between 2017 and 2019, we can state that the improvements noted for some indicators (e.g., 'Irregularly employed', 'Perception of safety walking alone in the dark') were too slight and not enough to compensate for the indicators with negative variation, especially for the indicators that showed the greatest decline for almost all the regions ('Percentage of permits issued for political asylum and humanitarian reasons' and 'Crowding of prisons'). In 2021 some indicators had a shortened range of values that may be due to the simultaneous worsening of performance for regions that

were previously better (e.g., 'Percentage of permits issued for political asylum and humanitarian reasons'), the improvement of those that were previously worse (e.g., 'Women and political representation at the local level'; 'Number of victims of intentional homicide', 'Perception of safety walking alone in the dark', 'Crowding of prisons') or both (e.g., 'Ratio between the employment rates (25-49 years) of women with children and women without children'). This resulted in an unchanged median value. Over the period analysed, a continuous trend could be observed for two indicators in different directions: 'Percentage of permits issued for political asylum and humanitarian reasons' decreasing and 'Perception of safety walking alone in the dark' growing.

The People index pointed out an improvement between 2017 and 2019, more significant for the values in the first and second quantiles. However, in 2021 the general performance dropped severely: the highest value of the index in 2021 was under the median value of both 2017 and 2019. Looking at the data, the causes of this drop could be multiple. Poverty data ('Risk of poverty or social exclusion') showed a marked worsening, along with a severe falloff of GDP pro capita growth ('Annual growth rate of real GDP per inhabitant'), which involved all the regions although with different strengths. Furthermore, some criteria linked to the quality of life showed a great worsening ('Excess weight among children aged 3 to 17 years'; 'Smoking (Standardized Rates)').

The trend of Planet over the three years is the most peculiar among the four indices. Like People, we observe an improvement of performance in 2019 and a subse-

quent decline in 2021. The jump between 2017 and 2019, however, was more pronounced than in People while the subsequent decline brought the performances back to a level comparable to 2017, although with a slight improvement in the edge values. Moreover, in 2019 there was a great reduction in the range of values, proving a general enhancement of the environmental performance in all the regions since even the worst had results comparable to the ones shown by the top group in 2017. This result could be probably due mainly to three indicators: 'Forest fire impact', 'Illegal building', and 'Emissions of PM10'. The three indicators had a constant positive trend from 2017 and 2019 (except the South of Italy for 'Emissions of PM10') while from 2019 to 2021 the two indicators related to forest fires and to PM10 had a great decline, for almost all the regions. In addition, the 'Percentage of people living in homes with structural problems or humidity problems' had a sensible decline between 2019 and 2021. In relation to the 'Forest fire impact' indicator, we also investigated the historical data series starting from 2005, and the results showed that in the years 2017 and 2021 there were two outlier years for the whole country, being also the Italian average data higher than in the rest of the historical series. It is also to note that, for the dimension Planet, three other indicators remained essentially constant from 2017 to 2021 ('Protected areas', 'Incidence of urban green areas on the urbanized surface of cities', 'Fragmentation index of the natural and agricultural territory'); therefore, the results within the dimension were very influenced by the variations in the other indicators, already mentioned.

Prosperity's trend was close to that presented by Peace, although in the opposite direction between 2017 and 2019, and with overall smaller changes. In particular, it showed a small improvement between the first two years, mainly in the top values area, and then in 2021 there was an improvement of the lowest values with a contemporary deterioration of the best ones. Moreover, Prosperity showed a very low value of the median in all three years. For a better comprehension of the results, we considered the economic, social, and technological sub-dimensions. For the economic dimension, the most interesting criterion was 'Gross disposable income per capita', which showed an increment in 2019 and then a decrease in 2021; these changes were different between regions with the highest and lowest absolute incomes. Between 2017 and 2019, the income increased less in percentage terms in regions with the highest absolute values than in those with the lowest ones. At the same time, in 2021 the decline in the richest regions was more pronounced, returning to 2017 levels, while in the lowest-income regions the reduction was more limited.
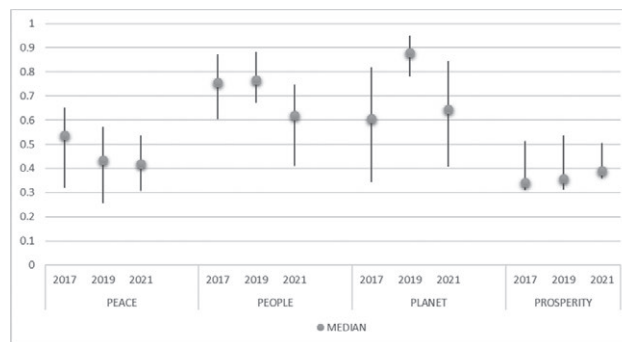

Figure 4. Range values and median of the Ps Indices.

On the Social side, the indicators did not change significantly, except for the ones linked to waste management ('Transfer of urban waste to landfills'; 'Separate collection of urban waste') where there was an improvement in 2017, with some differences among the regions, and then a worsening, generalized only for the separate collection of the urban waste. In the technologies sub-dimension the values of the criterion 'Firms with innovative product and/or process activities (per 100 firms)' highlighted a huge reduction in 2021, which was almost present in almost all the regions. In particular, the reduction hit deeply the regions with a previous high level of innovation.

In conclusion, the trend of the Global index seemed to be influenced first by the performance of the Planet dimension but also of People for 2019 while in 2021 all the indices contributed to the drops of the performance, with particular regard for People. In general, we found a very low interaction between the four P over the three years. Only positive weak correlations were found: the strongest, although weak, was between Peace and Planet dimensions.

