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Urban Sustainability and SDGs Implementation Between Regional Strategy and Local Practice: Case of Sardinia

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Abstract

The UN Sustainable Development Goals (SDGs) provide a global agenda toward 2030 that need to be implemented at the local level to become effective. This chapter presents the Italian case study and describes how these goals are being integrated into the Sardinian Regional Sustainable Development Strategy (SRSvS). In particular, this chapter illustrates the methodology developed for SDGs localization at the neighborhood level, to support the implementation of the Regional Strategy. The main component of this methodology is an SDG-based evaluation framework for integrated sustainability assessment of urban and territorial transformations. The evaluation framework is designed to become a centerpiece in the institutionalization of sustainability assessment across the

public administrations, and to promote sustainability through urban projects and policies. This work raises critical questions about the current practices and suggests how SDGs-oriented urban strategies and projects can offer a comprehensive a common framework of principles and criteria against which different interventions can be assessed and justified. The chapter concludes with a discussion of the potential more general relevance of such an approach, and some suggestions for future research and practice.

Introduction

The "localization" of the Sustainable Development Goals (SDGs) constitutes an important step in the implementation of the United Nations 2030 Agenda for Sustainable Development. The problem of SDGs localization concerns the adaption, implementation, and evaluation of the SDGs at the local territorial scale to allow local authorities and stakeholders define, plan, and implement concrete strategies and actions for achieving specific and locally adapted sustainability goals (United Nations Development Group 2014; Fisher and Fukuda-Parr 2019).

The 2030 Agenda indicates that national and sub-national governments, on a voluntary basis, identify strategic priorities and significant objectives for the achievement of different goals at the local scale. Following this recommendation, in recent years, numerous national, regional, and municipal administrations have set up their own "positioning reports" and "Local Voluntary Reviews" (VLRs), with respect to the 2030 Agenda (Ortiz-Moya et al. 2021; European Commission et al. 2022). These strategic documents identify specific sets of indicators to assess and monitor the progress, and therefore the effectiveness of various policies, projects, and interventions implemented in pursuing goals of sustainable development (Khussamov et al. 2020). In this context, the 2030 Agenda emphasizes the central role of evaluation of policies, plans, and projects in their interactions across environmental, socioeconomic, and governance dimensions, to pursue a systematic assessment and monitoring of the progress on sustainability goals (UNDESA 2019).

In Italy the SDGs have been implemented at the national level through the "National Sustainable Development Strategy 2017/2030" (Strategia Nazionale per lo Sviluppo Sostenibile – SNSvS) (Law no. 221/2015) enacted on 22 December 2017, almost two years after the approval of the 2030 Agenda. The SNSvS is the first national strategy to promote an integrated vision of sustainable development in Italy, reintegrating the fragmented framework of policies implemented so far in various sectors of sustainable development, starting from the "Action Strategy for Sustainable Development" (2002–2010), last updated in 2015.

To support the process of implementation, territorialization, and monitoring of the SNSvS, regions and autonomous provinces are required to draft their regional and sub-regional strategies (Cavalli et al. 2020b; Saiu and Blečić 2022a). Currently 16 of the 21 Italian regions and autonomous provinces have approved their local strategies (Ministero della Transizione Ecologica 2021).

The process of elaboration of the "Regional Sustainable Development Strategy" (Strategia Regionale per lo Sviluppo Sostenibile, SRSvS) by the Autonomous Region of Sardinia (RAS) – the second largest Mediterranean island and the third Italian Region for extension – the so-called "Sardinia2030," began at the end of 2018, and was concluded in October 2021 (Regione Autonoma della Sardegna 2021a; Regione Autonoma della Sardegna 2021b). The Preliminary Document of SRSvS, adopted in December 2020, was drawn up by the regional Presidency, four regional Agencies, and the Inter-councilor Working Group, made up of over 100 representatives from all 12 regional councilors, through an articulated process of consultation involving central and regional administrations and their agencies, research institutes, civil society groups, and other local stakeholders. Such an articulated process reflects the multi-dimensional nature of the 2030 Agenda and the Italian SNSvS. The elaboration process of the SRSvS is based on a participatory approach and on a multi-actor and multi-level governance, necessary to favor the dialogue between the territorial institutional system and the different intersectoral competences. Programming by objectives was built on the Goals of the 2030 Agenda and on the policy objectives of the Development and Cohesion Funds. The SRSvS has also provided a Positioning Report that analyses the representative ISTAT indicators and provides the degree of achievement of the Sustainable Development Goals in Sardinia, compared with the national level and with other Italian and European regions. Furthermore, an effort has been put is the integration between the strategic vision, the SDGs, and the financial instruments for implementation (community, national, and regional resources), as explained in section "The Strategy for Sustainable Development at National and Regional level in Italy: Structure, Mission and Goals".

Both in the Italian and in the Sardinian strategies, cities and human settlements are identified to play a central role in the achievement of different sustainability goals, since they are the specific locus of relevant socioeconomic and environmental processes. Indeed, about two-thirds of the 234 indicators in the SDGs framework have an "urban component" (UN-Habitat 2022). For this reason, urban planning, policies, and design can contribute to the achievement of many goals through spatial visions, strategies and plans, policies, rules, tools, institutional mechanisms, participatory processes that can be drivers for a substantial change in the relations between built and natural environments, in the spatial and functional organization of urban areas and in citizens' habits and lifestyles (Banchiero et al. 2020; Saiu 2020).

However, SDGs-oriented decision-making is not yet part of normal government practice today. In most of the cases, local administrations use SDGs to classify and assess their current activities, rather than as a guide for future actions: there are few tools for supporting public administrations in evaluating urban transformation interventions in terms of their objective impacts on SDGs. Furthermore, models and

indicators currently used to evaluate urban sustainability are mainly referred to the regional or urban macro-scale and cannot effectively represent a neighborhood or a specific sub-urban area (the urban micro-scale) that is the level where ordinary processes of city transformation take place. These everyday practices have important implications both for the daily life of the residents of that area, but in many cases – especially in relation to integrated urban development policies – for the entire urban population.

This work seeks to contribute to the discussion around the problem of SDGs "localisation" and operationalization at the neighborhood level, presenting a methodology developed for the definition of an operational model for the sustainability assessment at that scale. In particular, this chapter presents the ongoing research project "Evaluation of urban sustainability through mobility and capability analysis" (Urban SOS.Lab) carried out by the Department of Civil and Environmental Engineering and Architecture of the University of Cagliari for the Autonomous Region of Sardinia within the implementation of the SRSvS.

The chapter begins by introducing the main policy objectives and actions toward the SDGs in Italy and its National Strategy for the Implementation of the 2030 Agenda (section "Background: Sustainable Development and SDGs Evaluation and Monitoring in Italy"). Then, the structure of the Sardinian Regional Strategy for Sustainable Development, with focus on its components relevant for *urban* sustainability is described (section "The Strategy for Sustainable Development at National and Regional level in Italy: Structure, Mission and Goals"). The analysis of these selected "urban" components provides a first guidance for the development of an assessment tool to evaluate the current performance of a given urban area and guide local policy makers and communities in their decision process to implement effective plans, projects, and programs, in terms of their impacts on the 2030 Agenda and SRSvS goals. Thus, the structure of its tool – the Neighbourhood SDGs-based assessment Index (N.SDGs Index) – is presented (section "Toward an Evaluation Model for SRSvS Implementation at Micro-urban Level").

Finally, results, several open issues, and future developments are discussed (section "Results and Discussion").

Background: Sustainable Development and SDGs Evaluation and Monitoring in Italy

With the adoption of the 2030 Agenda for Sustainable Development, the UN sets 17 Sustainable Development Goals (SDGs) which member nations voluntarily agree to incorporate and implement through their national and local agendas. Italy's formal commitment to the implementation of the 2030 Agenda began with the promulgation of the Law 221/2015 for the National Strategy for Sustainable Development (Strategia Nazionale per lo Sviluppo Sostenibile – SNSvS) definitively approved in 2017 after an intense technical work led by the Ministry of the Environment and Protection of Land and Sea (today called Ministry of Ecological Transition).

The Italian government has promoted other initiatives directed toward integrated sustainable development. Among these one of the most interesting is the integration in the economic policy, alongside the traditional indicators (such as GDP, employment, deficit, and public debt), of the indicators of so-called "Equitable and Sustainable Well-being" (Benessere Equo e Sostenibile, BES), developed by the Italian National Statistical Institute (Istat) and required by the Budget Reform Law approved in 2016. Italy is the first among the OECD and G7 countries to have introduced and attached these supplementary indicators in the Economic and Financial Document (DEF), the main legislative financial and economic planning act in Italy before the Yearly Budget Act (Dello Strologo et al. 2021). The BES framework has been applied at the provincial and municipal level ("Provincial BES" and "URBES" initiatives) (ISTAT 2021a).

It is interesting to note that the BES conceptual structure is in many ways similar to the SDGs framework (Giacalone et al. 2018). In fact, many SDGs can easily be related to different categories of the BES that cover nine many aspects that directly influence well-being such as health, education and training, work, economic welfare, social relations, safety, environment and landscape, and cultural heritage (Giovannini 2011). Moreover, the 2020 Budget Law has integrated different regulations for pursuing SDGs achievement (ASviS 2020).

