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## Public spending and green finance: A systematic literature review

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### ABSTRACT

The public sector is being urged to actively participate in sustainability challenges more than ever before. In response, we present a systematic literature review on sustainable finance in European public administrations, particularly environmental aspects. This paper provides a systematic literature review on sustainable finance in European public administrations. It analyzes 82 papers published between 1992 and 2022, identifying areas of investigation such as sustainable development planning, sustainability accounting, measurement tools, and public-private partnerships. Further research is needed in green finance, particularly in financing methods.

### 1. Introduction

Sustainability has been at the center of every European development program in the past few years. Since 1992, with the Maastricht Treaty (Treaty on E.U., 1992), the issue of sustainable development has become part of both the E.U. legal framework and the shared ideology, together with the awareness of the need to transform the economic development model in the direction of environmental and social sustainability. This change was prompted by the adoption of agreements and action programs on a global scale - first, the Paris Agreement of 2015 and the United Nations 2030 Agenda, which defines the 17 Sustainable Development Goals (SDGs) - and at the E.U. level, with the Action Plan ([European Commission, 2018](#)), the European Green Deal ([European Commission, 2020a](#)) and the Recovery Plan ([European Commission, 2020b](#)).

The European Commission (E.C.) has estimated that, as part of the plan to achieve the goals of the Green Deal, at least one trillion euros should be used for investment over the next ten years to ensure the transition to a fair and climate-resilient economy. In this context, the role of the financial system is crucial, and that of sustainable finance, which represents a significant innovation to put the financial system at the service of collective well-being by integrating environmental, social, and governance (ESG) principles into decisions on the direction of capital flows ([Ren et al., 2023](#)).

The involvement of the public sector is essential, on the one hand, as a financial operator implementing projects oriented towards the welfare of communities and the protection of territories, and on the other, as promoter and coordinator of the sustainable transition process at the territorial level. This awareness is recognized and validated by relevant players in the international context, such as the OECD and the Joint Research Centre (JRC) of the E.C.; in particular:

- the OECD has repeatedly stressed the need to foster an evolution of the traditional financing model of public spending towards more anchored solutions to impact finance and the partnership between the public and private sectors ([OECD, 2019](#)); from a methodological point of view, it has defined a framework of evaluation indicators at the local level to measure the distance of cities and regions concerning the SDGs ([OECD, 2021](#));

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- the JRC of the E.C. has developed the Urban 2030 (Joint Research Centre, 2021) project to support local governments in monitoring the achievement of the 2030 Agenda for Sustainable Development and its SDGs at the local level by promoting transformative and inclusive actions and underlining some good practices.

Considering the evolutionary path that the public sector faces, this work analyses state-of-the-art sustainable finance research in the public sector. Specifically, the scope of analysis is on government departments at the national (es. Ministries), regional and local levels (es. Municipalities) (hereinafter Public Administration or P.A.) of European Member States. Moreover, considering that the public sector has an enormous impact on green finance through different channels (Zhang et al., 2021), we add a green lens to the entire study to measure the weight of green finance and practices in the public administration sector.

The study follows an evidence-based practice by adopting a replicable, scientific and transparent process that aims to minimize bias through exhaustive literature searches of academic research (Tranfield et al., 2009).

To the best of our knowledge, this is the first contribution of this kind; even though there are systematic literature reviews considering public administration, they vertically focus only on some topics relating to sustainable finance. For instance, national SDG development planning (Allen et al., 2017), and public accountability integrating sustainability reporting (Biondi et al., 2018).

This work analyses the literature regarding the analysis of public policies on sustainability by providing an overview of the main investigation perspectives and related results. Finally, it focuses on environmental aspects, highlighting the most significant issues faced by public administrations, as well as the policies and financial instruments used to solve or mitigate such issues. Among the pillars of sustainability, green finance appears to be the most urgent and requires attention from all stakeholders (Dervi et al., 2022).