3.2.1 The geographical repartitions of Ps Indices

To deepen the analysis, we considered the evolution of the 4 Ps indices in the different regions, grouped into the three geographical repartitions. Figures 5 to 7 show the evolution across the three years of the 4 Ps indices, stacked one on top of the other, one for each geographical repartition of north, central, and south Italy. In northern Italy (Figure 5) the general trend, first positive or stable (from 2017 to 2019) and then negative (2021) is clearly visible and this could be probably due mostly to the trend of the dimension Planet, which is positive from 2017 to 2019 and negative from 2019 to 2021, maintaining in any case a higher level in 2021 than in 2017. As mentioned in the previous paragraph, this trend within Planet could be due
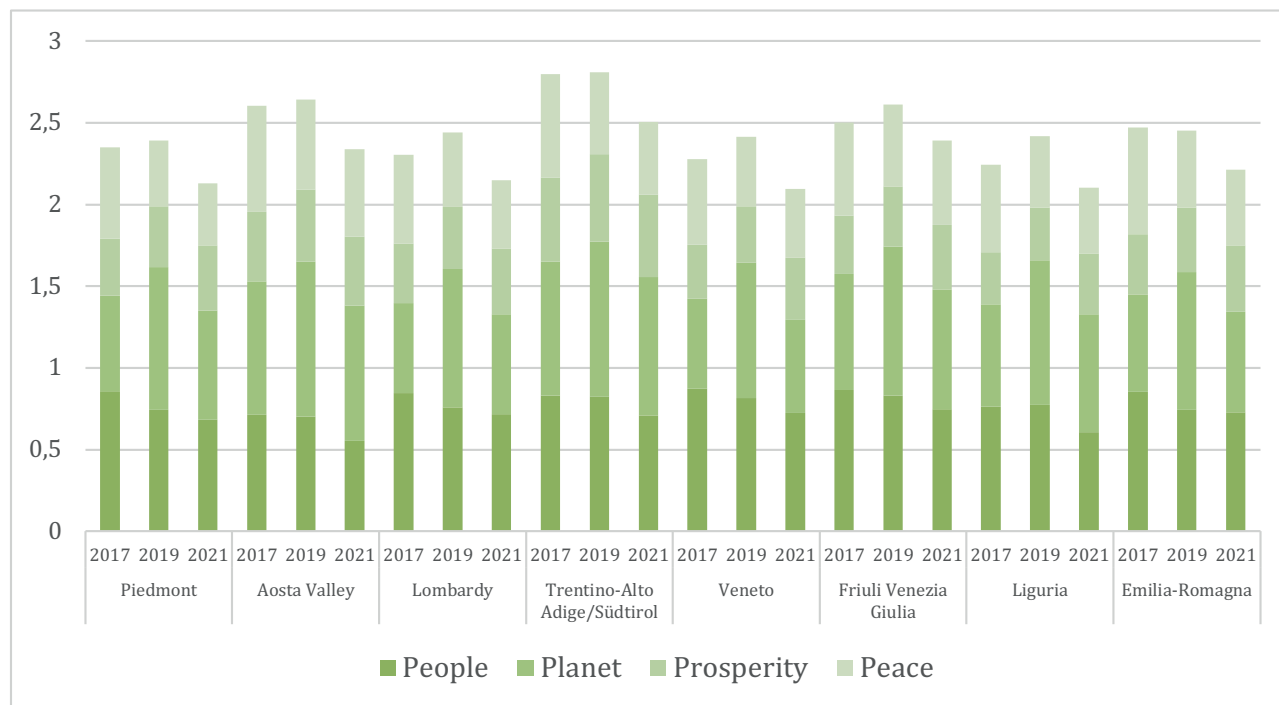
Figure 5. Bar of sustainability – Northern Italy (2017-2019-2021).

to some of the indicators that before had an improvement ('Forest fire impact', 'Illegal building' and 'Emissions of PM10'), while some of them had a sensible drop in 2021 (in the north 'Emissions of PM10' and 'Percentage of people living in homes with structural problems or humidity problems'). The PM10 emissions were generally higher in the northern area (except for Liguria and Trentino), due to the presence of many industrial sites and the geographical conformation of the territory. On the contrary, the data related to illegal building were always best for the north and worst for the south of Italy.

At the same time, Peace and People followed a different direction for almost all the regions, showing a continuous decline over the years to which only two regions narrowly escape: Liguria (with a slight increase in People between 2017 and 2019) and Friuli Venezia Giulia (with a slight increase in Peace between 2019 and 2021). For the Peace dimension, the two criteria 'Percentage of permits issued for political asylum and humanitarian reasons' and 'Crowding of prisons' were the main cause of the worsening in 2019, while in 2021 there was a general deterioration of the 'Ratio between the employment rates (25-49 years) of women with children and women without children' which was balanced by the improvement of other indicators including the relevant one of 'Crowding of prisons'. The northern regions maintained over the years the best perfor-

mances in terms of 'Irregularly employed' and 'Duration of civil proceedings'. The worsening for the People dimension was mainly linked to two criteria, 'Overburden of the cost of housing' and 'Annual growth rate of real GDP per inhabitant'; between 2019 and 2021 also 'Risk of poverty or social exclusion' worsened. Moreover, although the criteria for the quality of life were generally good in northern Italy, this geographical area resulted to be the tail light for the 'Persons aged 14 and over with risk behaviour for alcohol'. Although it is not possible to declare a causality linked to the pandemic event, it is possible to say that between 2019 and 2021 some indicators linked to equality or social vulnerability worsened.

The Prosperity dimension was the most stable, although with a positive trend, with the exception of Trentino Alto Adige and Friuli Venezia Giulia, whose index decreased from 2019 to 2021. Generally speaking, all northern regions performed well considering most of the criteria, however for 'Public institutions that adopt forms of social and/or environmental reporting' and 'Electricity from renewable sources' the behaviour was very variable and the area included both the best and the worst regions at the same time.