In 2016, the Italian Ministry of the Environment and the Protection of the Territory and the Sea (Ministero dell'Ambiente e della Tutela del Territorio e del Mare, MATTM; since 2021 the Ministry of Ecological Transition, MITE) published the "The Italian positioning on the 17 UN Sustainable Development Goals," developed through a selection of national indicators closest to Inter-Agency and Expert Group on SDG Indicators (IAEG-SDGs), which provided the centerpiece reference for the main national strategic document on sustainable development, the "National Sustainable Development Strategy" (SNSvS), described more in detail in the next section. The 2017 update of the Italian positioning report (Ministero dell'Ambiente e la Tutela del Territorio e del Mare 2017) was developed in accordance with the "Istat indicators for sustainable development" and with data from the "2016 BES Report."

Many other indicators and data have been collected for assessing and monitoring the impacts of these laws and the performance on SDGs in different Italian territories [32]. The Italian National Institute of Statistics (ISTAT) has a central role in this process. Since 2018 ISTAT has published a yearly "SDGs Report. Statistical information for 2030 Agenda in Italy," which describes Italy's positioning on the SDGs, by also deepening some thematic and analytical aspects both at the territorial level, and with respect to the different socio-demographic characteristics of the population (ISTAT 2022). This report, updated in 2021 (ISTAT 2021b), demonstrates the commitment of the Italian National Statistical System on the progressive extension of the "mapping" of the indicators proposed by the United nations Inter Agency Expert Group on SDGs (UN-IAEG-SDGs).

Data and information systems relevant to the monitoring of SDGs are managed not only by public research organizations but also by other entities such as the Italian Alliance for Sustainable Development (Alleanza Nazionale per lo Sviluppo Sostenibile, ASviS), an association bringing together almost 300 member

organizations among the civil society, constituted in February 2016, one month after the 2030 Agenda took effect, with the mission to raise the awareness and to mobilize the Italian society, economic stakeholders and institutions on the importance of SDGs in addressing economic, social, and environmental issues.

Since 2016, about two years before ISTAT's report appeared in 2018, ASviS elaborated its first annual report "Italy and the Sustainable Development Goals" (ISTAT 2021c) which analyzed the progress of Italy in achieving the SDGs by highlighting what has been done and what still needs to be done. Alongside this document, since 2020 ASviS elaborates the report "The territories and the Sustainable Development Goals" (ASviS 2021a) dedicated to the specific territorial contexts (regions, autonomous provinces, metropolitan cities, cities, and urban areas) which set out the proposals of the ISTAT annual Report both on a territorial basis and by SDG, offering a link between the goals and the policies to be implemented (ASviS 2021b). Furthermore, ASviS in collaboration with "urban@it – National Centre for Urban Policies Studies" publishes since 2018 the Italian "Urban Agenda for Sustainable Development" (Urban@it 2018), an analysis of Italian urban settlements with aim to contribute to the definition of a National Urban Agenda for sustainable development, which still does not exist in Italy.

Another interesting report on SDGs in Italy is carried out by the Fondazione Eni Enrico Mattei (FEEM), a non-profit, policy-oriented, international research center, founded in 1989. The FEEM Sustainable Development Report (SDR) 2021 "Towards sustainability. A tool to support the Regions" (FEEM 2021) which includes a dashboard of SDGs-based indicators, developed by a group of independent experts led by Jeffrey D. Sachs, president of the United Nations Sustainable Development Solutions Network (SDSN). A more detailed analysis of the specific Italian urban realities is provided by the SDSN Italian "SDGs City Index" (FEEM and SDSN 2019). This index, developed in 2017 by SDSN for the US cities, alongside the global index (Global SDG Index), defines a ranking among the evaluated cities. The 2020 edition of this Report presents and compares 46 basic indicators on 16 out of 17 SDGs, from over 100 Italian cities, in order to highlight critical points and many of the challenges facing the local administrators in 2030 Agenda implementation (Cavalli et al. 2020a).

Another interesting initiative is being developed by the Italian Coordination for Local Agenda 21 (Il Coordinamento Agende 21 Locali Italiane) to define a set of indicators and guidelines for integrating the SDGs into the program budget and performance reporting of Municipalities, to directly connect the SDGs assessment with the decision-making and political process.

All these documents are generally fairly concise, easily readable, and adequately illustrated to be accessible to general audience, in hope to increase the awareness on sustainability at different territorial scales, and to promote a wider employment of SDGs as a reference framework for activities and actions.

The Strategy for Sustainable Development at National and Regional Level in Italy: Structure, Mission, and Goals

The Italian "National Sustainable Development Strategy" (SNSvS) defines a system of national strategic objectives for guiding policy interventions and investment along the 2030 Agenda five core areas (the 5Ps): People, Planet, Prosperity, Peace, and Partnership, encompassing multiple dimensions of sustainability. Each area includes a system of strategic goals, specific for the national context, defined according to data from the Italian "positioning report" which identified the main strengths and weaknesses that can enhance or hinder the achievement of 2030 Agenda in Italy (Ministero dell'Ambiente e della Tutela del Territorio e del Mare 2017). Four of these areas predominantly cover the local dimension of sustainable development (Table 1), while the last area concerns the "external dimension" of the 2030 Agenda, including guiding principles and purposes for international cooperation programs. The three-year review of the SNSvN is currently underway, also to reframe the challenges triggered by the COVID-19 pandemic, underlining the link between the "health of the planet" and of the people.

Italian Regions and Metropolitan Cities are designated to play a crucial role in SNSvS. All these local territorial units, in fact, have been called upon to contribute to the achievement of national objectives through their own specific strategy. In this context, the Autonomous Region of Sardinia signed a Collaboration Agreement in 2018 and then a second one in 2020 with the Italian Ministry of Ecological Transition (MiTE) which coordinates the elaboration process of the SNSvN, as well as with the Universities of Cagliari and Sassari, the Metropolitan City of Cagliari and all the entities and organizations that are carrying out the initiative coordinated and financed by the MiTE useful to the definition of the Sardinian regional strategy. Sardegna2030 was drawn up in line with the SNSvN and the EU Cohesion Policy 2021–27, endorsed by the European Parliament and the Council on 24 June 2021 (European Commission 2021), which represents one of the main tools for the implementation of SNSvN (Cavalli et al. 2020c; Cavalli et al. 2021).

At the regional level, *Sardegna2030* has been elaborated according to the framework of existing plans and programs that have played a pivotal role in leading the process of strategy elaboration. In particular: (1) the "Regional Development Program 2020–2024," the main instrument of regional financial and economic planning; (2) the "Regional Strategy for Adaptation to Climate Change" (SRACC), based on a specific study about the future climate scenarios of Sardinia at 2050; (3) the Regional "Smart Specialization Strategy," aimed at identifying territorial research and innovation excellence and their growth potential.

According to the structure of the EU Cohesion Policy, Sardegna2030 is articulated around five strategic topics:

"Sardegna + Intelligente" (A Smarter Sardinia): aims to increase research, innovation, and competitiveness through the development of advanced technologies and smart specialization of different economic sectors, the innovation of production and product processes, the development of new skills for new jobs,

Table 1 The structure of the Italian "National Sustainable Development Strategy" (SNSvS)

Core area	Strategic choices	Strategic goals
People	I. Tackle poverty and social exclusion by reducing territorial gaps	(I.1) Poverty; (I.2) material and food deprivation; (I.3) discomfort in housing
	II. Guarantee the conditions for the development of human potential	(II.1) Unemployment; (II.2) social protection and welfare; (II.3) education; (II.4) deviance
	III. Promote health and Well-being	(III.1) Environmental and anthropogenic risks; (III.2) healthy lifestyles; (III.3) health and care services
Planet	I. Halt biodiversity loss	(I.1) Species and habitats; (I.2) invasive alien species; (I.3) land and sea protected areas; (I.4) genetic resources and natural ecosystems related to agriculture, forestry and aquaculture; (I.5) natural capital planning and accounting
	II. Ensure sustainable management of natural resources	(II.1) Marine and coastal environment; (II.2) land consumption and desertification; (II.3) soil and water pollution; (II.4) integrated Management of Water Resources; (II.5) water efficiency; (II.6) emissions and pollutants concentration in the atmosphere; (II.7) forests
	III. Create resilient communities and territories, preserve landscapes and cultural heritage	(III.1) Resilience of communities and territories; (III.2) environmental performance of buildings, infrastructures and open spaces; (III.3) urban regeneration and accessibility; (III.4) defragmentation of ecosystems and ecological connections (urban-rural); (III.5) Management of Territories, landscapes and cultural heritage
Prosperity	I. Funding and promoting sustainable research and innovation	(I.1) Investments in Research and Development; (I.2) digital agenda and smart grids; (I.3) processes and products innovation and technology transfer
	II. Ensure full employment and quality training	(II.1) Accessibility, quality and continuity of training; (II:2) quality employment
	III. Affirm sustainable models of production and consumption	(III.1) Resource efficiency and circular economy; (III.2) environmental taxation; (III.3) access to financial resources; (III.4) social and environmental responsibility in businesses and administrations; (III.5) waste; (III.6) sustainable tourism; (III.7) agriculture and forestry; (III.8) aquaculture and fishing; (III.9) Italian excellence

(continued)

Table 1 (continued)

Core area	Strategic choices	Strategic goals
	IV. Decarbonize the economy	(IV.1) Energy efficiency; (IV.2) sustainable mobility of people and goods; (IV.3) climate-altering emissions
Peace	I. Promote a non-violent and inclusive society	(I.1) Violence against women and children; (I.2) integration and inclusion of migrants, ethnic and religious minorities
	II. Eliminate all forms of discrimination	(II.1) Exploitation of labor; (II.2) gender equality; (II.3) respect for diversity
	III. Ensure legality and justice	(III.1) Fight against crime; (III.2) public sector corruption; (III.3) judicial system

with attention to micro, small, and medium enterprises which are prevalent in Sardinia. Furthermore, applied research is promoted to strengthen the interconnections between research centers, universities, and users (companies and institutions). In this context, the conservation, renovation, reuse, and management of the Sardinian historical-cultural heritage are indicated as an interesting and strategic field of research and innovation.

