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Integrating Adaptation to Climate Change into Sustainable Development Policy and Planning

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Abstract: Adaptation to climate change and sustainable development have become core elements of international, European, and national policies and strategies. At worst, adaptation to climate change can trigger negative responses—maladaptation—in terms of raising greenhouse-gas emissions and exacerbating the vulnerability of specific groups of people, which both run counter to sustainable development principles. Thus, the integration of sustainable climate change adaptation objectives into a sustainable development framework can pave the way for planning scenarios, in which resilience intertwines with sustainability. Studies concerning this issue are quite lacking, and methods useful for assessing the relationship 'adaptation-sustainable development' are scarcely investigated. In this study, we focus on environmental sustainability and aim at proposing and applying a method for assessing the coherence between climate change adaptation objectives and sustainable development objectives (i.e., national strategic goals) included in the Italian National Adaptation Plan to Climate Change and, respectively, in the National Sustainable Development Strategy. We found that most adaptation objectives appear to be unrelated with national strategic goals, while none of them clearly hinder environmental sustainability, that is, the adaptation objectives are not inclined to promote maladaptation. There is still plenty of room to work on sustainable adaptation objectives to be consistent with sustainable development ones.

Keywords: 2030 Agenda; sustainable development; environmental sustainability; adaptation to climate change; governance; sustainable artificialization; resilience; protection of human life and biodiversity; maladaptation

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1. Introduction

This research lies on two pillars recognized as relevant to the European Union: adaptation to climate change and promotion of sustainable development. The European Commission [1] stated that "[c]limate adaptation and resilience objectives are embedded in the EU-level COVID-19 pandemic recovery effort. […] The National Recovery and Resilience Plans are expected to support investments and reforms to improve climate resilience across the entire EU". In addition, "[…] The EU is fully committed to playing an active role in helping to maximize progress towards the Sustainable Development Goals" [2].

Adaptation to climate change means adapting human and natural systems to current or expected climatic events in order to minimize harm or maximize benefits [3]. According to the original definition, sustainable development means "[...] development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [4]. Sustainable development consists of three dimensions: economic, social, and environmental [5]. In this study, the focus is on "environmental sustainability",

which can be defined as "the ability of the environment to support a defined level of environmental quality and natural resource extraction rates indefinitely" [6].

According to the scientific literature [7,8], adaptation to climate change and sustainable development are themes of international relevance. European institutions have promoted a series of initiatives aimed at addressing these issues (for example, [5,9–13]). Making sustainable development a priority and achieving sustainable development goals are consistent with the efforts to adapt to climate change [14]. The integration of biodiversity and ecosystem-conservation issues and adaptation to climate change into plans, programs, and projects has been recognized as of primary importance in the European Union [15].

In the worst-case scenario, adaptation to climate change can trigger negative responses—maladaptation—in terms of raising greenhouse-gas emissions and exacerbating the vulnerability of specific groups of people, high costs compared to alternative approaches, reducing the motivation to adapt and leading to path dependency (see Barnett and O'Neill, [16]), and can imply unsustainable development. Paradoxically, climate-change adaptation has the potential to negatively affect sustainable development, by exacerbating negative effect on people and environment [17–24]. According to Schipper [25], maladaptation outcomes (described in terms of "Rebounding Vulnerability") can hinder sustainable development. As an example of maladaptation, the Organization for Economic Co-operation and Development refers to the rural communities, who can adopt adaptation strategies that could prove unsustainable in the long term; e.g., "short-term adaptation strategies in response to a decrease in rainfall could include over-exploitation of groundwater resources, which could actually exacerbate vulnerability over the longer term" [26]. According to Rahman [27], there is a need to assess adaptation measures in terms of sustainable development as a basis for sustainable adaptation, i.e., "a set of actions that contribute to socially and environmentally sustainable development pathways, including social justice and environmental integrity" [27].

Back in 2005, Munasinghe and Swart [28] argued that "[the] great majority of sustainable development strategies are not related to climate change, but they could make adaptation more successful. Similarly, many climate change adaptation policies certainly will help to make development more sustainable". In addition, Eriksen et al. [22] proposed four principles with the purpose of guiding sustainable adaptation responses, which involve context of vulnerability, values and interests, local knowledge, and feedback concerning local-global processes (more details in Eriksen et al. [22]).

Thus, the interest of scholars on the relationship "adaptation to climate change-sustainable development" is remarkable, and in light of these premises, it is worth investigating if national adaptation policies, strategies, or plans are considering sustainable development principles or, at the very least, are not defining adaptation objectives that could lead to socially, economically, and/or environmentally unsustainable results in the long term, i.e., by way of a non-exhaustive example, trigger an increase of energy consumption and greenhouse-gas emissions and contribute to social inequity and the poverty of specific groups of people.

The EU strategy for adaptation to climate change (EU strategy, [10]) and the Italian national strategy for adaptation to climate change (SNACC, [29]) provide an adaptation-to-climate-change framework for regional and sub-regional strategies and plans. The objectives of the Italian National Adaptation Plan to Climate Change (NAPCC; Piano nazionale di adattamento ai cambiamenti climatici: Italian acronym, PNACC) are consistent with those of EU Strategy and SNACC. In turn, NAPCC is a framework for lower-level planning tools. National and regional strategies and plans should include climate-change adaptation objectives (CCAOs) consistent with EU Strategy and SNACC and, therefore, with the adaptation objectives defined in PNACC. The Italian National Sustainable Development Strategy (NSDS; Strategia nazionale per lo sviluppo sostenibile: Italian acronym, SNSvS)—which is consistent with the 2030 Agenda—is a framework for

strategies and plans in terms of sustainable development issues. Therefore, national and regional strategies and plans should include objectives consistent with those of the 2030 Agenda and NSDS.