Considering all the 4 Ps, none of the regions came back to the sustainability level shown in 2017. Moreover, Emilia Romagna is the only region that showed a negative global trend also in 2019, although the difference
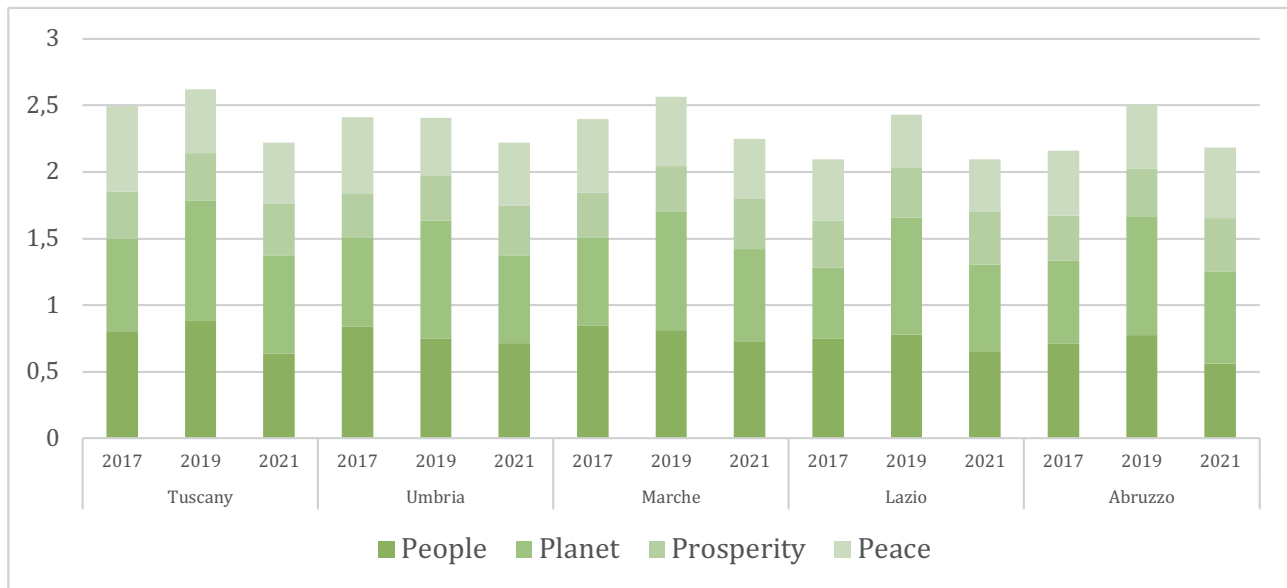
Figure 6. Bars of sustainability – Central Italy (2017-2019-2021).

with 2017 was slight. This result was due to the lowering of both People and Peace; Planet increased in 2019 for this region, however, it could not compensate the decrease of the other two dimensions. The two highly ranked regions (Valle d'Aosta and Trentino Alto Adige) did not improve significantly between 2017 and 2019, although, as for the other regions, the good performance of Planet.

In the central Italy (Figure 6) all the regions, except for Umbria, which was rather stable, presented a positive global trend from 2017 to 2019, due to the high increase in the Planet dimension, especially for 'Forest fire impact' and in particular for Lazio region. Peace and People almost presented a negative trend (with the exception of Tuscany and Lazio for People), while Prosperity remained stable, although with a positive trend. Also for this geographical division, the decrease recorded in 2019 in Peace was due to the worsening of the indicators 'Percentage of permits issued for political asylum and humanitarian reasons' and 'Crowding of prisons', such as for the Northern area.

In 2021 a worsening affected all the regions, which reached a total value lower than in the first year considered, with the sole exception of Lazio, which returned to the 2017 level. All the dimensions decreased in 2021 with the exception of Prosperity, which presented stable or higher values in comparison to both 2017 and 2019. For Prosperity, the better position was mainly linked to three criteria: 'Families with a fixed and/or mobile broadband connection', 'Firms with innovative product and/or

process activities (per 100 firms)', and 'Energy intensity'. However, the classification reached for Prosperity in 2021 by the Central regions corresponded to a Low or very Low Class: only Lazio ranked as the medium. Although this classification is in line with the previous two for the area, it is to note a worsening of the Tuscany results.