"Sardegna + Verde" (A Greener Sardinia): aims to link social issues to environmental challenges for an inclusive ecological transition, considering the communities and their right to live in clean and healthy ecosystems as a priority issue. The main strategic objectives concern biodiversity conservation, restoration, and enhancement of ecosystem services, the responsible management and use of natural resources, and the protection of territories from risks associated with climate change impacts (hydrogeological risk, drought, fires, heat waves, and coastal erosion), according to the Regional Climate Change Adaptation Strategy (SRACC). In addition to these objectives, this strategic theme includes the environmental remediation of soils and groundwaters and air pollution, and the sustainable management of water and waste resources that affect human well-being and health. Furthermore, the development of local supply chains of products and services is encouraged (agricultural, livestock, fishing, industrial, commercial, and sustainable tourism).

"Sardegna + Connessa" (A more Connected Sardinia): aims to strengthen the connections and the sustainable accessibility of the territory in both physical and digital form, which could have a significant impact on social inclusion, public health, and economic opportunities, especially given the insular condition of the Sardinia. In particular, the impact of transportation on the environment, in terms of energy consumption, resources, and climate-altering emissions appears central to regional policies. The strategic objectives and macro-actions included in this strategic theme aim to define a set of integrated interventions for the improvement of local public transport system, the promotion of alternative mobility modes both in urban and extra-urban areas, and the investments in sustainable infrastructures

and materials that reduce pollutants and climate-altering emissions and allow to control the land consumption.

"Sardegna + Sociale" (A more Social Sardinia): aims to improve social, cultural, and work well-being. The main objective is the improvement of employment quality through the implementation of active employment policies, the support for self-employment and entrepreneurship, the great investment in education and skill development for children and youth, and in the continuous training for all segments of the population. Another goal is to support disadvantaged people through the improvement of accessibility and effectiveness of health services, and the promotion of community welfare organizations. Finally, this theme aims to enhance and improve the accessibility of cultural heritage (both material and immaterial), to expand the participation and cultural vitality of citizens, visitors, businesses, and communities, and to increase opportunities for active citizenship, enhancing their role in economic development, inclusion, and social innovation.

"Sardegna + Vicina" (A Sardinia Closer to Citizens): aims to promote a broader, integrated, and inclusive development strategy through the preservation and the promotion of natural and cultural heritage, and the promotion of sustainable tourism. To this end, this strategic theme includes interventions to enhance the engagement, the involvement, and the participation of citizens and stakeholders, and to promote education for sustainable development and global citizenship. Other goals concern the landscape protection and valorization: the improvement of ecosystem functionality and of the appropriate use of natural and semi-natural areas; the requalification and the rehabilitation of historical and cultural heritage settlements and landscapes; the recovery and reuse of abandoned and unused building and spaces. Finally, this theme aims to strengthen the administrative capacity of the local and regional public actors to make planning and management processes more efficient.

Strategic regional objectives, macro-actions, and specific actions to be implemented to achieve each of these five strategic themes were defined according to the data provided by the already mentioned "Positioning Report," last updated in October 2021 (Regione Autonoma della Sardegna 2021c) which offers the analysis of the context and measures the distance for achieving the SDGs in Sardinia. Table 2 shows the structure of the SRSvS.

The first preparatory phase for the elaboration of the Strategy was the mapping of the regional plans and programs related to the objectives of the 2030 Agenda and to the National Strategy for Sustainable Development. This phase began in May 2019 and was carried out through the use and processing of the most up-to-date datasets made available to official European and Italian national statistical sources. Thus 213 elementary indicators were identified, aggregated into a set of composite indicators, and subdivided by 17 SDGs (Regione Autonoma della Sardegna 2021c) (Fig. 1).

More in detail, with respect to SDG 11, the Positioning Report analyzes the progress made toward this goal through a set of indicators related to selected priority areas: the quality of settlements, buildings, and transport services, the efficiency and

Table 2 The relations between the EU Cohesion Policy and the SRSvS structure

2021–2027 EU cohesion policy	Sardinian "Regional Sustainable Development Strategy" (SRSvS)				
Policy objectives	Strategic theme	Description	N. of strategic objectives	N. of macro actions	N. of specific actions
A more competitive and smarter Europe	A smarter, innovative, and digitized Sardinia	Innovate and strengthen the administrative capacity and competitiveness of the innovation-oriented production system	4	13	82
A greener, low-carbon transitioning towards a net zero carbon economy	A greener Sardinia for people, businesses, and institutions	Protect biodiversity, act for the climate, promote the energy transition, and adopt a circular economy model	13	38	214
A more connected Europe by enhancing mobility	A more connected and accessible Sardinia	Making the digital and mobility network efficient for the connection and continuity of territories	4	14	81
A more social and inclusive Europe	A more social, educated, and prosperous Sardinia	Generate widespread well-being based on competence, work, inclusion, and health	9	27	151
Europe closer to citizens by fostering the sustainable and integrated development of all types of territories	Sardinia closer to citizens, identitary, and hospitable	Promote culture and enhance the historical, artistic, and natural heritage of the territory	4	12	59
		Total	**34**	**104**	**587**

sustainability of waste management, air quality, and urban greenery. Sardinia ranks well on indicators related to the waste cycle, the reduction of pollutants in the atmosphere, and the level of greenery in urban areas. On the other hand, the structural damage of many buildings, the building expansion in some areas, and the scarcity of sustainable mobility need to be improved.

In particular, according to data from the Italian National Institute of Statistics (ISTAT n.d.), the Italian Institute for Environmental Protection and Research

Fig. 1 SDGs in Italy and Sardinia: national and regional average in 2018. (Source: Figure modified by the authors from the Sardinia Positioning Report (Regione Autonoma della Sardegna 2021c, p. 9). Data processing on ASviS methodology based on the Adjusted Mazziotta-Pareto Index (AMPI))

(ISPRA 2022), and the Center for Economic and Social Research on Construction and Territory (CRESME 2022):

Pollution Resources

- Urban air quality – PM10 (ISTAT 2019a) (Sardinia 9.1% – Italy 22%).
- Delivery of municipal waste to landfill (ISPRA 2019) (Sardinia 22.4% – Italy 20.9%).
- Separate collection of urban waste (ISPRA 2019) (Sardinia 73.3% – Italy 61.3%).

Buildings

- Percentage of people living in homes with structural or humidity problems (ISTAT 2019b) (Sardinia 19.1% – Italy 14%).

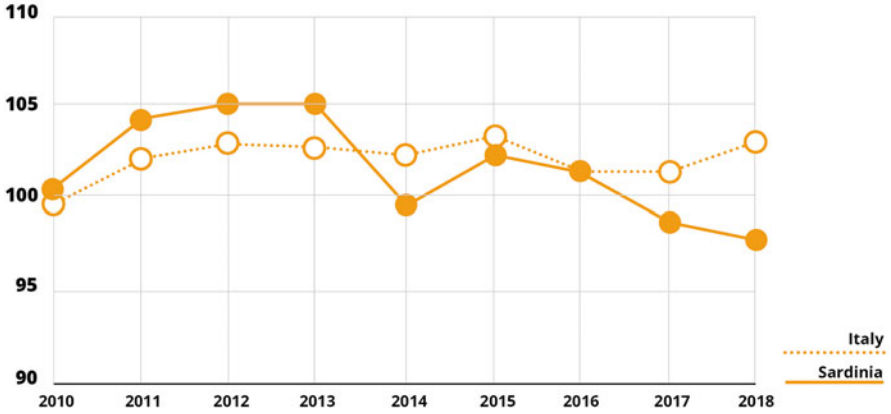

Fig. 2 Trend of Goal 11 composite index: comparison between the Italian and the Sardinian average for the period 2010–2018. (Source: Figure modified by the authors from the Sardinia Positioning Report (Regione Autonoma della Sardegna 2021c, p.31). Data processing on ASviS methodology based on the Adjusted Mazziotta-Pareto Index (AMPI))

- Percentage of people living in overcrowded housing (ISTAT 2019b) (Sardinia 22.5% – Italy 28.3%).