The NAPCC acts as a (non-mandatory) framework for lower-level planning tools, while the NSDS acts as a framework for equal or lower-level strategies and lower-level planning tools. Thus, the focus of this research is on climate change adaptation objectives (CCAOs) and national strategic goals (NSGs).

The integration of CCAOs into sustainable development objectives (i.e., National strategic goals, NSGs) could provide policymakers, decision-makers, and planners with sound bases to promote resilience and sustainable human activities from national to local scales. The scientific literature has scarcely addressed the relationship CCAOs-NSGs and pointed out the relevance of including adaptation principia into sustainable development strategies. In addition, scientific literature lacks research concerning methods for scrutinizing such a kind of relationship. Thus, this study aims at providing answers to two research questions (RQs). RQ1: can we propose a method for pointing out the relationship between strategic tools concerning adaptation to climate change and sustainable development? RQ2: can the method be applied to suggest the integration of adaptation to climate change issues into sustainable development strategies? We aim at demonstrating that the method can play a role in integrating adaptation objectives into sustainable development strategies.

In this paper, we aim at illustrating and applying a method for assessing the coherence between NAPCC [30] and NSDS [31]. CCAOs of NAPCC that are consistent with NSGs included into NSDS could be part of a Regional Strategy for Sustainable Development based on sustainable adaptation approaches.

The paper unfolds as follows. In Section 2, we summarize the main features of both the Italian National Adaptation Plan to Climate Change and National Sustainable Development Strategy. In Section 3, we describe the methodological approach, while in Section 4 and 5, we present and, respectively, discuss the findings. In Section 6, we report on the concluding remarks.

2. Italian National Adaptation Plan to Climate Change and National Sustainable Development Strategy

In this section, we report on the main features and contents of both Italian National Adaptation Plan to Climate Change [30] and National Sustainable Development Strategy [31].

2.1. Italian National Adaptation Plan to Climate Change

NAPCC aims at promoting the implementation of the National Strategy for Adaptation to Climate Change [29]. The main objective of NAPCC is to translate the national reference framework on adaptation into functional terms, with the purpose of planning adaptation actions at different government levels and in various sectors. NAPCC is the result of a multilevel governance process based on the involvement of several stakeholders (policy makers, experts, researchers, etc.), with the aim of identifying a set of connected and synergistic activities for adaptation to climate change. The Plan includes information concerning climate scenarios, risk appetite, sectoral impacts and vulnerabilities, sectoral adaptation actions, roles for the implementation of adaptation actions, as well as coordination tools among different levels of government. NAPCC consists of four main parts: (i) context analysis, climate scenarios and climate vulnerability; (ii) adaptation actions; (iii) tools for participation, monitoring, and evaluation; (iv) criteria for implementation and guidelines on the use of NAPCC.

As for the first part, NAPCC defines six homogeneous climatic macro-regions for terrestrial areas and two homogeneous climatic macro-regions for marine areas. The homogeneous climatic macro-regions include parts of the national territory that have the same climatic conditions, with respect to a definite historical period; within the

homogeneous climatic macro-regions, NAPCC identifies the areas that will have to face similar climatic anomalies. Summary fact sheets have been drawn up for the definition of adaptation actions tailored to each of the homogeneous climatic macro-regions. Typical summary fact sheets contain: (i) the current climatic characterization of the macro-region; (ii) the homogeneous climatic areas identified and the respective prevalent climatic anomalies; (iii) the characterization of the macro-regions; (iv) the summary of the main threats and opportunities expected for each sector; (v) the assessment of the potential impact for each sector analyzed. The second part revolves around the increase of resilience of the Italian territory and the ability to adapt to climate change, by identifying (i) a set of sectoral adaptation actions, (ii) possible subjects for their implementation, and (iii) necessary financial resources and possible sources of funding. A set of 361 sectoral adaptation actions have been set by experts, who collaborated in the design of the Plan. The third part of NAPCC concerns the participatory process, the governance system, and the methods for monitoring and assessing the adaptation actions. The planning process was accompanied by public consultations with the purpose of (i) investigating the perception of stakeholders regarding the issue of adaptation to climate change, and (ii) assessing the possible actions to be undertaken and the most effective governance models to promote the process of adaptation to climate change. All the documents produced as part of the drafting process of NAPCC have been subjected to a scientific review. Finally, in the fourth part, NAPCC proposes a path to be followed at the local scale to promote the implementation of its content by the local authorities, and a guide on the use of NAPCC is provided. The Plan proposes a series of sectoral actions and identifies the most relevant actions to increase the adaptive capacity of the territories.

NAPCC considers sectors such as water resources, desertification, geological, hydrological, and hydraulic instability, terrestrial ecosystems, inland and transitional water ecosystems; forests, agriculture, aquaculture, tourism, health, urban settlements, transport, cultural heritage, dangerous industries, and infrastructures (Ministry of the Environment, Land and Sea, 2018). We focused on 'forests', 'agriculture', 'urban settlements', and 'water resources'.

2.2. National Sustainable Development Strategy

NSDS, approved in December 2017, is strategic for sectoral and territorial policies in Italy. It sets out at national level the principles and objectives of the 2030 Agenda for Sustainable Development, by considering four guiding principles: 'integration', 'universality', 'transformation', and 'inclusion' [31]. NSDS is structured in five areas, which correspond to the ones recalled in the 2030 Agenda: People, Planet, Prosperity, Peace, and Partnership. Each area consists of a system of strategic choices declined into national strategic goals (NSGs), which are specific to the Italian context and complementary to the 169 targets of 2030 Agenda. An additional—sixth—area regards the so-called "vectors for sustainability", which must be considered as essential elements for the achievement of the NSGs. The strategic choices identify the priorities that Italy is called upon to respond to. We focused on Area 'Planet' (Table 1, the full list is reported in [32]).