The trend among the southern regions (Figure 7) is similar to the ones already seen, although the enhancement of the performance between 2017 and 2019 was stronger than in the other geographical areas. Looking at the singular dimensions, the biggest contribution to this raise was due to the great increase of Planet (for the indicators already mentioned above, in particular for the south 'Forest fire impact'), and to a moderate one of People. In particular, in the People dimension, three criteria improved between the two years ('Unemployment rate', 'Young people who do not work and do not study (NEET 15-24 years)', 'Annual growth rate of real GDP per inhabitant'). To note in such a dimension, the bad performance in two lifestyle criteria, 'Excess weight among children aged 3 to 17 years' and 'Healthy life expectancy at birth', which were always among the worst in comparison to the other geographic areas and also worsening in the considering period. Again, Peace and Prosperity were more stable, although some regions acted differently. For instance, if we consider Peace, Calabria was more stable between 2017 and 2019 and made progress between 2019 and 2021 (due to the improvement of 'Women and political representation at the local level' and 'Number of victims of intentional homicide'), although remained in the
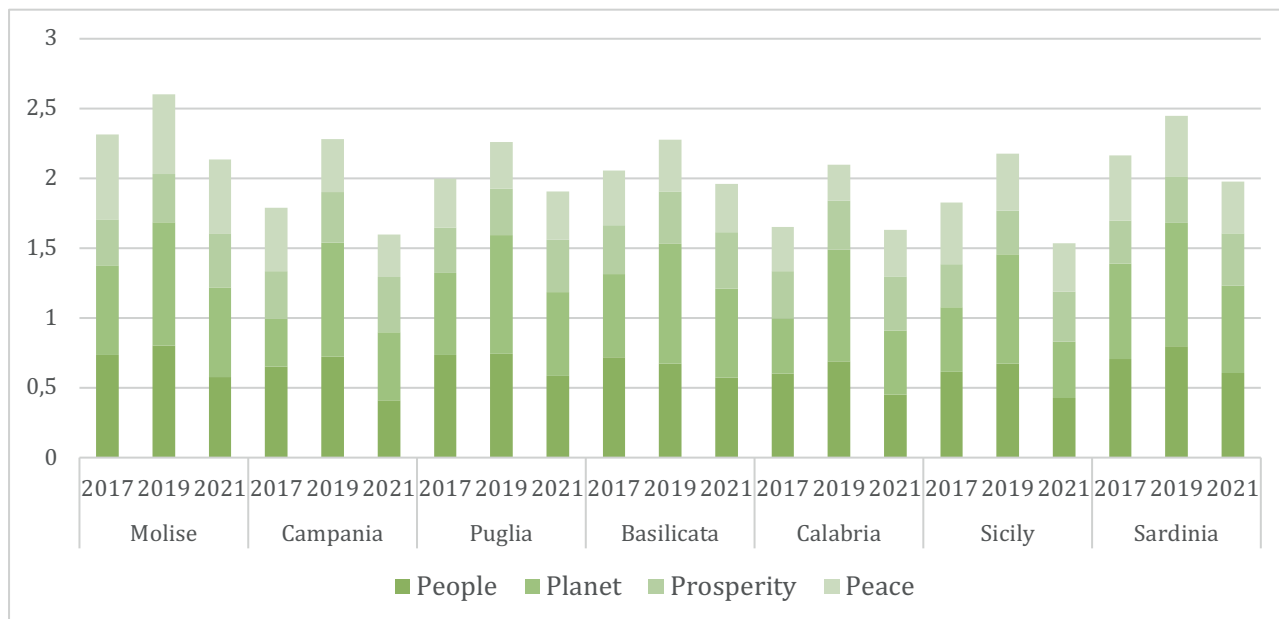
Figure 7. Bars of sustainability – Southern Italy (2017-2019-2021).

worst group, while Campania region constantly obtained worse performances (mainly caused by the worsening of 'Anti-violence centers and shelters rate per 100,000 women > 14 years old' and 'Percentage of permits issued for political asylum and humanitarian reasons') changing from Medium in 2017 to Very Low in 2021. In general, the southern regions maintained over the years the worst performances in terms of 'Irregularly employed' and 'Duration of civil proceedings'. In 2021 Abruzzo and Molise stand out compared to the other southern regions because of their good performances regarding several indicators: 'Anti-violence centers and shelters rate per 100,000 women > 14 years old', 'Percentage of permits issued for political asylum and humanitarian reasons', 'Ratio between the employment rates (25-49 years) of women with children and women without children', 'Number of victims of intentional homicide', 'Percentage of inmates awaiting first judgment out of the total inmates'.

This, along with the very bad results in Planet, caused a drop from the Medium class in 2019 to the Very Low class in 2021 in the Global index seen before. In comparison to the other areas, in the Southern the drop between 2019 and 2021 was greater in the People performance. The increase in the unemployment rate and the decrease in the GDP were the indicators that mostly affected these outcomes.

In general, looking at the results above discussed, it is possible to note a general common trend of the Planet dimension, which increased from 2017 to 2019 and then decreased in 2021, for all the Italian Regions. The Prosperity dimension was the most stable for the three years and all the geographical repartitions. The People and Peace dimensions did not have a global common trend, but followed different directions, depending on the single Regions. Moreover, although some general trends for homogenous geographical areas are present, there is great variability even within them. In order to make the comprehension of the results clear the maps of all the indices for all the years are provided as Appendix B.

Given the historical gap between the North and the South of Italy in terms of social and economic development, it is reasonable to expect the highlighted discrepancies when studying the sustainability performances between the different Italian territories. The origins of the regional gap between Northern and Southern Italy is one of the oldest and most controversial issues in Italian economics and politics (Daniele and Malanima, 2011; Felice, 2013; Russo 1991; Zamagni 1987). As explained in Federico G. et al. (2019), the existence of a North-South disparity and its evolution are inferred not only from the abundant anecdotal evidence on the backwardness of the South but also from the main economic data (e.g., GPD, real wages).

Although there are still few works that evaluated the sustainable development of Italian Regions in relation to Agenda 2030 or NSDS, the gap between the North and the South of the country was already made explicit (e.g.,

Alaimo and Maggino, 2019; D'Adamo et al., 2021; Ionescu et al. 2021; Pulselli et al., 2019). Alaimo and Maggino (2019) evaluated the sustainability of the Italian regions, focusing only on the first three Sustainable Development Goals. They selected 19 basic indicators, divided among the goals considered, in time series from 2009 to 2017. The selection of the indicators was influenced by the need to have data available at the regional disaggregation level. With their work, they wanted to emphasize not only how a gap actually exist between the North and the South of the country, but also how the synthesis tends often to be representative of situations profoundly different from each other, as a result of different values in the basic indicators, or similar situations between them (Alaimo and Maggino, 2019). Because of the different time frame and database used is not possible to make a comparison between their and our outcomes. However, the scenario described by their work is in line with the baseline scenario (2017) used in the present study. Our results are substantially aligned whit the findings of other existing work which show the differences between the various Italian regions. Looking at the 2021 assessment, in agreement with the observations of Ionescu et al. (2021), Abruzzo outperforms other Southern regions, while Lazio is the least performing among Central regions. The first position in the global sustainability ranking of Trentino Alto Adige confirms the results of D'Adamo et al. (2021) as well.