Settlement quality

- Soil waterproofing and land consumption per capita (ISPRA 2019) (Sardinia 483 sqm/cap – Italy 355 sqm/cap).
- Unlawful building index (CRESME 2022) (Sardinia 27.7% – Italy 17.7%).
- Incidence of urban green areas on the total urbanized surface (ISTAT 2019b) (Sardinia 9.8% – Italy 9%).

Mobility

- Families who report difficulties in connecting with public transport in the area where they reside (ISTAT 2020) (Sardinia 18.8% – Italy 30.2%).
- Students who usually travel to reach the place of study only by public transport (ISTAT 2020) (Sardinia 25.8% – Italy 26.8%).
- People who habitually move to reach the workplace only by private means (ISTAT 2020) (Sardinia 78.5% – Italy 75%).

The composite indicator of Goal 11 highlights a worsening of the regional data compared to the national one. In the 2010–2018 period, after an initial positive trend with the regional average values above the national ones until 2013; there is a marked decline in the regional average value of the index, which comes to discount a differential of five percentage points in 2018 (Fig. 2).

This positioning worsened in 2021, according to the data of the six ISTAT Report "Italy and the Sustainable Development Goals," published in 2021. The Report shows a rather dire situation due to the impact of the pandemic crisis: nine Goals have deteriorated, among these the SDG11 in which Italy is below the EU average (ASviS 2021a).

As for Italy, the data referring to Sardinia show that there are still great challenges that cities must face. In the framework of the numerous and complex interrelations between Goal 11 and the other SDGs, it is possible to highlight that the achievement of the 2030 Agenda goals in Sardinia will be strongly related to the issues of sustainable urban regeneration which include interventions for energy efficiency and building renovation, the enhancement of active and sustainable mobility, and the improvement of urban green that affect the health and well-being of people and the environment.

The central role of the SDG 11 confirms that cities and human settlements are the privileged place for experimentation of innovative solutions to support the transition toward sustainable development models. This priority is confirmed by the operational guidelines of the SRSvS, as demonstrated by the analysis of the relationships between the various strategic objectives of the Sardegna 2030 Strategy and the 17 SDGs. Goal 11, in fact, is in the first place, followed by Goals 8, 9, 12, and 17, while in the middle position there are Goals 3, 4, 15, and 16. At the last places there are Goals 1, 2, 6, and 7 (see Table 3).

Toward an Evaluation Model for SRSvS Implementation at Micro-urban Level

The discussion so far has shown the need for evaluation tools to guide and monitor the implementation of the SRSvS in Sardinian urban areas. For this purpose, a comprehensive and fine-grain urban evaluation framework is developed by a combination of criteria for a micro-urban level (neighborhood scale) which is considered one of the most appropriate spatial units to assess many aspects of urban sustainability (Sala Benites et al. 2020; Sharifi et al. 2021). The proposed framework, in fact, is based on an integrated and transdisciplinary approach which assumes the city as continuous process of transformation, influenced by various factors that involve different urban elements and urban functionings, such as infrastructures, services, economic activities, natural environment and ecosystems, people's behaviors and needs, community participation, and awareness.

Within this logic, this framework combines different dimensions of urban sustainability, up to proposing an aggregated index – the Neighborhood SDGs-based assessment index, N.SDGs Index – allowing global and thematic evaluation with *explicit* association to the SDGs, as described below.

Methodology

The development of the evaluation framework involved four phases (Fig. 3):

Phase 1. Definition of the multicriteria evaluation structure. In the first phase, the structure for a comprehensive assessment model of neighborhood sustainability is defined following two steps: the identification of relevant evaluation topics and

Table 3 The relation between SRSvS strategic objectives and SDGs

SRSvS		SDGs																
Strategic theme	Strategic objectives	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
+ **Smart**	I1. Strengthen administrative efficiency and dialogue between institutions, citizens, and stakeholders through the innovation of the public administration.								●								●	
	I2. Strengthen the competitiveness of businesses by facilitating sustainable organizational and product innovation processes.									●			●				●	
	I3. Support research and development and foster the connection between companies, research centers, universities, and higher education institutes.								●	●								●
	I4. Improve digital accessibility and strengthen the offer of public services provided digitally.				●				●	●		●						
+ **Green**	V1. Safeguard biodiversity, restoring and enhancing ecosystem services.		●	●								●		●	●	●		
	V2. Improve production, quality, and sustainability of agricultural, livestock, and fish products and make the supply chain more efficient.		●										●		●	●		
	V3. Promote human well-being and health related to the environmental remediation (soil, air, and water systems).			●			●			●		●			●	●		
	V4. Improve the management of water resources in order to reduce the exposure to						●					●	●			●		

(continued)

Table 3 (continued)

SRSvS		SDGs																
Strategic theme	Strategic objectives	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	extreme events such as drought and heat waves.																	
	V5. Reduce production and implement integrated waste management.											●	●				●	●
	V6. Promote responsible production and consumption.				●			●	●	●		●	●					
	V7. Achieve sustainable tourism for socioeconomic development, biodiversity, and cultural heritage protection.				●				●				●		●	●		
	V8. Ensure sustainable management of the coastal strip and maritime space.											●	●	●	●	●		
	V9. Reduce exposure to floods and landslides.											●		●		●		
	V10. Improve the fire prevention and management system.															●		●
	V11. Make planning tools consistent with climate change adaptation policies.			●								●		●				●
	V12. Decarbonize the economy of human activities through the energy efficiency improvement.							●		●		●	●			●		
	V13. Decarbonize the economy of productive activities.							●		●			●					

+ **Connected**	C1. Improve accessibility to Sardinia and ensure territorial continuity.									●	●	●					●	
	C2. Strengthen public and private sustainable mobility.				●					●	●	●						●
	C3. Reduce the environmental impact and improve road safety.			●						●		●				●		
	C4. Strengthen digital connectivity.			●	●					●	●							●
+ **Social**	S1. Reduce unemployment, improve access to quality employment, and promote self-employment opportunities.				●	●			●			●	●					●
	S2. Create job opportunities and provide services to rural population for widespread well-being.			●					●			●						
	S3. Reduce early school leaving and raising skills among young people.				●	●					●						●	●
	S4. Improve the functionality and safety of school buildings and innovation in teaching.			●	●						●	●						
	S5. Improve school buildings safety and functionality.			●		●				●		●						
	S6. Reduce the gender gap, encourage active inclusion, equal opportunities, and employability.					●			●		●						●	●
	S7. Reduce poverty and promote social integration of people at risk of poverty or social exclusion.	●		●		●					●	●						
	S8. Ensure healthy and safe working environments.			●					●	●								
	S9. Sustain, improve, and ensure the use of cultural, identity, and natural attractions.				●				●	●		●						●

(continued)

Table 3 (continued)

SRSvS		SDGs																
Strategic theme	Strategic objectives	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
+ Closer to citizens	G1. Improve governance for territorial sustainable development.								●			●	●				●	●
	G2. Promote communication and education and raise awareness about sustainable development.				●							●	●	●			●	
	G3. Protect and enhance the regional landscape.								●			●	●			●	●	
	G4. Ensure legality and justice.								●		●						●	●

Source: Elaborated by authors from SRSvS documents (Regione Autonoma della Sardegna (2021a)

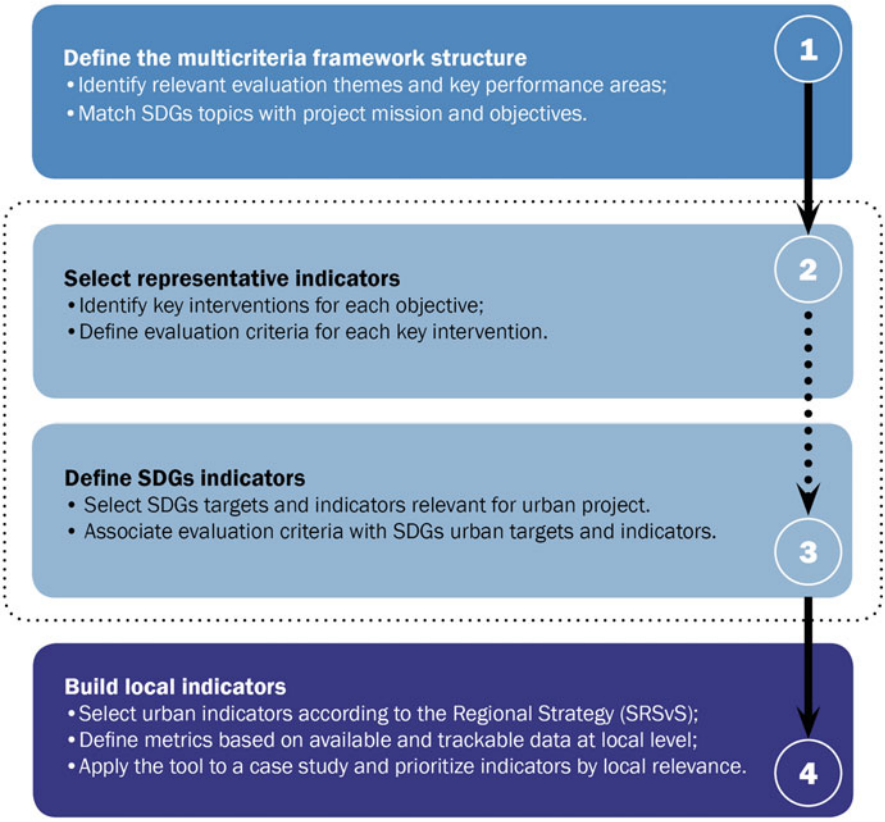

Fig. 3 The four phases of tool implementation process; stages 2 and 3 are carried out in parallel to ensure correlation between global and local visions

key performance areas, according to the SDGs framework; and the detection of relationships between SDGs topics and project's mission and objectives at the neighborhood scale. SDGs are assumed as the starting point to choose suitable themes and challenges for neighborhood sustainability.