Table 1. National Strategic Goals by strategic choices in the area 'Planet' (Italian Ministry for the Protection of the Environmental, Land, and Sea [31,32]). Note to readers: please refer to Supplementary Material (a separate file available on-line), which includes the full list of National Strategic Goals by areas and strategic choices [32]. Table 1 is for illustrative purposes and lacks details, which are included in Supplementary Material.

Area	Strategic choices	National Strategic Goals (NSGs)	Code
Planet	Halt the loss of biodiversity	- Safeguard and improve the conservation status of species […]	I.1
		- Halt the spreading of invasive alien species […]	I.2
		- Increase […] protected areas […]	I.3
		- Protect and restore genetic resources […]	I.4
		- Mainstream natural capital accounting in planning […]	I.5
	Ensure the sustainable management of natural resources	- Provide biologically diverse and dynamic seas […]	II.1
		- Halt soil consumption […]	II.2
		- Minimize pollutant loads […]	II.3
		- Implement integrated water resource […]	II.4
		- Maximize water efficiency […]	II.5
		- Minimize emissions […]	II.6
		- Ensure sustainable forest management […]	II.7
	Create resilient communities and territories, protect landscapes and cultural heritage	- Prevent anthropogenic and environmental risk […]	III.1
		- Guarantee high environmental performances […]	III.2
		- Boost urban regeneration […]	III.3
		- Ensure ecosystems restoration […]	III.4
		- Ensure the development of […] sustainable management of […] landscapes […]	III.5

3. Method

International and Italian studies on the coherence between adaptation plans and sustainable development strategies are still lacking. We aim to fill this research gap by focusing on the concept of 'external coherence'. By 'coherence' analysis, we mean the process of critical investigation aimed at assessing whether objectives of the NAPCC have the potential to facilitate (coherence) or not (indifference), or hinder (inconsistency), the achievement of the NSGs of the NSDS. The concept of external coherence is a well-known approach in planning practice [33–36] even in the context of the strategic environmental assessment (SEA) [35,37,38], which is a typical operational tool for supporting and realizing environmental sustainability policies and actions [39]. Coherence analysis allows us to establish complementary relationships between the objectives of a given plan and the objectives of other plans developed in the same territorial area. The plans should also ensure a certain degree of external coherence with respect to the structure of their reference policies (the so-called compliance with political mandates); the coherence of the plans with other policies or plans developed in the same territorial area should also be ensured, with the purpose of generating synergies and/or avoiding redundancies [36].

External coherence analysis is currently applied in SEA procedures [40,41] and is divided into 'vertical' and 'horizontal' coherence. Vertical external coherence analysis supports the check (consistency) of objectives of a given plan or program, with respect to the environmental sustainability objectives defined at regional, national, and European scales. On the other hand, the horizontal external coherence analysis refers to the

compatibility of the objectives of a plan or program with the objectives of sector plans belonging to the same governance/government level over the same territorial area.

Inspired by the scientific literature and current practice on SEA [33,35,42,43], our comparison between NAPCC and NSDS objectives is based on the concept of external coherence.

As for the operationalization of the method, we propose the integration of content analysis of official reports of NAPCC and NSDS and interviews with experts. Content analysis—i.e., the scrutiny of the contents included in a document—is widely used in the literature (see, for example, [44–46]) and allows us to obtain a first overview on the consistency between objectives. The critical reading of the text supports the full understanding of nuances and details and is useful for reconstructing a faithful picture of the contents (as in [44]). Content analysis is intended to be complemented by interviews with experts in several scientific and technical sectors: the aim is to refine the judgments of consistency, by considering an external point of view. In fact, interviews make it possible to acquire different points of view on the same topic and are a validated and widely used tool in the scientific literature (see, for example, [47–49]).

3.1. Criteria

We operationalize consistency analysis, by adopting a criteria-based method including two steps (Table 2).

Table 2. Methodological steps and criteria for assessing the consistency between NAPCC and NSDS.

Step	Code	Type	Tools	Description	References
1	CR01	Qualitative	Evaluation grid	Consistency based on the analysis of the text. Systematic analysis of the text with respect to scientific literature and practice to ascertain whether an objective of NAPCC is consistent with one or more goals of NSDS.	Ullah and Sepasgozar [46]; De Montis et al. [44].
2	CR02	Quantitative	Scoring system		De Montis et al. [50]; Cortinovis and Geneletti [51]; Hurlimann et al. [43]
3	CR03	Quali-quantitative	Stakeholder's interview	Consistency based on the judgments of experts (stakeholders). The interviewees are guided to assess quantitatively the level of consistency, according to the following scores: from −1 and −0.1: inconsistency; 0: indifference; from 0.1 and 1: consistency. The arithmetic mean provides the overall judgment of consistency/inconsistency.	Fischer et al. [52]; De Montis [48].

In the first step, we assess the coherence of the contents of NAPCC and NSDS by text analysis (CR01). We aim at identifying nuances and relationships not immediately detectable with a simple uncritical reading of the documents. In the second step, we proceed by evaluating the level of coherence emerging from interviews with experts in the field of SEA, adaptation to climate change, land and environmental planning, forest sciences, agricultural sciences, green infrastructures, and other ones (CR02). In this approach, we combine qualitative analysis (text analysis) with qualitative-quantitative analysis (coherence judgments) in a framework that can be easily replicable to other contexts.