4. CONCLUSIONS

This paper was a first attempt to evaluate the early stages of the Italian Sustainable Development Strategy application, approved in 2017. In order to do so, it was decided to develop an evaluation framework using the 5 Ps (Partnership, Peace, People, Planet, Prosperity) into which the national strategy is divided, based on the 2030 agenda. Because of the absence of data, one of them, Partnership, was excluded. The resulting integrated system of indicators has been built by choosing the regional level, to have a medium-scale analysis; four indices, one for each P, plus a Global one were computed. Three reference years were chosen: 2017, which being the year of approval itself can be considered as a benchmark; 2019 to assess the initial momentum; 2021 representing the short-term effects of the pandemic event COVID-19.

The analysis carried out with SSAM, an integrated multicriteria analysis tool in a geographic environment, showed how the implementation of the strategy generated positive effects on the level of sustainable development of the Italian regions. However, these effects

were not uniform and mainly concerned environmental aspects (Planet Dimension) followed by human well-being (People Dimension). The positive trend noted in 2019 was interrupted and even reversed in 2021, materializing the short-term effects of the pandemic from COVID-19, which strongly affected all the areas and all the dimensions, pushing back the sustainable development level of the Italian regions. As expected, the Sustainability level of the Northern regions was higher than that of the Southern ones, although the differences were not always pronounced. Considering the three years, the distance between the North and South changed significantly, and overall, COVID-19 seemed to have affected most the level of sustainable development in the south. In policy perspective, limiting the analysis and monitoring of the strategy to the national level is a very weak approach, because of the high level of internal socio-economic and territorial diversity of Italy. The differences in regional performances should be considered at the national level to better address the funding distribution among the regions in specific areas, for instance the ones connected to healthcare for improving the quality in the South. At the same time, Regional Decision Makers, on the ground of their relative results can learn how to better prioritize their sustainable strategy, to be tailored to the territorial needs. Political context matters and hence, in-depth engagement with the history of the territory is necessary to understand how to address targets. For example, our work has shown that the historical gap present between the North and the South is still present and is reinforced even in the post-pandemic when looking at income-related indicators, for example. The absence of a general direction for the areas People and Peace requires regional-specific actions, focusing specifically on the local weak points. Optimally, evaluative and technical support and policy initiatives should act jointly to set local targets that ensure both consistency with the national plan and the correct impetus in local reality.

Given the wide scope of the National Strategy, this assessment does not aim to be exhaustive, but it is intended to be an initial analytical tool for public decision-makers, especially to understand in which areas there have been the biggest setbacks due to the pandemic, or in which areas there has been a greater effect of the pandemic, or conversely a better ability to counter negative trends. The main strength of the proposed framework is the easy readability of the results, thanks to the GIS support, which can be very helpful for monitoring the effect of a crucial strategy for Italy. The short available reference period does not allow to gather a clear direction. Further monitoring should be run, at least

once every two years, in order to trace trends and, at the same time, to have the opportunity to speed them up or to slow them done for continuous policy action.

Despite the theoretical soundness of the work, there are some limitations mainly related to the availability and the possibility to update the data used to construct the indicators. Indeed, the coverage of data availability is uneven among the four P's used as assessment dimensions. In particular, Planet appears to be the dimension in which timely updating is most difficult. The absence of updated data makes the role of the always-updated criteria more crucial to the assessments; moreover, the absence of a suitable update resulted in the exclusion of some criteria that would have been useful instead in assessing Planet. Moreover, due also to the limitation in data availability, some goals had to be excluded, more precisely: Goals 6 (Clean water and sanitation), 14 (Life below water), and 17 (Partnerships for the goals). The exclusion in particular of the first one maybe gives a not complete picture of the differences between regions, considering the structural infrastructure problems present in Southern Italy. Finally, in order to have a more solid evaluation it should be useful to include at least ideal points quantitatively and grounded on policy indications. However, given the absence of clear quantitative targets for all the criteria, and in the presence of indications without a specific direction (e.g., decrease, increase, etc.), it was decided to base the analysis on the distribution of available data. Further development of the research can cover both the possibility to have a more complete set of indicators thanks to a better data quality, but also to include specific targets for each criterion, to have an absolute valuation of the achievement level instead of a relative one.

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APPENDIX A

Table 1. People indicators.

Goal	Indicator Code	NSSD Strategic Choice	National Strategic Objective	Selected indicator	Gain / Cost	Source	UM
1	PE_POVERTY	Fight poverty and social exclusion by eliminating territorial gaps	Reduce the intensity of poverty	Risk of poverty or social exclusion	C	Istat	%
1	PE_WATER	Fight poverty and social exclusion by eliminating territorial gaps	Fight food and material deprivation	Families complaining of irregularities in the water supply	C	Istat	%
1	PE_HOUSE	Fight poverty and social exclusion by eliminating territorial gaps	Reduce housing deprivation	Overburden of the cost of housing	C	Istat	%
1	PE_LANDSL	Promote health and well-being	Reduce population exposure to anthropogenic and environmental risk	Population exposed to risk of landslides	C	Ispra	%
2	PE_OBESITY	Promote health and well-being	Promote healthy lifestyles and strengthen prevention healthcare systems	Excess weight among children aged 3 to 17 years	C	Istat	%
3	PE_LIFE	Promote health and well-being	Promote healthy lifestyles and strengthen prevention healthcare systems	Healthy life expectancy at birth	G	Istat	Average number of years
3	PE_SMOKE	Promote health and well-being	Promote healthy lifestyles and strengthen prevention healthcare systems	Smoking (Standardized Rates)	C	Istat	Standardized rates per 100 people
3	PE_BEDS	Promote health and well-being	Guarantee access to effective healthcare services and reduce territorial gaps	Beds in ordinary hospitalization in public and private healthcare institutions	G	Istat	every 10,000 inhabitants
3	PE_ALCOL	Ensuring the conditions for the development of human potential	Combat deviance through prevention and social integration of vulnerable individuals	Persons aged 14 and over with risk behavior for alcohol (Alcohol standardized rates)	C	Istat	Standardized rates per 100 people
4	PE_ABAND	Ensuring the conditions for the development of human potential	Reduce the school drop-out rate and enhance the education system	Early exit from the education and training system	C	Istat	%
4	PE_DEGREE	Ensuring the conditions for the development of human potential	Reduce unemployment for the weakest segments of the population	Graduates and other tertiary qualifications (ages 30-34)	G	Istat	%
8	PE_UNEMPL	Ensuring the conditions for the development of human potential	Reduce unemployment for the weakest segments of the population	Unemployment rate	C	Istat	%
8	PE_NEET	Ensuring the conditions for the development of human potential	Reduce unemployment for the weakest segments of the population	Young people who do not work and do not study (NEET 15-24 years)	C	Istat	%
8	PE_GDP	Ensuring the conditions for the development of human potential	Ensure the effectiveness of social protection and security system	Annual growth rate of real GDP per inhabitant	G	Istat	%

Table 2. Planet Indicators.