Phase 2. Selection of representative indicators. In the second phase, carried out in parallel with the third phase, the key urban design interventions and related evaluation criteria for achieving the objectives identified in phase 1 are defined. For this purpose, the selection of relevant tools currently in use for the assessment of urban sustainability at the city and district/neighborhood level are analyzed. Among these, the City Prosperity Index developed by UN-Habitat (UN-Habitat 2016) and a selection of well-known Neighbourhood Sustainability Assessment (NSA) tools such as LEED for Cities and Communities (Green Building Council, United States), BREEAM for Communities (Building Research Establishment, United Kingdom), ITACA protocol for Urban areas (Institute for Innovation and

Transparency in Procurement and Environmental Compatibility Italy), DGNB for Urban Districts (German Sustainable Building Council, Germany), and CASBEE (Japan Sustainable Building Council, and Consortium, Japan) (e.g., Sharifi and Murayama 2013; Sharifi and Murayama 2014; Saiu 2017; Feleki et al. 2018; Kaur and Garg 2019; Sharifi et al. 2021).

The alignment between these multicriteria tools and the SDGs framework has been demonstrated by recent studies (e.g., Saiu et al. 2022a; Saiu and Blečić 2022a, b) and by the same organizations in order to encourage the achievement of SDGs through their certification systems. For example, DGNB provides an additional incentive – the "Agenda 2030 bonuses" – for selected criteria that are associated with SDGs (DGNB 2020; DGNB 2021). In the proposed index, each criterion – that corresponds to a particular project intervention – is associated with selected SDGs targets (see Phase 3).

Phase 3. Identification of SDGs "urban targets." In the third phase, the 169 SDGs targets and over 230 related indicators relevant for an urban project are analyzed. In addition to Goal 11, in fact, an in-depth analysis of all SDGs was carried out in order to identify other goals related to urban planning and design interventions, with particular attention for neighborhood scale. Following this procedure, a set of "urban targets" and indicators are identified (Saiu and Blečić 2022a). We did not consider the 19 targets of SDG 17 "Partnership for the Goals" as not applicable at the neighborhood level. SDG 17, in fact, is the most transversal goal aimed to develop an effective dialogue and cooperation between different actors for SDGs achievement (Stockholm Resilience Centre 2016).

Phase 4. Definition of local indicators. The aim of the last phase is to move "from global to local." The key interventions and related indicators for the integrated assessment of neighborhood sustainability have been related to the specific actions of SRSvS that can be implemented in urban areas. In particular, the general indicators of the SRSvS are related to indicators specific to the assessment of the neighborhood scale, previously selected.

Subsequently, to make the framework operational in the local context of the Sardina urban areas, the open access databases and information sources (regional and municipal) are analyzed, in order to verify which data and measures can be easily extracted and processed, and implemented during the time. The proposed evaluation tool, in fact, aims to be user-friendly and easy-to-use by regional and municipal administrations, local technicians, and planners, and for this reason it requires a simple infrastructure and management system.

The final selection of indicators and targets, as well as the hierarchization of data, is completed through the application of the evaluation framework to a case study. This experimentation, currently undergoing, will allow to test the applicability and validity of the model. All data are implemented on a Geographic Information System (GIS) platform that allows both the automatization of the calculation and the georeferencing of thematic indicators and synthetic indices of sustainability (Saiu et al. 2022b). The geographic spatialization of these values through maps provides an immediate visualization of critical points and strengths of the analyzed micro-

urban context in relation to different performance areas, as well as to the SDGs, suggesting priorities and actions for their improvement.

This approach makes the proposed tool extremely operational because it can allow to analyze and evaluate the starting point of a given neighborhood/urban area in terms of sustainability performances and to verify potential impacts (positive, pejorative, or neutral) of various planning and design choices that can be defined according to the priorities and preferences expressed by various stakeholders, constituting a valid decision aid tool.

Results and Discussion

The N.SDGs evaluation framework integrates four critical dimensions: urban mobility and accessibility; equity and social inclusion; urban vitality and attractivity; environmental quality and human well-being.

Each of these dimensions is associated with a thematic index, divided into sub-indices that determine the overall index and, at the same time, allow to evaluate specific topics which contribute to the achievement of different SDGs targets, as Table 4 shows. Intervention, regulation, and investment must ensure a balanced development of all these dimensions which are conceptualized as follows:

I1. Urban mobility and accessibility – in addition to the improvement of public transport called for by the SDG Target 11.2 "provide access to safe, affordable, accessible and sustainable transport systems for all" – considers two forms of active mobility walkability and cyclability, as alternative or complementary modes of movement. Instead of a "mono-modality," in fact, sustainable transport must offer complementary multi-modal choices, in order to respond to different needs of different users. These different forms of urban mobility and accessibility can be mobilized through planning and urban design at different scales. In terms of evaluation at the neighborhood level, this requires to consider relevant street elements, such as roads, sidewalks, pedestrian paths and dedicated crossings, travel lanes dedicated to cycling or public transit, stops and stations, obstacles and barriers, and intermodal nodes. In addition to these, the tool integrates the analysis of level of service (e.g., frequency) and urban context quality (e.g., lighting, active street life, and active street frontages) that affect safety and therefore the choice of different modes of movement. This dimension is also related to the SDGs targets on improvement of health and well-being, pollution reduction, which can be affected by the reduction of motorized traffic, and by policies favoring sustainable and active mobility.

I2. Equity and social inclusion refers to the social dimension of sustainable development which is often neglected in urban sustainability assessment. Recently, some assessment tools such as LEED for Cities and Communities (U.S. Green Building Council 2019) are implementing these issues which are central to the 2030 Agenda. At the neighborhood level, reducing urban inequalities involves not only actions on economic poverty, but also on the conditions of

Table 4 The N.SDGs evaluation framework: dimension, sub-indices, and related SDGs targets

Dimension	Sub-indices	SDGs targets
I1. Urban mobility and accessibility	I. Public transport	3.4. Promote mental health and well-being 3.6 Reduce road traffic accidents 7.2. Increase substantially the share of renewable energy 7.3. Double the global rate of improvement in energy efficiency. 8.4. Reduce the built environment's footprint and decouple economic growth from environmental degradation 9.1. Develop quality, reliable, sustainable, and resilient infrastructures 11.2. Provide access to safe, affordable, accessible, and sustainable transport systems
	II. Walkability	
	III. Cyclability	
	IV. Intermodality	
I2. Equity and social inclusion	I. Social diversity	1.4. Provide equal access to basic services 3.4. Promote mental health and well-being 4.7. Promote education for sustainable development and sustainable lifestyles 5.2. End violence against and exploitation of women and girls 5.5. Ensure full participation in leadership and decision-making. 6.b. Improve participation 10.2. Empower and promote the social inclusion 10.3. Ensure equal opportunities. 11.1. Ensure access for all to adequate, safe, and affordable housing and basic services 11.3. Enhance inclusive and sustainable urbanization and capacity for participatory, integrated, and sustainable human settlement planning and management 12.8. Improve information and awareness for sustainable development and lifestyles 13.3. Improve awareness-raising and planning capacity on climate change mitigation and adaptation 16.7. Ensure responsive, inclusive, participatory, and representative decision-making at all levels
	II. Universal accessibility	
	III. Social support	
	IV. Participation & Awareness	
	V. Gender equality	
I3. Urban vitality and attractivity	I. Functional diversity	4.4. Increase technical and vocational skills, for employment, decent jobs, and entrepreneurship 8.9. Promote sustainable tourism that creates jobs and promotes local culture and products 11.4. Strengthen efforts to protect and safeguard the world's cultural and natural heritage 12.b. Develop and implement sustainable tourism
	II. Economic vitality	
	III. Cultural vitality	
	IV. Touristic attractivity	

(continued)

Table 4 (continued)

Dimension	Sub-indices	SDGs targets
I4. Environmental quality and human well-being	I. Urban naturalness	1.5. Improve the resilience to natural disaster and extreme weather of the vulnerable people 3.4. Promote mental health and well-being 3.9. Reduce air, water, and soil pollution and contamination. 3.d. Strengthen the capacity for early warning, risk reduction, and management of health risks 11.4. Protect and safeguard the world's cultural and natural heritage. 11.5. Reduce the deaths and people affected by disasters 11.7. Provide universal access to safe, inclusive, and accessible, green and public spaces 11.B. Increase cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters 13.1. Improve resilience to natural disasters and extreme weather 13.2. Integrate climate change measures into planning 15.3. Combat desertification, restore degraded land and soil 15.9. Integrate ecosystem and biodiversity values into planning
	II. CO_2 reduction capacity	
	III. Environmental well-being	
	IV. Environmental safety	

spatial marginalization, related to the accessibility of social services, education, health care, and on community participation in governance and decision making. The proposed framework allows to evaluate the accessibility of the nearest services – also considering those located in other urban areas if not located in the analyzed area – by the neighborhood inhabitants. All these factors increase the individual's opportunities and enable the population to improve living standards.