3.2. Evaluation Grid

Inspired by the scientific literature and current SEA practice [39,42,43,53], the comparison between objectives of NAPCC and NSDS is based on the concept of external coherence and on the use of evaluation grids (or matrices). The coherence between

NAPCC and NSDS is recognized when an objective of NAPCC aims to also promote the achievement of at least one objective of NSDS; we consider 'indifferent' an objective of NAPCC that does not directly influence the achievement of objectives included in NSDS; we consider 'inconsistent' an objective of NAPCC that hinders the achievement of objectives identified in NSDS [38,42,54], i.e., an effective CCAO has negative impacts in terms of environmental sustainability. Coherence analysis between NAPCC and NSDS is carried out in three phases: (i) identification of the relevant NSGs retrieved from NSDS; (ii) identification of the CCAOs drawn from NAPCC; (iii) comparison—and assessment of coherence—between objectives of NAPCC and goals of NSDS. The evaluation of the consistency of NAPCC-NSDS is carried out through an objective-by-goals comparison that gauges if a given objective of NAPCC converges in a hard or soft pattern (strong and weak consistency), diverges (inconsistency), or is unrelated (no relationship), with respect to the NSGs of NSDS. Any uncertainties in the assessment are highlighted by using a question mark. An evaluation grid is defined for the following four sectors of the NAPCC (see an example in Table 3): Urban settlements (8 objectives), Agriculture (10), Forests (7), and Water resources (12). The grid also includes 17 NSGs drawn from NSDS (Area 'Planet').

Table 3. Sample of evaluation grid. Very dark blue, soft yellow, and crossed cells with white background mean, respectively, full, weak, and negative consistency between objectives. The empty white cell means no relationship between objectives, while the question mark (?) stands for uncertainty in the assessment.

		NSGs			
		Goal 01	Goal 02	Goal 03	…
CCAOs	Objective 01	?		?	
	Objective 02				
	Objective 03				
	…		?		

Legend

	Strong consistency between objectives of NAPCC-NSDS
	Weak consistency between objectives of NAPCC-NSDS
	Inconsistency between objectives of NAPCC-NSDS
	No relationship
?	Uncertainty in the assessment

Because the use of colors is central in science communication for its intuitive immediacy, we use a simple set of colors to make the meaning of the relationship between objectives of NAPCC and goals of NSDS as clear as possible even for people prone to color-vision deficiency [55,56]. Following Katsnelson [56], we suggest colors that should work fine for most people (see '5 tips on designing colorblind-friendly visualizations': https://www.tableau.com/about/blog/examining-data-viz-rules-dont-use-red-green-together, latest accessed on 10 February 2022) and that are inspired by the cividis color map (https://www.ncl.ucar.edu/Document/Graphics/ColorTables/cividis.shtml, latest accessed on 10 February 2022). Very dark blue (#002a64 Color Hex), soft yellow (#e5cf5a), and crossed cells with white background mean, respectively, full, weak, and negative consistency between objectives (Color Hex Color Codes: https://www.color-hex.com, latest accessed on 10 February 2022). The empty white cell means no relationship between objectives, while the question mark stands for uncertainty in the assessment. Finally, we checked the quality of the grid by using the Color Blindness Simulator to see how it looks "to people with colour vision deficiencies" [56] (Color Blindness Simulator, Coblis: https://www.color-blindness.com, latest accessed on 11 February 2022). We are aware that

it is not the best combination of colors in absolute terms, but we feel this is an acceptable solution to allow most people to correctly interpret the meaning of the grid.

If we cross-reference the 17 NSGs of the NSDS with the CCAOs falling in the four NAPCC sectors, we can obtain: 136 relationships for Urban settlements, 170 for Agriculture, 119 for Forests, and 204 for Water Resources. The consistency judgments were assigned by three researchers specializing in climate change adaptation, strategic environmental assessment, landscape planning, and green infrastructure. The judgments were based on (i) considerations rooted in scientific and/or technical literature (grey literature), or (ii) public documents issued by public and private bodies of recognized reliability. This aspect is key to reduce the subjectivity of the assessment.

3.3. Scoring System

Quantitative approaches (i.e., based on quantitative measures) are considered useful for translating complex information into more accessible knowledge for less expert individuals, although such a translation is likely to result in the loss of informative contents when compared to qualitative analyses [50]. As a countermeasure, we adopted a scoring system inspired by the works of De Montis et al. [50], Cortinovis and Geneletti [51], and Hurlimann et al. [43]. Table 4 illustrates the motivations of the quali-quantitative scoring correspondence system.

Table 4. The motivations underlying the quali-quantitative scoring correspondence system.

Scoring Correspondence		Motivation
Quantitative	**Qualitative**	
5	Full consistency	The objective of NAPCC allows the achievement of NSDS goal(s)
3	Weak consistency	The objective of NAPCC, if slightly modified or supplemented, allows the achievement of NSDS goal(s)
1	Uncertainty in the assessment	There is uncertainty on the consistency between NAPCC objective(s) and NSDS goal(s)
0	No relationship	There is no relationship between NAPCC objective(s) and NSDS goal(s)
−5	Negative consistency	The objective of NAPCC could hinder the achievement of NSDS goal(s)

The score ranges from −5 (negative consistency) to 5 (full consistency). The maximum score—$Max(\text{SCORE}_x)$—of each NAPCC sector—x—is calculated by Equation (1):

$$Max(\text{SCORE}_x) = X \times Y \times 5, \quad (1)$$

where X is the total number of rows, Y the total numbers of columns, and 5 the score assigned to the cell when full consistency occurs. Thus, the $Max(\text{SCORE}_x)$ for Urban settlements, Agriculture, Forests, and Water resources is, respectively, 680 (8 rows times 17 columns times 5), 850, 595, and 1020.

We assign the score to the cells of the matrix according to the qualitative system described in Section 3.2: very dark blue, 5; soft yellow, 3; white, 0; cell with question mark, 1; crossed cell, −5. Then, we add up the scores of each matrix and obtain a global score (GB_x). Finally, GB_x is divided by $Max(\text{SCORE}_x)$ to obtain a performance index (PI_x); see Equation (2):

$$PI_x = \frac{GB_x}{Max(\text{SCORE}_x)}, \quad (2)$$

where PI_x provides a quantitative consistency assessment between CCAOs and NSGs. In other words, PI_x shows a measurable performance of the NAPCC sectors in terms of support to NSGs. PI_x ranges from −1 (minimum value, i.e., none of the CCAOs objectives allows the achievement of NSDS goals) to 1 (maximum value, i.e., all CCAOs allow the achievement of NSDS goals).