The analysis of unexplored or unsolved research questions represents the main contribution of this work, a valuable study for orienting future research in a functional way to meet the needs of policymakers. The systematic review highlights how, among other things, a more significant effort of analysis is necessary, both in measuring the impact of public policies and in the budgeting of public expenditure, and from a public-private partnership perspective. The paper is structured as follows: Paragraph 2 describes the research methodology used, explaining the steps that led to the construction of the database; paragraph 3 answers the research questions by reporting the results of the analysis and the primary evidence related to green finance and public sector; paragraph 4 provides the main conclusions.

## 2. Methodology

The paper adopts the systematic literature review methodology, in line with the current trend of scientific studies (Niñerola et al., 2020; Ferreira et al., 2018; Crossan and Apaydin, 2010; Venkatesh et al., 2007), to lay the foundation for the field of sustainable finance for P.A.s, acknowledging that the evolution of the business model towards a sustainable transition, from a multidimensional perspective, must take place while respecting the balance between sustainability and public spending management.

Moreover, through the use of text mining approaches, following the last literature reviews published in different academic disciplines (Hoang et al., 2023; Karami et al., 2020), the work tries to understand the coverage of green topics in the collected sample across the main streams of the literature identified.

To do that, the paper uses the "coverage per article", which refers to the proportion of an article devoted to discussing a particular issue (Barkemeyer et al., 2017; Puglisi and Snyder, 2011).

The analysis is developed through the steps of planning, execution and descriptive classification of the results (Fig. 1) by following

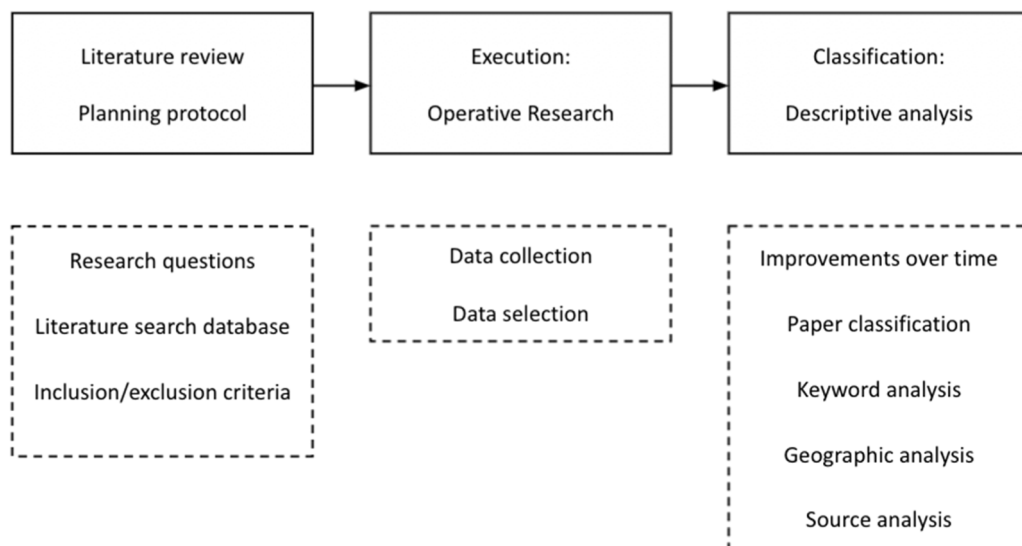


Fig. 1. Methodological Stages of Systematic Analysis.

the process indicated by [Tranfield et al. \(2003\)](#) and [Kitchenham \(2004\)](#).

### 2.1. Research questions, database and criteria for inclusion or exclusion

Starting from the research question, this study investigates the following:

- What are the main perspectives underlined by the literature on sustainable finance in the public sector over the last 30 years?
- What are the investigative gaps and the limits of the current scenario based on the considered perspectives?
- Is green finance part of the public resource management strategy?