I3. Urban vitality and attractivity includes all services and activities that attract people to come and walk in the area. This refers to three different sub-dimensions related to an array of different public and social uses such as institutional, educational, cultural, and recreational, but also commercial activities that contribute to economic growth and development, by generating income and employment, and contribute to the creation of neighborhood identity. In this context, in addition to the evaluation of cultural and creative jobs that describes the cultural vibrancy of the neighborhood, we consider the touristic attractivity and hospitality as well as all the additional and complementary services to the accommodation (e.g., tourist information points and attractions).

I4. Environmental quality and human well-being considers four sub-dimensions. The first refers to urban public green infrastructure and naturalness (including

parks, gardens, tree-lined avenues but also incidental green spaces) that contribute to positive health and well-being benefits for neighborhood inhabitants (Blečić et al. 2020; Saiu and Pinna 2020; Blečić and Saiu 2021; Pinna and Saiu 2021). At the same time, we analyze the performance – albedo effect and permeability – of all public soils and pavements (including vehicular streets, sidewalks, pedestrian paths, and public spaces) in order to make a preliminary assessment of their contribution in neighborhood microclimate (referring to urban heat island) and resilience (referring to run-off delay). Finally, this dimension considers the CO_2 sequestration capacity of all of these elements in order to understand and assess their overall and specific impact.

Link with the Regional Strategy (SRSvS)

As previously described, the N.SDGs was explicitly designed to be strongly integrated within the Regional Strategy (SRSvS), as a tool for implementing sustainability in urban areas. In this subsection we highlight the coherence between the N. SDGs on the one hand and the objectives and macro-actions provided for the five key thematic areas of the SRSvS on the other. We identify 22 strategic objectives (Table 5) and 38 macro-actions (Table 6) that represent, respectively, 65% and 36.5% of their total number.

In particular, there are 10 strategic objectives (S2, S5, S6, S7, S9, V1, V7, V11, G1, G2) of the 22 totals, about 50%, which are related to the dimension "I2. Equity and social inclusion" of the N.SDGs framework. This also happens for another nine strategic objectives (C3, S8, V1, V3, V4, V6, V9, V12, G9) related to the dimension "I4. Environmental quality and human well-being," while the dimension "I1. Urban mobility and accessibility" and "I3. Urban vitality and attractivity," are respectively, related only to two or three objectives (see Table 5).

Furthermore, Table 5 highlights the cross-impacts of the selected strategic objectives among different dimensions of the N.SDGs. For example, the objective "V1. Safeguard biodiversity, restoring and enhancing ecosystem services" is related to the dimension "I2. Equity and social inclusion" through the macro-action "M_V1.3. Raising awareness of the importance of biodiversity for human health and well-being" and to the dimension I4 through the two macro-actions "M_V1.1. Safeguard of biodiversity, restoring and enhancing ecosystem services" and "M_V1.4. Management of natural areas exposed to anthropogenic pressure," as reported in Table 6.

This aspect of impacts across the targets highlights the interdependencies between the SDGs (Le Blanc 2015) which must be carefully considered to exploit the full potential of each action: "While each goal and target represent a different facet of sustainable development, many of these goals and targets are related and progress on one goal can affect progress on another. Therefore, in order to effectively monitor the whole complex web of sustainable development, an understanding of the interlinkages is needed" (UNSC 2019). The Interlinkages Working Group of the IAEG-SDG addressed this question in order to ensure that the statistical system can help to connect different policy fields, supporting a more integrated and systematic

Table 5 The relations between the N.SDGs dimensions and SRSvS Strategic Objectives

SRSvS – strategic objectives		N.SDGs dimensions			
		I1	I2	I3	I4
C2	Strengthen public and private sustainable mobility	●			
C3	Reduce the environmental impact and improve road safety	●			●
S1	Reduce unemployment, improve access to quality employment and promote self-employment opportunities			●	
S2	Create job opportunities and provide services to rural population for widespread well-being		●		
S3	Reduce early school leaving and raising skills among young people				
S5	Improve school buildings safety and functionality		●		
S6	Reduce the gender gap, encourage active inclusion, equal opportunities, and employability		●		
S7	Reduce poverty, promote social integration of people at risk of poverty or social exclusion		●		
S8	Ensure healthy and safe working environments				●
S9	Sustain, improve and ensure the use of cultural, identity, and natural attractions		●		
V1	Safeguard biodiversity, restoring and enhancing ecosystem services		●		●
V3	Promote human well-being and health related to the environmental remediation (soil, air, and water systems)				●
V4	Improve the management of water resources in order to reduce the exposure to extreme events such as drought and heat waves				●
V6	Promote responsible production and consumption				●
V7	Achieve sustainable tourism for socioeconomic development, biodiversity, and cultural heritage protection		●	●	
V9	Reduce exposure to floods and landslides				●
V11	Make planning tools consistent with climate change adaptation policies		●		
V12	Decarbonize the economy of human activities through the energy efficiency improvement				●
V13	Decarbonize productive activities			●	
G1	Improve governance for territorial sustainable development		●		
G2	Promote communication and education and raise awareness about sustainable development		●		
G3	Protect and enhance the regional landscape				●

analysis of economic, social, and environmental development, as defined in the SDG monitoring system.

A further comment concerns the number of macro-actions of which, as has already been written, only 36.5% appear related to the project on an urban scale. Even in this case, the distribution of the 38 selected macro-actions is not homogeneously distributed among the four dimensions of the N.SDGs framework. With

Table 6 The relations between the N.SDGs dimensions and SRSvS actions

N.SDGs dimensions	SRSvS – selected macro-actions	
I1. Urban mobility and accessibility	M_C2.1	Improvement of local public transport supply and attractiveness
	M_C2.2	Interventions for alternative mobility in urban and extra-urban areas
	M_C2.4	New strategies and tools for sustainable management of mobility demand
	M_C2.5	Interventions for emissions reduction of local public transport fleet
	M_C2.6	Improvement of student mobility also to reduce early school leaving
	M_C2.8	Interventions for inclusive mobility
	M_C3.1	Mobility and transport planning to rationalize land use
I2. Equity and social inclusion	M_S2.2	Improvement of support services for elderly people
	M_S5.1	Continuity of care by improving access to health and care service
	M_S5.2	Development of proximity health care and assistance models
	M_S6.1	Incentives for active participation, employability, and career and pay progress of women
	M_S6.2	Improve work-life balance, including childcare and services for non-self-sufficient people
	M_S7.2	Ensure physical and digital accessibility of public services to people with disabilities
	M_S7.4	Improvement of health and safety of homes and interventions for assisted living
	M_S9.1	Improvement of cultural and natural heritage, quality and usability of facilities and services
	M_S9.3	Creation of intersectoral cultural projects aimed at contributing to health and well-being
	M_V1.3	Raising awareness of the importance of biodiversity for human well-being and health
	M_V7.3	Material and immaterial interventions that favor the aware and responsible tourism
	M_V11.1	Actions to mainstream climate change in programming and planning at all levels
	M_G1.4	Involvement of local populations in programming and planning choices
	M_G2.2	Awareness campaigns and education programs for sustainability and global citizenship
I3. Urban vitality and attractivity	M_S1.1	Actions to encourage the creation of new job opportunities
	M_V7.1	Development of an integrated sustainable tourism offer throughout the island and ecotourism offer in the areas of greatest environmental value

(continued)

Table 6 (continued)

N.SDGs dimensions	SRSvS – selected macro-actions	
	M_V13.1	Support for innovation, research, and development of small and medium enterprises in new energy sectors and to the development of low CO_2 emissions products
I4. Environmental quality and human well-being	M_S8.1	Promotion of health risk prevention policies in living and working environments
	M_V1.1	Safeguard of biodiversity, restoring and enhancing ecosystem services
	M_V1.4	Management of natural areas exposed to anthropogenic pressure
	M_V3.1	Restoration of the environmental quality for people's well-being and health
	M_V4.1	Interventions for sustainable and integrated management of water resources
	M_V4.4	Interventions for risk reduction and management
	M_V6.1	Support for production processes with low environmental impact and high social impact and stimulation of responsible consumption
	M_V9.2	Risk reduction interventions in urban and production areas.
	M_V12.1	Implement smart grid, micro grid, grid edge systems, regional environmental energy plan
	M_V12.3	Encourage resilient energy communities, from an infrastructural and regulatory point of view
	M_G3.1	Programs for the protection and improvement of environmental landscape
	M_G3.3	Programs for the conservation and improvement of the settlement landscape
	M_C3.2	Interventions to improve road safety and reduce noise pollution
	M_C3.3	Interventions to reduce the pollution of road infrastructures

14 macro-action, the dimensions "I2. Equity and social inclusion" and "I4. Environmental quality and human well-being" clearly prevail (Table 6).