As a final check, we assess the correlation of each variable (X and Y, values in columns) included in the grids of Appendix A. We perform a correlation analysis to calculate the correlation coefficient (r) by Equation (3):

$$r = \frac{\sum(x-\bar{x})(y-\bar{y})}{\sqrt{\sum(x-\bar{x})^2 \sum(y-\bar{y})^2}}, \quad (3)$$

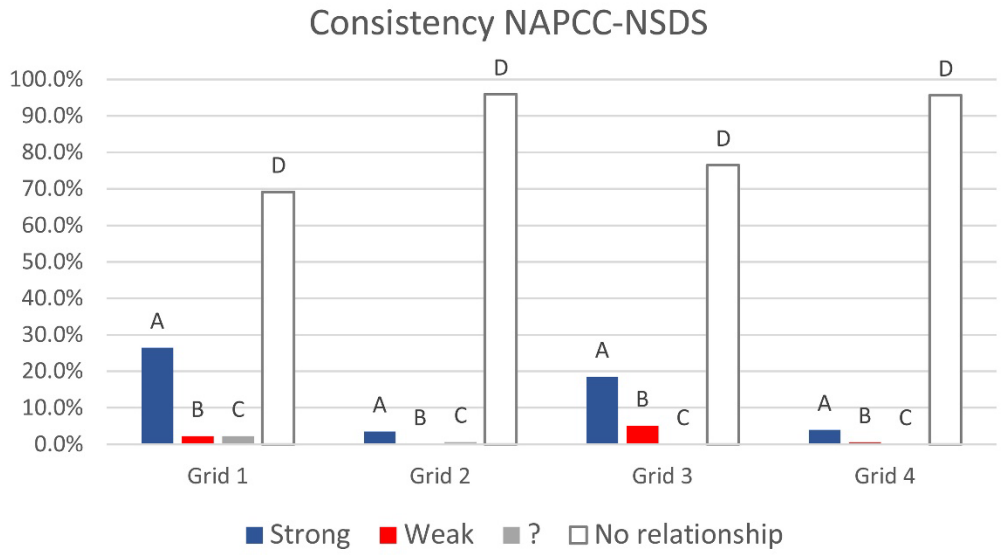
where x and y stand for the values of the variables X and Y, while $\bar{x}$ and $\bar{y}$ for the mean of X and Y variable.

3.4. Stakeholder's Interview

England et al. [57] assessed the consistency of documents concerning agricultural policy, development plans, and water policy in three African countries, with respect to the theme of adaptation to climate change. The documents were analyzed by using an approach based on content analysis through criteria and scores. The authors also conducted interviews with experts regarding the results obtained in the evaluation phase. Inspired by England et al. [57], the content analysis of NAPCC and NSDS can be complemented by a quali-quantitative judgment expressed by interviewees (second criterion: CR02). The involvement of different stakeholders can be useful to provide a non-academic judgment on the same object: a similar approach was followed by De Montis [48] in the context of strategic environmental assessment of energy planning tools of Italian regions and provinces.

4. Results

The evaluation grids (hereafter 'grids') in Appendix A shows the consistency between the objectives of NSDS and those of NAPCC. Table A1 highlights 36 points of strong coherence between NAPCC and NSDS; i.e., 18 couples of objectives/goals are strongly consistent with each other, while three points of consistency need further investigation, and three points show weak consistency. In Table A2, six points of strong coherence emerge, while one point of consistency needs further investigation. Table A3 shows 22 points of strong coherence and six points of weak consistency. Finally, Table A4 stresses eight points of strong coherence, and one point of weak consistency. Figure 1 summarizes a comparative analysis of the findings. An example of the rationale of analysis is available in Appendix B.



		Grid 1	Grid 2	Grid 3	Grid 4
A	**Strong**	26.5%	3.5%	18.5%	3.9%
B	**Weak**	2.2%	0.0%	5.0%	0.5%
C	**?**	2.2%	0.6%	0.0%	0.0%
D	**No relationship**	69.1%	95.9%	76.5%	95.6%

Figure 1. Summary of the results of the grid-based coherence analysis between NAPCC and NSDS. Legend of the level of consistency: A for strong, B for weak, C for uncertain, and D for indifferent. Grid 1 refers to Urban settlements, Grid 2 to Agriculture, Grid 3 to Forests, and Grid 4 to Water resources.

Beyond the details, a remarkable result is that most CCAOs are indifferent to NSGs.

Grid 1 refers to Urban settlements (136 potential relationships between objectives of NAPCC and NSDS): 26% of the relationships between objectives are strong. In Grid 2, 'Agriculture' (170 potential relationships), 3 'Forests' (119 potential relationships), and 4 'Water resources' (204), we found strong relationships, according to the following percentages: 4%, 18%, and 4%. Urban settlements and Forests are the most represented sectors of NAPCC consistent with the NSGs of NSDS (Area 'Planet'), while the 96% of CCAOs of Agriculture and Water resources do not show clear relationship with the NSGs of NSDS.

Below, we provide the reader with a detailed description of the findings. As for Grid 1 (Urban settlements), the three most representative objectives of NAPCC are "Promote scientific research on the nature and magnitude of climate change in the urban context and risk assessment" (code IU_001., see Table A1 in Appendix A), "Increase knowledge, education, and training on vulnerability and adaptation at the urban scale" (IU_002.), and "Promotion of planning and design for risk prevention and facilitate monitoring" (IU_003.), while the three most representative objectives of NSDS are "Prevent anthropogenic and environmental risk and strengthen urban and territorial resilience" (III.1), "III.2 Guarantee high environmental performances of buildings, infrastructures and open spaces" (III.2), and "Maximize water efficiency and adjust withdrawals to water scarcity" (II.5).