Goal	Indicator Code	NSSD Strategic Choice	National Strategic Objective	Selected indicator	Gain / Cost	Source	UM
10	PL_ PROBLEM	Create resilient communities and territories, protect landscapes and cultural heritage	Guarantee high environmental performances of buildings, infrastructures and open spaces	Percentage of people living in homes with structural problems or humidity problems	C	Istat	%
11	PL_ ILLEGAL	Create resilient communities and territories, protect landscapes and cultural heritage	Prevent anthropogenic and environmental risk and strengthen urban and territorial resilience	Illegal building	C	Center for economic and social market research for construction and the territory (Cresme)	For 100 licensed constructions
11	PL_PM10	Ensure the sustainable management of natural resources	Minimize emissions and reduce air pollutants concentration	Exceeding the daily limit value set for PM10 in provincial capitals/ metropolitan cities	C	Istat	No. of days
11	PL_ GREEN	Create resilient communities and territories, protect landscapes and cultural heritage	Boost urban regeneration, ensure sustainable urban accessibility and mobility	Incidence of urban green areas on the urbanized surface of cities	G	Istat	m^2 per 100 m^2 of urbanized area
13	PL_FIRE	Create resilient communities and territories, protect landscapes and cultural heritage	Prevent anthropogenic and environmental risk and strengthen urban and territorial resilience	Forest fire impact	C	Istat	For 1,000 km^2
15	PL_ PROTECT	Halt the loss of biodiversity	Increase terrestrial and maritime protected areas and ensure their effective management	Protected areas	G	Istat	%
15	PL_ WPROOF	Ensure the sustainable management of natural resources	Ensure sustainable forest management and combat forest abandonment and degradation	Soil waterproofing by artificial cover	C	Ispra	%
15	PL_ FRAGM	Create resilient communities and territories, protect landscapes and cultural heritage	Ensure ecosystems restoration and defragmentation, strengthen ecological urban/rural connections	Fragmentation index of the natural and agricultural territory	C	Ispra	%

Table 3. Prosperity Indicators

Goal	Indicator Code	NSSD Strategic Choice	National Strategic Objective	Selected indicator	Gain / Cost	Source	UM
1	PR_TRANSP	Decarbonize the economy	Increase sustainable mobility of people and goods	Families declaring difficulties in connecting with public transport in the area where they live	C	Istat	%
1	PR_BAND	Fund and promote sustainable research and innovation	Implement the digital agenda and improve the spread of smart networks	Families with a fixed and/ or mobile broadband connection	G	Istat	%
1	PR_LANDF	Ensure sustainable production and consumption patterns	Dematerialize the economy, improving the efficient use of resources and the circular economy	Transfer of urban waste to landfills	C	Ispra	%
2	PR_ORGANIC	Ensure sustainable production and consumption patterns	Boost sustainable farming and forestry throughout the production and supply chain	Share of utilized agricultural area (UAA) covered by organic crops	G	Ministry of Agricultural, Food and Forestry Policies	%
4	PR_EDUCAT	Ensure full employment and high quality training	Ensure accessible, high quality and permanent training	Participation in continuing education	G	Istat	%
7	PR_RENEW	Decarbonize the economy	Increase energy efficiency and renewable energy production, avoiding or reducing impacts on natural and cultural heritage and the landscape	Electricity from renewable sources	G	GSE SpA – Energy Services Manager	%
7	PR_ENERINT	Decarbonize the economy	Increase energy efficiency and renewable energy production, avoiding or reducing impacts on natural and cultural heritage and the landscape	Energy intensity	C	Enea	Tons of oil equivalent (TOE) per million euro
9	PR_RESEARC	Fund and promote sustainable research and innovation	Increase the investments in research and development	Research intensity	G	Istat	%
9	PR_INNOV	Fund and promote sustainable research and innovation	Innovate processes and products and promote technological transfer	Firms with innovative product and/or process activities (per 100 firms)	G	Istat	%
10	PR_INCOME	Ensure full employment and high-quality training	Increase sustainable and high-quality employment	Gross disposable income per capita	G	Istat	Euros (current prices)
12	PR_RECYCL	Ensure sustainable production and consumption patterns	Dematerialize the economy, improving the efficient use of resources and circular economy	Separate collection of urban waste	G	Ispra	%
12	PR_EMAS	Ensure sustainable production and consumption patterns	Promote social and environmental responsibility in companies and institutions	Number of EMAS registered organizations/ companies	G	Ispra, Istat	Every 1,000 active enterprises
12	PR_REPORT	Ensure sustainable production and consumption patterns	Promote social and environmental responsibility in companies and institutions	Public institutions that adopt forms of social and/or environmental reporting	G	Istat	%
12	PR_TWASTE	Ensure sustainable production and consumption patterns	Promote the demand and increase the supply of sustainable tourism	Impact of tourism on waste	C	Ispra	kg per inhabitant equivalent
12	PR_TOURIN	Ensure sustainable production and consumption patterns	Promote the demand and increase the supply of sustainable tourism	Tourism intensity index	G	Istat	Per 1,000 inhabitants