This data is consistent with the regional scale of the SRSvS that focuses on large strategic objectives and requires specific tools for their implementation at the urban micro-scale of neighborhood, such as the proposed N.SDGs evaluation framework.

Conclusions

This chapter aims to contribute to the research question focused on how to implement the SDGs on a neighborhood level. It proposes a framework for the assessment of several sustainability dimensions using a set of selected criteria that have a

significant impact on all SDGs. The proposed methodology starts with the analysis of current regional strategy for sustainable development in order to define a mechanism for their implementation at suburban level.

It is important to observe that the N.SDGs evaluation framework is not designed to provide only indices and measurements relevant to assess and monitor urban sustainability at the urban micro-scale. It was also specifically devised to support city authorities, public and private entities, planners, and other stakeholders in the development of an informed decision-making, useful for identifying strategies for more realistic and effective interventions, by answering the following key questions highlighted by UN-Habitat in the City Prosperity Initiative:

- Which policies to implement?
- Where to allocate public and private resources?
- How to identify setbacks and opportunities?
- How to measure what has changed?

The first question leads to reflect on the potential impacts associated with each policy choice according to socio-cultural values and priorities of a peculiar local context. Every specific urban place such as a neighborhood unit, is unique in terms of its social, economic, environmental, and cultural development potential, and requires not only regional or city standards but also locally relevant priority measures. This implies the development of evaluation systems based on local place-based knowledge and an understanding of neighborhood inhabitants' needs, as well as potential climatic and environmental emergencies. The proposed model aims to reach this purpose through the definition of a simple, flexible, and locally based evaluation criteria, which can appropriately be contextualized against different suburban realities.

The second question raises another important issue about public and private capability for action. Every action requires effective governance supports and financial instruments for its implementation. In Europe, the opportunities offered by the massive investments of the "European Green Deal" for the "Socio-Ecological Transition" (European Commission 2019) ask governments and public administrations at all levels to optimize these economic resources by assessing the impacts of funded projects on different sustainable development goals. This objective can be reached also through the multicriteria decision aid method developed in this work.

Finally, the last two questions call for a greater role of local public administrations in monitoring and evaluation of projects that should cover all phases of planning and design process, according to the challenges proposed by the UN "Decade of Evaluation for Action" (2020–2030) (UNFPA 2020). Observing and measuring improvements of an urban area before, during, and after an intervention allow to set and evaluate the impact on different sustainability dimensions and to identify setbacks and failures that occur in the development process. In this context, the N.SDGs evaluation framework was devised to help administrations, citizens, and various stakeholders to gain an objective awareness of the current sustainability status of an urban area (diagnosis), of priorities that determine project choices (action plan) and

of the progress and results of projects and intervention in terms of their impacts on different SDGs (monitoring and impact evaluation).

Importantly, this begs the question of how the involvement and engagement of different actors can be promoted and can contribute to the development and implementation of the proposed evaluation framework at the neighborhood scale. Frameworks like this, in fact, have some practical limitations due to the current data availability and suitability.

Future studies should focus on optimization of data collection and analysis process through the local knowledge. Local realities and local knowledge, in fact, must be incorporated in a collaborative evaluation model that enables local governments to form strong public-private partnerships at the forefront of sustainability agenda.

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References

ASviS (2020) La Legge di Bilancio 2020 e lo sviluppo sostenibili. https://asvis.it/legge-di-bilancio-2020/. Accessed 21 Jan 2022

ASviS (2021a) Italy and the sustainable development goals. https://asvis.it/public/asvis2/files/Rapporto_ASviS/Rapporto_2021/Report_ASviS_ENG_2021.pdf. Accessed 26 Jan 2022

ASviS (2021b) I territori e gli Obiettivi di sviluppo sostenibile. https://asvis.it/public/asvis2/files/Rapporto_ASviS/Rapporto_2021/Rapporto_ASviSTerritori2021.pdf. Accessed 26 Jan 2022

Banchiero F, Blečić I, Saiu V, Trunfio GA (2020) Neighbourhood Park vitality potential: from Jane Jacobs's theory to evaluation model. Sustainability 12:5881. https://doi.org/10.3390/su12155881

Blečić I, Saiu V (2021) Assessing urban green spaces availability: a comparison between planning standards and a high-Fidelity accessibility evaluation. In: Innovation in urban and regional planning. Springer, Cham, pp 339–347. https://doi.org/10.1007/978-3-030-68824-0_37

Blečić I, Saiu V, Trunfio GA (2020) Towards a high-Fidelity assessment of urban green spaces walking accessibility. In: Gervasi O, Murgante B, Misra S, Garau C, Blečić I, Taniar D, Apduhan BO, Rocha AMAC, Tarantino E, Torre CM, Karaca Y (eds) International conference

on computational science and its applications – ICCSA 2020. Springer, Cham, pp 535–549. https://doi.org/10.1007/978-3-030-58811-3_39
Cavalli L, Farnia L, Lizzi G, Romani IG, Alibegovic M, Vergalli S (2020a) The SDSN Italia SDGs city index two years later: update report. SSRN Journal. https://doi.org/10.2139/ssrn.3733706
Cavalli L, Farnia L, Vergalli S, Lizzi G, Romani IG, Alibegovic M (2020b) Knowing the present for a sustainable future: the SDGs index for the provinces and metropolitan cities of Italy. FEEM Report No. 01–2020. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3733673. Accessed 20 Jan 2021
Cavalli L, Sanna S, Alibegovic M, Arras F, Cocco G, Farnia L, Manca E, Mulas LF, Onnis M, Ortu S, Romani IG, Testa M (2020c) The contribution of the European cohesion policy to the 2030 agenda: an application to the autonomous region of Sardinia. SSRN J. https://doi.org/10.2139/ssrn.3706003
Cavalli L, Sanna S, Alibegovic M, Arras F, Cocco G, Farnia L, Manca E, Mulas LF, Onnis M, Ortu S, Romani IG, Testa M (2021) Sustainable development goals and the European cohesion policy: an application to the autonomous region of Sardinia. J Urban Ecol 7(1). https://doi.org/10.1093/jue/juab038
CRESME Ricerche economiche, sociologiche e di mercato nell'edilizia. http://www.cresme.it/. Accessed 28 Jan 2022
Dello Strologo A, D'Andrassi E, Paoloni N, Mattei G (2021) Italy versus other European countries: sustainable development goals, policies and future hypothetical results. Sustainability 13(6): 3417. https://doi.org/10.3390/su13063417
DGNB (2020) Building for a better world. How buildings contribute to the UN Sustainable Development Goals (SDGs) https://www.dgnb.de/de/verein/publikationen/bestellung/downloads/DGNB_Report_Building_for_a_better_world.pdf. Accessed 26 Jan 2022
DGNB (2021) Building for a better world: new DGNB report on the sustainable development goals. https://www.dgnb.de/de/aktuell/pressemitteilungen/2021/dgnb-report-sdgs. Accessed 3 Mar 2022
European Commission (2019) A European green deal. https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en. Accessed 25 Jun 2022
European Commission (2021) EU cohesion policy: priorities for 2021–2027. https://ec.europa.eu/regional_policy/en/policy/how/priorities. Accessed 19 Jan 2022
European Commission, Joint Research Centre, Siragusa A, Stamos I, Bertozzi C, et al. (2022) European handbook for SDG voluntary local reviews: 2022nd publications office of the European union. https://data.europa.eu/doi/10.2760/355330. Accessed 25 May 2022
FEEM (2021) Verso la sostenibilità. Uno strumento a supporto delle Regioni. https://www.feem.it/en/publications/reports/. Accessed 26 Jan 2022
FEEM, SDSN (2019) SDSN Italia SDGs city index. https://www.feem.it/en/research/programs/firms-and-cities-towards-sustainability/ongoing-projects/the-italian-index-on-sdgs/. Accessed 28 Jan 2022
Feleki E, Vlachokostas C, Moussiopoulos N (2018) Characterisation of sustainability in urban areas: an analysis of assessment tools with emphasis on European cities. Sustain Cities Soc 43: 563–577. https://doi.org/10.1016/j.scs.2018.08.025
Fisher A, Fukuda-Parr S (2019) Introduction – data, knowledge, politics and localizing the SDGs. J Hum Dev Capab 20(4):375–385. https://doi.org/10.1080/19452829.2019.1669144
Giacalone M, Mattera R, Cusatelli C (2018) Do sustainable well-being indicators affect GDP? Evidence from a longitudinal study in Italy based on BES approach. RIEDS – The Italian Journal of Economic, Demographic and Statistical Studies 72(3):125–148
Giovannini E (2011) Misurare il benessere equo e sostenibile per cambiare comportamenti individuali e scelte politiche. Rivista di Studi sulla Sostenibilità 1(1):15–17
ISPRA (2022) Annuario dei Dati Ambientali. https://annuario.isprambiente.it/. Accessed 28 Jan 2022
ISTAT (2019a) Rapporto BES 2019: Il benessere equo e sostenibile in Italia. https://www.istat.it/it/archivio/236714. Accessed 26 Jan 2022