As regards Grid 2 (Agriculture), there is not a clear cluster of relationships between objectives. The most representative objective of NAPCC is "Promote the selection of genotypes that are resilient and resistant to climate change" (AG_008., see Table A2 in Appendix A), while the most representative NSGs of NSDS is "Safeguard and improve the conservation of species and habitats in terrestrial and aquatic ecosystems" (I.1).

Regarding Grid 3 (Forests), the three most representative objectives of NAPCC are "Promote and strengthen actions related to innovation, research, education, and training" (FO_001., see Table A3 in Appendix A), "Protect and conserve biodiversity and increase resilience in the forest sector" (FO_002.), and "Increase resilience in the forest sector and maintenance of ecosystem services by promoting sustainable forest planning and management" (FO_007.), while the two most representative NSGs of NSDS are "Safeguard and improve the conservation of species and habitats in terrestrial and aquatic ecosystems" (I.1) and "Halt the spreading of invasive alien species" (I.2).

Finally, in Grid 4 (Water resources), the two most representative objectives of NAPCC are "Raising awareness in communities" (RI_001., see Table A4 in Appendix A) and "Improve the effectiveness of the regulation concerning the use of the resource (water)" (RI_008.), while the two most representative of NSDS are "Implement integrated water resource management at all levels" (II.4) and "Maximize water efficiency and adjust withdrawals to water scarcity" (II.5).

Below we provide the findings of the quantitative approach (Figure 2).

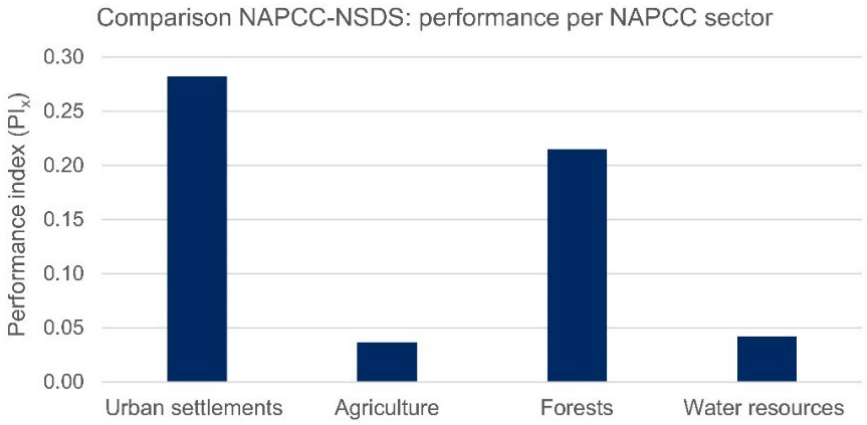


Figure 2. Comparison between NAPCC and NSDS: the bars represent the performance of the NAPCC sectors against the set of NSDS goals.

Urban settlements (0.28) and Forests (0.22) show the best performance, while Agriculture (0.04) and Water resources (0.04) appear to be weak, in terms of consistency with the NSDS goals.

Finally, according to the correlation analysis (Table A5 in Appendix A), we found strong correlation between few national sustainable development goals. As an example, the goals I.5 and II.4, sector Urban settlements, show r equal to 1, while the goals I.4 and III.1, sector Forest, show r equal to 0.891. We did not report all the values of r because some were not significant.

According to both the qualitative and quantitative approaches, we found that most adaptation objectives appear to be unrelated with national strategic goals, while none of them clearly hinder environmental sustainability, i.e., the adaptation objectives are not inclined to promote maladaptation.

5. Discussion

NAPCC is consistent with certain objectives of NSDS. The most consistent objectives fall within the sectors Urban settlements and Forests, while Water resources and Agriculture show less relevance in terms of relationships emerging from the objective-by-goal comparison. We did not investigate the reasons why the sectors Urban settlements and Forests include more CCAOs able to contribute to achieving sustainable development than Water resources and Agriculture. As for Forest, we might hypothesize it is obvious that a remarkable cluster of CCAOs promote sustainability approaches as "forests are still vital elements of Europe's landscape, […] provide clean water and air, protect soil, cool

down cities, protect them from heavy flooding, offer essential habitat to diverse species, contribute to human health and well-being, and are an essential ally in the fight against biodiversity loss and climate changes" [58]. We need to clarify the issues through future research.

This study has stressed a critical issue concerning the NAPCC. In fact, a very high percentage of empty cells characterizes the four grids, which means there is still plenty of room to work on sustainable CCAOs. The most critical sectors are Agriculture (170 potential relationships) and Water resources (204) that show very low percentage of relationship with NSGs. In this regard, future updates of NAPCC should consider introducing more considerations of sustainable-development issues.

As for RQ1, the method has proven to be useful in pointing out relationships between the objectives of the two Italian tools, the first one aimed at promoting resilience against a changing climate, while the second at promoting sustainable development. With regard to NSDS, we focused on the Area 'Planet', while we considered four sectors of NAPCC: Forests, Agriculture, Urban settlements, Water resources. Therefore, we considered a subset of objectives of both NSDS and NAPCC, but the method can be applied to the full set objectives. The method has been inspired by previous research and planning approaches [33,35,42,43], and we feel it could be applied in other European member states once it is properly tailored to specific contexts.

As for RQ2, although many objectives of NAPCC appear not to be clearly related to objectives of NSDS, some of them could be relevant to the drafting process of regional strategies for sustainable development. As an example, the objectives of NAPCC, "Promote scientific research on the nature and magnitude of climate change in the urban context and risk assessment" and "Promotion of planning and design for risk prevention and facilitate monitoring", appear to be key to achieving at least eight NSGs; the objective "Promote and strengthen actions related to innovation, research, education, and training" supports the achievement of three NSGs; the objectives "Promote and strengthen actions related to innovation, research, education, and training" and "Protect and conserve biodiversity and increase resilience in the forest sector" can contribute to meeting six NSGs; finally, the objectives "Raising awareness in communities" and "Improve the effectiveness of the regulation concerning the use of the resource (water)" can play a role in meeting two NSGs.