Table 4. Peace Indicators.

| Goal	Indicator Code	SnSvS Strategic Choice	National Strategic Objective	Selected indicator	Gain / Cost	Source	UM
5	PA_ANTIV	Promote a non-violent and inclusive society	Prevent violence against women and children and provide adequate assistance to victims	Anti-violence centers and shelters rate per 100,000 women > 14 years old	G	Istat	Per 100,000 women
5	PA_EMPLW	End discrimination in all its forms	Guarantee gender equality	Ratio between the employment rates (25-49 years) of women with children and women without children	G	Istat	%
5	PA_REPRESW	End discrimination in all its forms	Guarantee gender equality	Women and political representation at the local level	G	Individual regional councils	%
8	PA_IRREMPL	End discrimination in all its forms	End all forms of labour exploitation and ensure workers' rights	Irregularly employed	C	Istat	%
10	PA_PERMIT	Promote a non-violent and inclusive society	Guarantee migrants' and asylum seekers' reception and the full integration of ethnic and religious minorities	Percentage of permits issued for political asylum and humanitarian reasons	G	Istat	%
16	PA_HOMICID	Ensure legality and justice	Reinforce the fight against crime	Number of victims of intentional homicide	C	Ministry of the Interior	Per 100,000 inhabitants
16	PA_SAFETY	Ensure legality and justice	Reinforce the fight against crime	Perception of safety walking alone in the dark	G	Istat	%
16	PA_JUDGE	Ensure legality and justice	Ensure just and efficient judiciary system	Percentage of inmates awaiting first judgment out of the total inmates	C	Ministry of Justice – Department of prison administration	%
16	PA_PRISONS	Ensure legality and justice	Ensure just and efficient judiciary system	Crowding of prisons	C	Istat	%
16	PA_CIVPRO	Ensure legality and justice	Ensure just and efficient judiciary system	Duration of civil proceedings	C	Ministry of Justice	No. of days

APPENDIX B
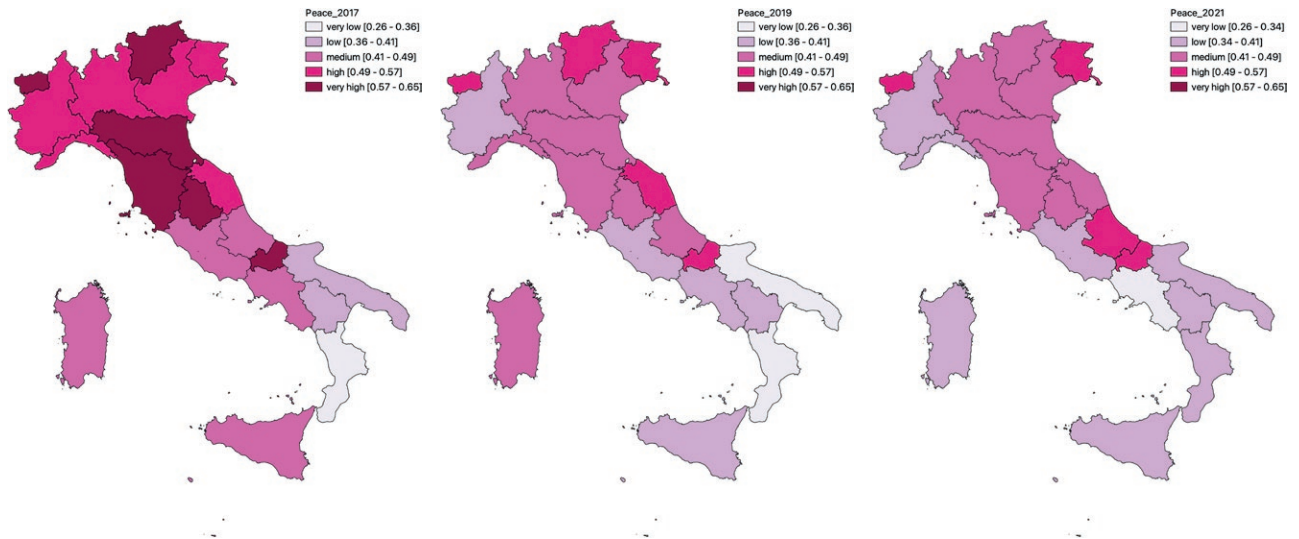
Figure 8. Regional distribution of the Peace index (years: 2017, 2019, 2021).
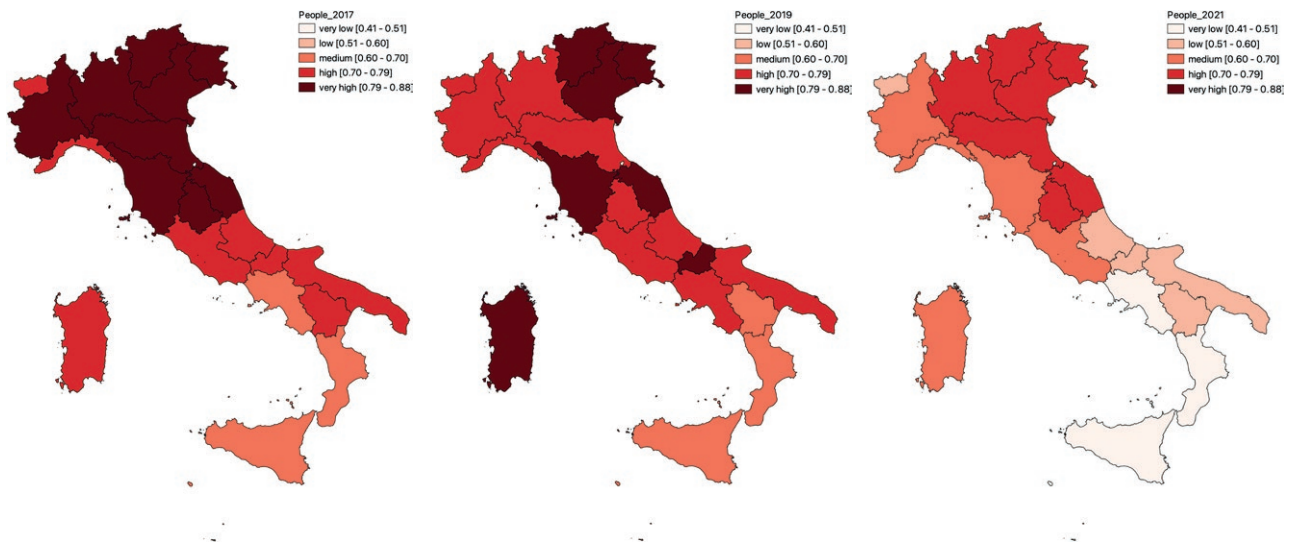