ISTAT (2019b) Indagine sulle condizioni di vita. https://www.istat.it/it/archivio/216947. Accessed 26 Jan 2022
ISTAT (2020) Rapporto SDGS 2020. Informazioni statistiche per l'Agenda 2030 in Italia. https://www.istat.it/it/archivio/242819. Accessed 26 Jan 2022
ISTAT (2021a) Il BES dei Territori. https://www.istat.it/it/benessere-e-sostenibilit%C3%A0/la-misurazione-del-benessere-(bes)/il-bes-dei-territori. Accessed 28 Jan 2022
ISTAT (2021b) Rapporto SDGs 2021. Informazioni statistiche per l'Agenda 2030 in Italia. https://www.istat.it/storage/rapporti-tematici/sdgs/2021/Rapporto-SDGs-2021.pdf. Accessed 26 Jan 2022
ISTAT (2021c) Il Rapporto SDGs. https://www.istat.it/it/benessere-e-sostenibilit%C3%A0/obiettivi-di-sviluppo-sostenibile/il-rapporto-sdgs. Accessed 28 Jan 2022
ISTAT (2022) ISTAT indicators for sustainable development goals. https://www.istat.it/en/well-being-and-sustainability/sustainable-development-goals/istat-indicators-for-sustainable-development. Accessed 21 Jan 2022
ISTAT (n.d.) Statistiche e banche dati per l'Italia. http://dati.istat.it/. Accessed 28 Jan 2022
Kaur H, Garg P (2019) Urban sustainability assessment tools: a review. J Clean Prod 210:146–158. https://doi.org/10.1016/j.jclepro.2018.11.009
Khussamov R, Galiy E, Anisimov E, Ershova L, Nemkov D (2020) National strategies for sustainable development G-7: trends 2010–2020. In: E3S web of conferences. EDP Sciences, Les Ulis, France
Le Blanc D (2015) Towards integration at last? The sustainable development goals as a network of targets. Sustain Dev 23(3):176–187. https://doi.org/10.1002/sd.1582
Ministero dell'Ambiente e la Tutela del Territorio e del Mare (2017) Il posizionamento italiano rispetto ai 17 Obiettivi per lo Sviluppo sostenibile delle Nazioni Unite. https://www.mite.gov.it/sites/default/files/archivio/allegati/posizionamento_italia_sdgs_3_2_15022017.pdf. Accessed 26 Jan 2022
Ministero della Transizione Ecologica (2021) Strategie Regionali e Provinciali per lo Sviluppo Sostenibile. https://www.mite.gov.it/pagina/strategie-regionali-e-provinciali-lo-sviluppo-sostenibile. Accessed 18 Jan 2022
Ortiz-Moya F, Marcos ES, Kataoka Y, Fujino J (2021) State of the voluntary local reviews 2021: from reporting to action. Institute for Global Environmental. Strategies. https://www.iges.or.jp/en/pub/vlrs-2021/en. Accessed 25 May 2022
Pinna F, Saiu V (2021) Greenways as integrated systems: a proposal for planning and design guidelines based on case studies evaluation. Sustainability 13(20):11232. https://doi.org/10.3390/su132011232
Regione Autonoma della Sardegna (2021a) Sardegna2030. La Strategia della Regione Sardegna per lo Sviluppo Sostenibile. https://delibere.regione.sardegna.it/protected/57127/0/def/ref/DBR57095/. Accessed 4 Oct 2021
Regione Autonoma della Sardegna (2021b) Sardegna2030. http://www.regione.sardegna.it/j/v/2847?s=1&v=9&c=94636&na=1&n=4&nodesc=1&ph=1&disp=2. Accessed 30 Jan 2022
Regione Autonoma della Sardegna (2021c) Sardegna2030. Report di posizionamento Obiettivi di Sviluppo Sostenibile Agenda 2030 ONU. https://delibere.regione.sardegna.it/protected/57127/0/def/ref/DBR57095/
Saiu V (2017) The three pitfalls of sustainable city: a conceptual framework for evaluating the theory-practice gap. Sustainability 9(12):2311. https://doi.org/10.3390/su9122311
Saiu V (2020) Evaluating outwards regeneration effects (OREs) in neighborhood-based projects: a reversal of perspective and the proposal for a new tool. Sustainability 12(24):10559. https://doi.org/10.3390/su122410559
Saiu V, Blečić I (2022a) SDGs implementation in Italy: a comparative assessment of subnational strategies for sustainable development. In: Gervasi O, Murgante B, Misra S, Rocha AMAC, Garau C (eds) Computational science and its applications – ICCSA 2022 workshops, ICCSA 2022. Springer International Publishing, Cham, pp 627–638. https://doi.org/10.1007/978-3-031-10545-6_42

Saiu V, Blečić I (2022b) Sustainable development goals (SDGs) evaluation for neighbourhood planning and design. In: Calabrò F, Della Spina L, Piñeira Mantiñán MJ (eds) New Metropolitan Perspectives. NMP 2022. Lecture Notes in Networks and Systems, vol. 482. Springer Cham, pp 979–987. https://doi.org/10.1007/978-3-031-06825-6_93

Saiu V, Pinna F (2020) Beyond the infrastructure. Sustainable landscape regeneration through greenways: towards project guidelines for the Sardinia Island (Italy). In: International conference on computational science and its applications – ICCSA 2020. Springer, Cham, pp 321–336. https://doi.org/10.1007/978-3-030-58820-5_25

Saiu V, Blecic I, Meloni I (2022a) Making sustainability development goals (SDGs) operational at suburban level: potentials and limitations of neighbourhood sustainability assessment tools. Environ Impact Assess Rev 96. https://doi.org/10.1016/j.eiar.2022.106845

Saiu V, Blečić I, Meloni I, Piras F, Scappini B (2022b) Towards a SDGs based neighborhood sustainability evaluation framework: a tool for assessing sustainability at the urban micro-scale. In: Abastante F, Botero M, D'Alpaos C, Ingaramo L, Oppio A, Rosato P, Salvo F (eds) Urban Regeneration Through Valuation Systems for Innovation. Springer Cham, pp 195–215. https://doi.org/10.1007/978-3-031-12814-1_12

Sala Benites H, Osmond P, Rossi AMG (2020) Developing low-carbon communities with LEED-ND and climate tools and policies in São Paulo, Brazil. J Urban Plan Dev 146(1). https://doi.org/10.1061/(ASCE)UP.1943-5444.0000545

Sharifi A, Murayama A (2013) A critical review of seven selected neighborhood sustainability assessment tools. Environ Impact Assess Rev 38:73–87. https://doi.org/10.1016/j.eiar.2012.06.006

Sharifi A, Murayama A (2014) Neighborhood sustainability assessment in action: cross-evaluation of three assessment systems and their cases from the US, the UK, and Japan. Build Environ 72: 243–258. https://doi.org/10.1016/j.buildenv.2013.11.006

Sharifi A, Dawodu A, Cheshmehzangi A (2021) Neighborhood sustainability assessment tools: a review of success factors. J Clean Prod 293:125912. https://doi.org/10.1016/j.jclepro.2021.125912

Stockholm Resilience Centre (2016) Contributions to agenda 2030 – how Stockholm resilience Centre (SRC) contributed to the 2016 Swedish agenda 2030 HLPF report. https://www.stockholmresilience.org/research/research-news/2017-02-28-contributions-to-agenda-2030.html. Accessed 30 Oct 2020

U.S. Green Building Council (2019) LEED for cities and communities. https://www.usgbc.org/leed/rating-systems/leed-for-cities. Accessed 28 Jan 2022

UNDESA (2019) Compendium of national institutional arrangements for implementing the 2030 agenda for sustainable development. https://sustainabledevelopment.un.org/content/documents/22008UNPAN99132.pdf. Accessed 15 Oct 2020

UNFPA (2020) Join Eval4Action, a new campaign aligned to the decade of action. In: United Nations population fund. https://www.unfpa.org/updates/join-eval4action-new-campaign-aligned-decade-action. Accessed 24 Dec 2021

UN-Habitat (2016) Measurement of city prosperity. Methodology and metadata. https://unhabitat.org/sites/default/files/2019/02/CPI-METADATA.2016.pdf. Accessed 30 Jan 2020

UN-Habitat (2022) Sustainable development goals cities. https://unhabitat.org/programme/sustainable-development-goals-cities. Accessed 26 Jan 2022

United Nations Development Group (2014) Localizing the post-2015 development agenda: dialogues on implementation. UNDP, New York. https://sustainabledevelopment.un.org/content/documents/1909UNDP-MDG-Delivering-Post-2015-Report-2014.pdf. Accessed 30 Jan 2020

UNSC (2019) Interlinkages of the 2030 agenda for sustainable development. Prepared by the interlinkages working Group of the Inter-Agency and Expert Group on sustainable development goal indicators (IAEG-SDGs) United Nations statistical commission (UNSC). https://unstats.un.org/unsd/statcom/50th-session/documents/BG-Item3a-Interlinkages-2030-Agenda-for-Sustainable-Development-E.pdf. Accessed 30 Jan 2020

Urban@it (2018) L'Agenda urbana per lo sviluppo sostenibile. https://www.urbanit.it/. Accessed 28 Jan 2022