The CCAOs of NAPCC consistent with the NSGs of the NSDS could be considered as a sort of entry point for integrating adaptation to climate change considerations into NSDS, which could represent a framework for drafting up plans, programs, and projects that rely on sustainable development and adaptation principles. This approach appears to be coherent with Goal 13, "Take Urgent Action to Combat Climate Change and its Impacts", of the 2030 Agenda, which includes Target 13.2, "Integrate climate change measures into national policies, strategies and planning" [5], in which a Sustainable Development Goal indicator is "Number of countries with nationally determined contributions, long-term strategies, national adaptation plans and adaptation communications, as reported to the secretariat of the United Nations Framework Convention on Climate Change" [59].

NSDS has the potential to affect the four sectors investigated in this study, which are closely related to spatial, land-use, and landscape-planning issues [60]. Especially in urbanized areas, spatial planning plays a leading role in increasing the resilience in terms of adaptation to climate change and sustainability [61], as it can promote the integration of adaptation and mitigation considerations into planning practice [62–65]. As for the four sectors (Forests, Agriculture, Water resources, and Urban settlements), the integration of adaptation issues can find room when an SEA has to be performed in the drafting process of sectoral plans and programs [66], i.e., plans and programs "prepared for agriculture, forestry, […], waste management, water management, […]" [39]. In other words, once the principles of NAPCC (adaptation to climate change) permeate within objectives of NSDS (sustainable development), the resulting objectives can flow into a new strategy—i.e., a

regional strategy for sustainable development—that has potential to affect plans and programs on regional and sub-regional scales.

6. Conclusions

In this study, we proposed and applied a method for assessing the coherence between climate change adaptation objectives (CCAOs) and national strategic goals (NSGs) included respectively in the Italian National Adaptation Plan to Climate Change (NAPCC) and in the National Sustainable Development Strategy (NSDS). The method is rooted in scientific literature and SEA practice and allowed us to point out the objectives of NAPCC that converge (or diverge) towards sustainable development issues of NSDS. We have suggested a twofold approach, i.e., a content analysis of NAPCC and NSDS that needs to be complemented with interviews with stakeholders (experts in scientific and technical fields). The implementation of the method is useful to highlight CCAOs that can promote the achievement of -resilient-to-climate-change NSGs and that can be integrated into a regional strategy for sustainable development.

We found out that the highest percentage of consistent objectives fell within the sectors Urban settlements and Forests of NAPCC, while Water resources and Agriculture show scarce relevance in terms of contribution to achieve the NSGs included in NSDS. Water resources and Agriculture are both sectors vital to human beings, and in our opinion, national public bodies in charge should make greater efforts to define CCAOs able to strengthen a sustainable development, i.e., CCAOs that promote the achievement of SDOs.

The set of CCAOs consistent with SDOs can be introduced into national, regional, and sub-regional governance systems. Public bodies that have government responsibility are called upon to face such issues in guidance documents, manuals, and, ultimately, in plans and programs with the purpose of improving people's lives and safety.

This study shows limitations that will be addressed in future research. In the first place, we considered four sectors (Forests, Agriculture, Urban settlements, and Water resources) of NAPCC and one area (Planet) of NSDS. Thus, we did not provide the reader with a full comparison NAPCC-NSDS and open questions remain. In the second place, the method has been successfully applied in Italy, but other studies need to be carried out to point out any criticalities as it has also been meant to be applied in other international geographical and institutional contexts. Finally, in this study we focused on one pillar of sustainable development, i.e., environmental sustainability, while we did not consider the social and economic pillars. The two pillars are core elements of sustainable development and can be considered in the contexts of the Living Labs—which are a sort of interaction spaces aimed at promoting stakeholder engagement processes—according to the third criterion "Stakeholder's interview" described in Table 2. In fact, the interviews are intended to acquire the point of view of stakeholders with different competencies and professional skills, including social and economic background.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su14137634/s1. Full list of National Strategic Goals by areas and strategic choices. Source: Italian Ministry for the Environment Land and Sea. Directorate-General for Sustainable Development, Environmental Damage and International Affairs—Division I. *Voluntary National Review ITALY—National Sustainable Development Strategy*. July 2017. Link: https://sustainabledevelopment.un.org/content/documents/16341Italy.pdf (accessed on 10 June 2022).

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Appendix A

Evaluation grids.

Table A1. Evaluation grid concerning the relationships between Urban settlements (NAPCC) and Area 'Planet' (NSDS). Very dark blue, soft yellow, and crossed cells with white background mean, respectively, full, weak, and negative consistency between objectives. The white cell means no relationship between objectives, while the question mark (?) stands for uncertainty in the assessment.

		NSDS																
NAPCC: Urban Settlements		**I.1**	**I.2**	**I.3**	**I.4**	**I.5**	**II.1**	**II.2**	**II.3**	**II.4**	**II.5**	**II.6**	**II.7**	**III.1**	**III.2**	**III.3**	**III.4**	**III.5**
NAPCC	IU_001.	0	0	0	0	5	0	5	? 1	5	5	3	0	5	5	5	5	0
	IU_002.	0	0	0	0	0	0	5	? 1	0	5	3	0	5	5	0	5	0
	IU_003.	0	0	0	0	5	0	0	5	5	5	3	0	5	5	5	5	5
	IU_004.	0	0	0	0	0	0	5	0	0	5	0	0	5	5	5	5	5
	IU_005.	0	0	0	0	0	0	0	0	0	0	0	0	5	5	0	0	0
	IU_006.	0	0	0	0	0	0	0	0	0	0	0	0	5	5	? 1	0	0
	IU_007.	0	0	0	0	0	0	5	0	0	0	0	0	5	0	0	0	0
	IU_008.	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0

Table A2. Evaluation grid concerning the relationships between Agriculture (NAPCC) and Area 'Planet' (NSDS). Very dark blue, soft yellow, and crossed cells with white background mean, respectively, full, weak, and negative consistency between objectives. The white cell means no relationship between objectives, while the question mark (?) stands for uncertainty in the assessment.