After defining the research questions, operational choices related to the data collection phase were made; in particular, to ensure more excellent coverage of topics ([Keathley-Herring et al., 2016](#)), the research used the Scopus and Web of Science (WoS) academic databases for the extension and impact of the different fields ([Falagas et al., 2008](#)) and the comprehensive coverage in terms of publications ([Vieira and Gomes, 2009](#)), as well as the Business Source Complete (BSC) database. The inclusion/exclusion criteria to select those papers are:

- content corresponding to the research questions defined ex-ante; in this sense, the screening phase aims at identifying those materials that help to define, explicitly or implicitly, the research perspectives and best practices implemented at the European level on sustainable finance in the public sector and, on this path, what are the limits and the emerging criticalities;
- published over a sufficiently long period to include the different definitions of sustainable finance. The selected period, between 1992 and 2022, is defined based on the evolution and role that sustainability has played in the public debate and international political agendas. The principle of Sustainable Development emerged for the first time in the E.U. legal framework with the Maastricht Treaty in February 1992; in June of the same year, during the Earth Summit held in Rio de Janeiro, the first public definition of the word sustainability was created and, also, the Agenda21 was defined (the Action Program for the 21st century, which places sustainable development as a perspective to be pursued for people all over the world.<sup>1</sup>).
- whose reference context is limited to Europe. The purpose of the review involves the countries of the European Union due to the internal similarities relating to the capitalist model of the welfare state, which aims to guarantee citizens, especially the risk categories, a certain standard of living thanks to rigorous social protection, democracy and the recognition of citizenship rights; including papers analyzing non-European countries may introduce bias due to palpable differences in sustainability drivers and consequences ([Lozano and Martínez-Ferrero, 2022](#)).
- written in English, due to its general recognition as an international academic language (Genç and Bada, 2010) and in Italian;
- that open access type refers to peer-reviewed materials accessible online and available without restrictions ([Table 1](#)).

### 2.2. Sample collection and selection process

The process of research and selection of materials involved the adoption of a system of filters, which, by considering the most relevant variables for our analysis, allows us to define the final sample that has to be evaluated and discussed. In particular, we used EndNote<sup>2</sup> and Rayyan<sup>3</sup> as management software to assemble the materials and carry out a first screening; subsequently, the files were exported to Excel to analyze them more deeply. For the data collection activity, we queried the three selected databases (Scopus, WoS and BSC) using the following keywords, selected based on the potential contribution that the words could make to the literature analysis:

1. Public sustainable accounting;
2. Sustainable public finance;
3. Public sustainable expenditure;
4. Sustainable Development Goal government;
5. Impact finance public-private partnership;
6. Public sustainable innovation;
7. Pay by Results policy;
8. Public sustainability indicator;
9. Equitable and sustainable well-being.

Different research methods have been used to ensure the best results, depending on the database implemented and the Boolean operators “AND” and “OR” to combine the different terms. In particular, the research within the Scopus database was carried out using the “Article title, Abstract, Keywords” criterion; in WoS, the research was linked to the “Topic”, while all available materials were selected within Business Complete Source. The first results showed 44,921 documents, 23,853 of which were in Scopus, 20,760 in WoS,

<sup>1</sup> Ministry of Ecological Transition. *The path of sustainable development 1992*

<sup>2</sup> EndNote. Available from: <https://endnote.com/>

<sup>3</sup> Rayyan. Available from: <https://www.rayyan.ai/>

**Table 1**  
Inclusion and Exclusion Criteria of the Works Used for the Analysis.

Inclusion criteria of the works	Exclusion criteria
As part of the domain of sustainable public finance, where "sustainable" refers to the social, environmental and economic spheres.	Sustainable finance in the private sector and financial intermediaries;
Published from 1992 to 2021	economic sustainability in public finance
Peer reviewed articles	Out from the chosen time frame
Published in the Scopus, Wos and BSC databases	Reports, master's or doctoral theses, notes
Member countries of the European Union	Duplicates
	Extra-EU

and 308 BSC, distributed as in [Table 2](#).

Due to the discrepancies in the papers, we carried out a screening process aimed to select all the valuable articles that could answer the research questions. Together with the keywords used for the search results, to make the database more complete and inclusive, the authors, based on their studies, gathered additional materials related to the topics covered by this work. The selection process has been divided into two parts due to the transversality of the object of analysis: the first part concerned automatic screening, directly implemented during the research phase in various databases and consistently conducted in line with the defined exclusion criteria, and the second part, concerned a manual screening, implemented to explore the collected contents in greater depth and to define the research topic accurately. During the first screening phase, a definition was created of a series of filters, including crucial research elements, to limit and refine the survey; the filters were set within the various databases, and the results have been summarised in [Table 3](#). In particular, only the works with fully accessible content, drawn up or relating to the period between 1992 and 2021 and referring exclusively to the European context, have been selected from the 44,939 examined works collected following the first research (open filter access).