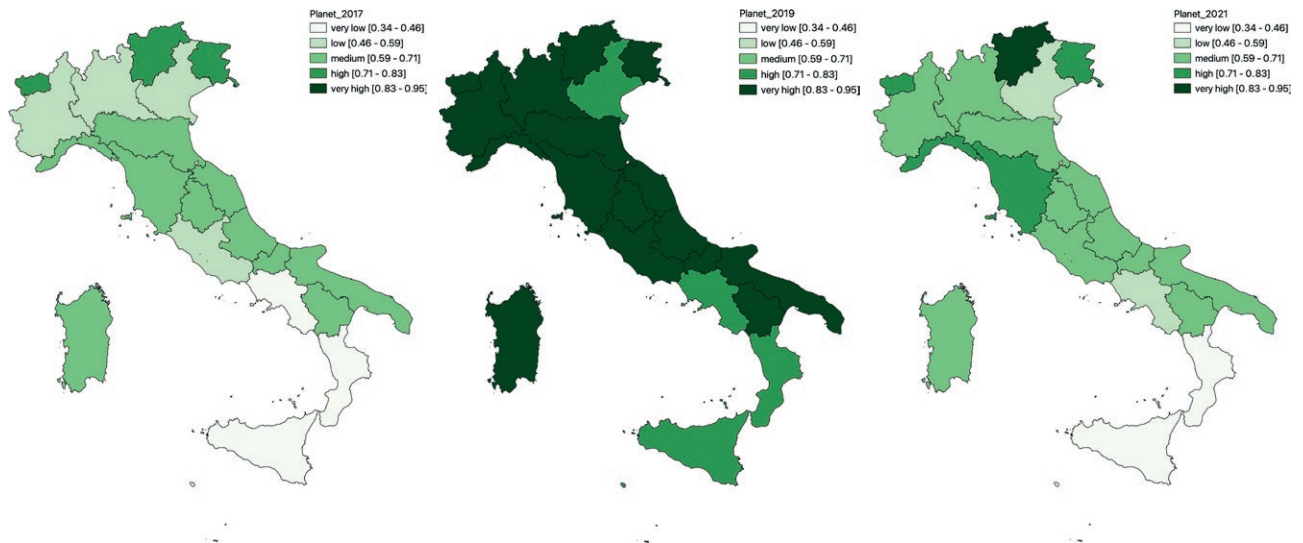**Figure 9.** Regional distribution of the People index (years: 2017, 2019, 2021).

Figure 10. Regional distribution of the Planet index (years: 2017, 2019, 2021).
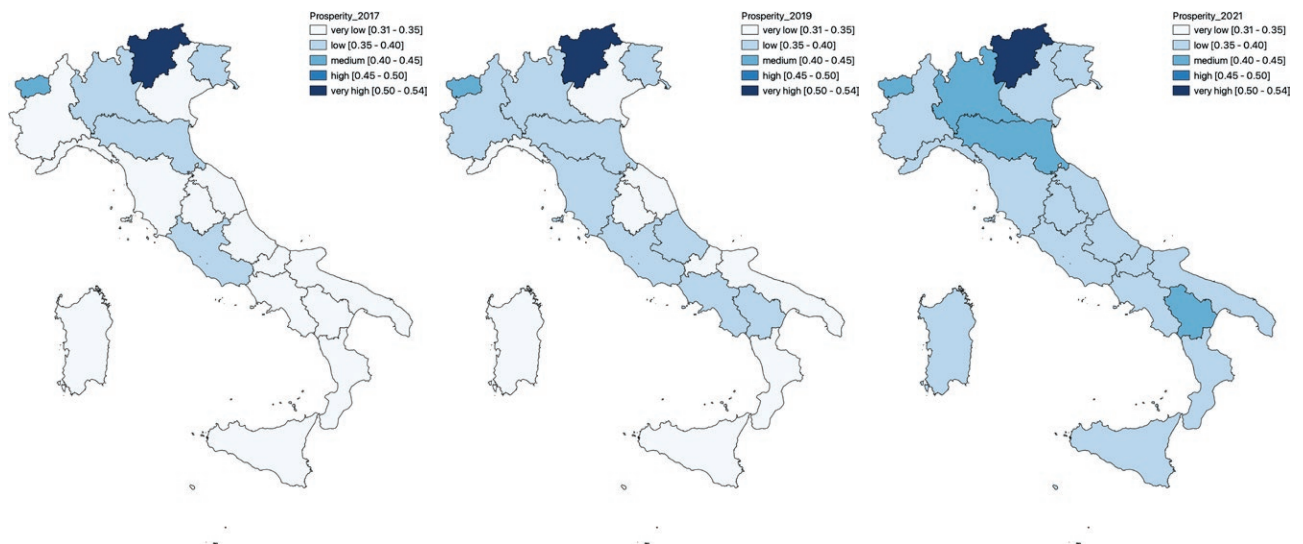

Figure 11. Regional distribution of the Prosperity index (years: 2017, 2019, 2021).