NAPCC: Agriculture		**NSDS**																
		I.1	**I.2**	**I.3**	**I.4**	**I.5**	**II.1**	**II.2**	**II.3**	**II.4**	**II.5**	**II.6**	**II.7**	**III.1**	**III.2**	**III.3**	**III.4**	**III.5**
NAPCC	AG_001.	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0
	AG_002.	0	0	0	0	0	0	5	0	0	5	0	0	0	0	0	0	0
	AG_003.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	AG_004.	0	0	0	0	? 1	0	0	0	0	0	0	0	0	0	0	0	0
	AG_005.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	AG_006.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	AG_007.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	AG_008.	5	5	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0
	AG_009.	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	AG_010.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A3. Evaluation grid concerning the relationships between Forests (NAPCC) and Area 'Planet' (NSDS). Very dark blue, soft yellow, and crossed cells with white background mean, respectively, full, weak, and negative consistency between objectives. The white cell means no relationship between objectives, while the question mark (?) stands for uncertainty in the assessment.

NAPCC: Forests		**NSDS**																
		I.1	**I.2**	**I.3**	**I.4**	**I.5**	**II.1**	**II.2**	**II.3**	**II.4**	**II.5**	**II.6**	**II.7**	**III.1**	**III.2**	**III.3**	**III.4**	**III.5**
NAPCC	FO_001.	5	5	0	0	0	0	0	5	0	0	5	5	0	0	0	0	5
	FO_002.	5	0	5	5	0	0	0	0	0	0	5	0	5	0	0	0	5
	FO_003.	0	0	0	0	0	0	5	0	0	0	3	0	3	0	0	0	0
	FO_004.	0	0	0	0	0	0	5	0	0	0	3	3	0	0	0	0	3
	FO_005.	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	FO_006.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0
	FO_007.	5	5	0	5	0	0	3	0	0	0	0	0	5	0	0	5	0

Table A4. Evaluation grid concerning the relationships between Water resources (NAPCC) and Area 'Planet' (NSDS). Very dark blue, soft yellow, and crossed cells with white background mean, respectively, full, weak, and negative consistency between objectives. The white cell means no relationship between objectives, while the question mark (?) stands for uncertainty in the assessment.

		NSDS																
NAPCC: Water Resources		**I.1**	**I.2**	**I.3**	**I.4**	**I.5**	**II.1**	**II.2**	**II.3**	**II.4**	**II.5**	**II.6**	**II.7**	**III.1**	**III.2**	**III.3**	**III.4**	**III.5**
NAPCC	RI _001.	0	0	0	0	0	0	0	0	5	5	0	0	0	0	0	0	0
	RI _002.	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0
	RI _003.	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0
	RI _004.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RI _005.	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0
	RI _006.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RI _007.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RI_008.	0	0	0	0	0	0	0	0	5	5	0	0	0	0	0	0	0
	RI_009.	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0
	RI_010.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RI_011.	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0
	RI_012.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A5. Correlation analysis: the most significant values of *r*.

Urban Settlement		**Agriculture**		**Forests**		**Water Resources**	
Variables	***r***	**Variables**	***r***	**Variables**	***r***	**Variables**	***r***
I.5-II.4	1.000	I.1-I.2	0.667	I.4-III.1	0.891	II.4-II.5	0.408
I.5-II.3	0.760	I.2-II.2	0.661	II.3-II.7	0.836		
I.5-II.6	0.745	II.2-II.5	0.661	II.6-III.5	0.885		
I.5-III.3	0.739			II.6-III.4	−0.682		
II.3-II.4	0.760						
II.4-II.6	0.745						
II.4-III.3	0.739						
II.5-III.4	0.775						
II.6-III.4	0.775						
III.3-III.4	0.746						
III.3-III.5	0.739						

Appendix B

Once the qualitative and quantitative analysis was performed with the support of technical and/or scientific documents or guidance from European or national institutions, the final assessment was based on several discussions between the researchers. After in-depth discussions, a summary of the different points of view was included, in the form of comments, in ad hoc tables. See, for example, Table A6.

Table A6. An example that summarizes the researchers' points of view (sector: Forest).

NAPCC Objectives/NSDS Goals (Codes)	Motivations	References
FO_001/III.5.	The objective of NAPCC "Promote and strengthen actions related to innovation, research, education and training" is consistent with the national development goal "Ensure the development of potential and the sustainable management of territories, landscapes, and cultural heritage" as training and education can help raise awareness and educate professionals, technicians, planners, ... with respect to the need to define strategies, plans, programs and actions to be adopted to enhance the sustainable management of landscapes and cultural heritage.	De Montis (2017) Pianificare il paesaggio rurale. https://eagri.uniss.it/pluginfile.php/712/mod_forum/attachment/426/DeMontis_2017_PPR_BD.pdf (accessed on 1 January 2021).
FO_007/III.4	The objective of NAPCC "Increase resilience in the forest sector and maintenance of ecosystem services by promoting sustainable forest planning and management" is consistent with the national development goal "Ensure ecosystems restoration and defragmentation, strengthen ecological urban-rural connections" as the achievement of the NAPCC objective can imply the promotion of green areas as elements of ecological (re)connection, by contributing to habitat defragmentation.	https://www.minambiente.it/sites/default/files/archivio/allegati/sviluppo_sostenibile/iii_rapporto_stato_capitale_naturale_2019.pdf (accessed on 18 January 2021).
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