Furthermore, the review included only the documents relating to the research domains covered by the analysis; the documents have been identified through an inclusive approach to incorporate those empirical materials whose applications may be transversal to different areas. Consequently, the domains "Social sciences," "Economics, econometrics and finance," "Business Management and Accounting," "Mathematics," "Decision sciences," and "Multidisciplinary" have been selected in the Scopus database; the categories used as inclusion filters in Wos were "Economics," "Management," "Public administration," "Political science," "Business," "Business and finance," "Social sciences interdisciplinary." On the contrary, in the BSC database, the filtering system, applicable to research domains, needs to be present/has not been applied due to the characteristics of the database itself, which only provides economic content. Finally, the filter system only includes works written in Italian, English or Spanish. The designed sample was then inserted into *citation management software* (EndNote) to eliminate inter and intra-database duplicates that have been included because of the use of the exact keywords in the various databases.

After having applied the search filters, the documents have been reduced to 2542 and then, after the elimination of duplicates, to 2211, distributed as follows:

- 1652 in Scopus;
- 690 in Web of Science;
- 169 in Business Source Complete;
- 18 in other sources.

The second step, *manual screening*, was carried out with Rayyan, a support tool for the management of the collected materials as part of the systematic reviews, for a quicker and more manageable selection of the documents to be included and excluded based on the reading of the title and abstract of all documents that have been incorporated. The final database was created, starting from the 2211 documents, and it consisted of 126 documents, as summarised in [Table 4](#). Subsequently, it was carried out a further screening step based on the integral reading of the text. The documents that did not comply with the research were not focused on the public sector and not related to the multidimensional aspect of sustainability have been eliminated; the analyzed database consisted of 78 papers.

The data collection and selection process led through standardized PRISMA techniques (M.J. et al., 2021; Moher et al., 2009), is

**Table 2**  
Sustainable Finance in Public Administration: Data Collection per Database.

	Scopus (A,A,K)	WoS (Topic)	BSC	Total
1. Public sustainable accounting	681	1931	8	2620
2. Sustainable public finance	1456	1393	111	2960
3. Public sustainable expenditure	936	620	9	1565
4. Sustainable Development Goal government	4817	648	32	5497
5. Impact finance public private partnership	228	2849	1	3078
6. Public sustainable innovation	3983	2474	16	6473
7. Pay by Results policy	9397	8920	109	18426
8. Public sustainability indicator	2344	1916	17	4277
9. Equitable and sustainable well-being	11	9	5	25
Total	23853	20760	308	44921

**Table 3**  
Sustainable Finance in Public Administration: Data Selection.

	Unfiltered	Open access filter	Temporal filter	Geographic filter	Domains filter	Language filter
Scopus	23842	7925	5750	2890	1723	1652
WoS	20751	8223	8223	3228	704	690
BSC	303	267	256	173	173	169
Other	18	18	18	18	18	18
Total	44896	16415	14229	6291	2600	2542
Total without duplicates						2211

summarised in Fig. 2.

### 3. The sample and its influential aspects

After having defined the database, a descriptive analysis of the collected materials was implemented to provide an overall overview of the documents through a series of variables:

- evolution of publications over time;
- classification of the document based on the nature of the analysis;
- keyword analysis;
- geographic analysis;
- analysis of the sources.

Regarding the years of publication, the sample analysis shows that there has been particularly intense research in the last four years (Fig. 3) on the most important international events that occurred in 2015: the signing of the Paris Agreement and the definition of the 2030 Agenda. The last two years, 2020 and 2021, have registered the highest number of publications, with 20 and 15 documents, respectively. Although in the previous years, there have been few publications, the current trend suggests that shortly, the number of publications will continue to increase, a sign of the growing importance and interest that the academic world has in the research topic.

The sample was divided into three groups (Fig. 4) according to the nature of the contents and the content analysis; in particular, the sample has been divided into:

- Review papers whose purpose is to analyze and describe the existing literature;
- technical-applicative papers, whose main objective is the development, calibration or refinement (and, possibly, the application) of a new or existing methodology or quantitative model;
- conceptual papers, whose focus is not the development of new models or the application of existing approaches but rather the discussion of some specific aspects or guidelines relating to the issue of sustainability in the public sector.

The keywords analysis was implemented by analyzing the abstracts of the papers using the *tag cloud*. The analysis, presented in Fig. 5, shows an attentive reflection compared to the frequency of use of keywords in the sample analyzed: the most relevant words are those written in large letters, while the smaller ones have not been used often.

"SDG" is the most common word used 63 times; "sustainable development" was used 59 times and "sustainability" 45 times; the words "government" and "indicators" were used 33 times, followed by "policies" 30, and "Planning" with a frequency of 29. It is further confirmed by this frequency analysis that the main trends in literature link to sustainable development planning (Ionescu et al., 2020, Raszowski et al., 2019), sustainability accounting policies (Florea et al., 2021, Biondi et al., 2018), and measurement tools (Balaras et al., 2019, Arbolino et al., 2017, Bonnet et al., 2021).

From a territorial perspective (Fig. 6), we can see how the analysis has been developed at three different levels: national, European and global.

Over half of the final sample of papers is focused on a national level: it analyses some aspects related to specific European countries, such as Italy (20 papers), Spain (11) or Poland (10); 19 % of the work, on the other hand, concerns documents that are not addressed to a specific geographical area, but have a global character, or analysis in which the territorial aspect is not taken into consideration. Finally, 7 % of the sample is focused on all countries of the European Union.

Many journals have published articles relating to the research topic. From the analysis of the sources, the distribution of the articles is highly concentrated on a single journal. In contrast, the remaining articles are distributed in a relatively homogeneous way among the other sources. Fig. 7 shows the journals that have published at least two articles related to sustainability in the public sector; we can

**Table 4**  
Sustainable Finance in Public Administration: Manual Screening.

	Initial composition	Off topic	Incorrect geographical context	Private sector	Wrong type of publication	Other	Output manual screening	Final output
Papers	2211	1506	325	109	5	141	126	78

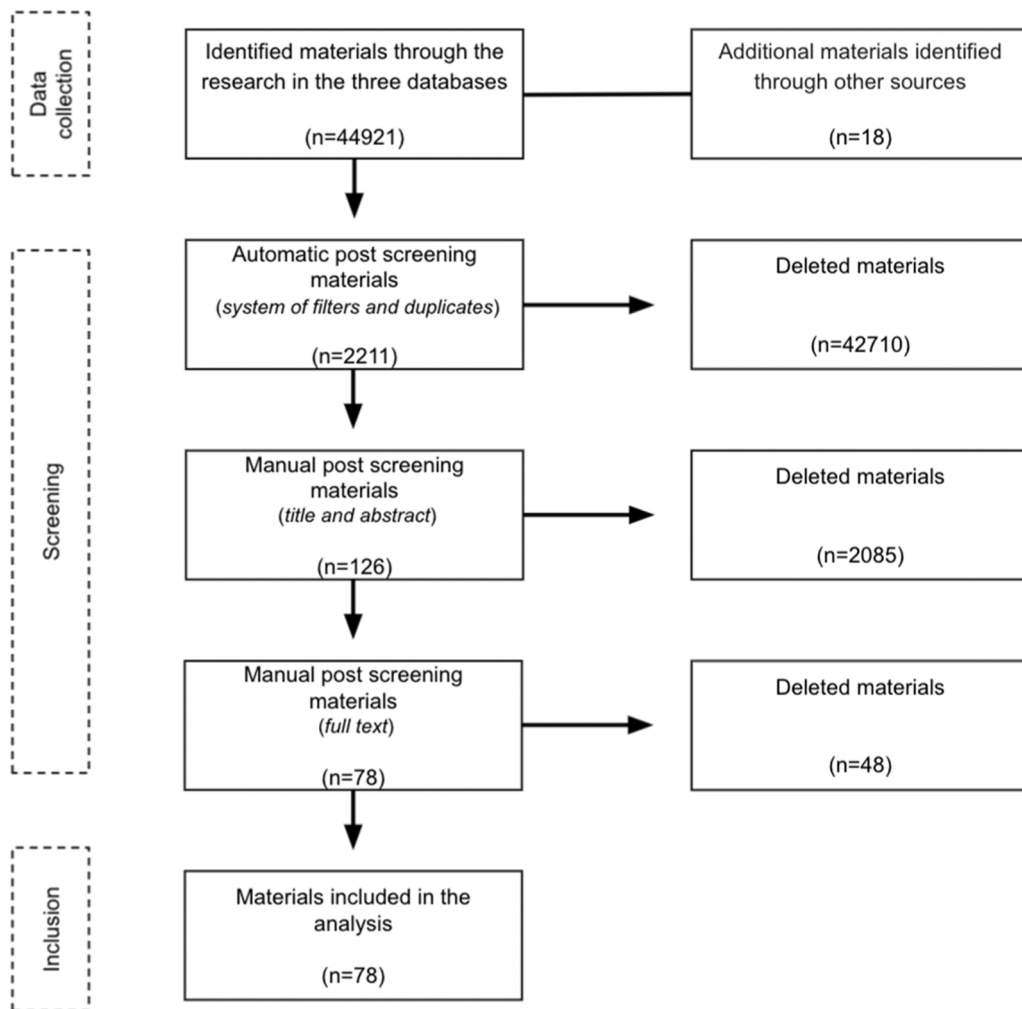


Fig. 2. PRISMA Flow Diagram.<sup>41</sup>

see how most of the articles (32 %) were published by Sustainability (Switzerland), followed by Journal of Cleaner Production (5.13 %) and Politics and Governance (3.84 %).

#### 4. The evolution of sustainability-related topics in the public sector

##### 4.1. Cluster analysis: the main streams of literature

We use a combination of systematic analysis and content analysis to gain a better understanding of the most relevant literature and provide accurate insights. Following the latest research by Khan et al. (2020) and Paltrinieri et al. (2023), we analyzed 82 articles. This includes the 78 articles used in our systematic analysis, as well as four influential articles that were collected from journals with an ABS ranking of at least two stars and published in 2022 and 2023. We aim to ensure that more recent contributions are not underrepresented in our analysis.

From the analysis of the selected literature, four research perspectives on sustainable finance in the European public sector emerged and developed over the last 30 years (Table 5).

The clusters have been built through an inductive approach, given the need for an already consolidated approach. In particular, the main research focus has been identified by analyzing the individual works and related keywords, which became a variable. The different clusters allow you to divide the collected material according to the rationale of the analysis or, more generally, the cluster content. 16 of the 82 papers analyzed are related to the planning for sustainable development, 15 deal with issues related to sustainability accounting, 38 deal with measurement tools and, finally, 13 concern the topic of public-private partnership.



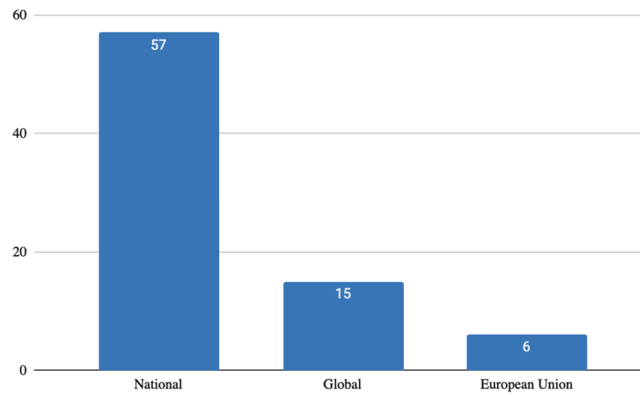


Fig. 6. Analysis of the Final Sample at Different Territorial Levels.

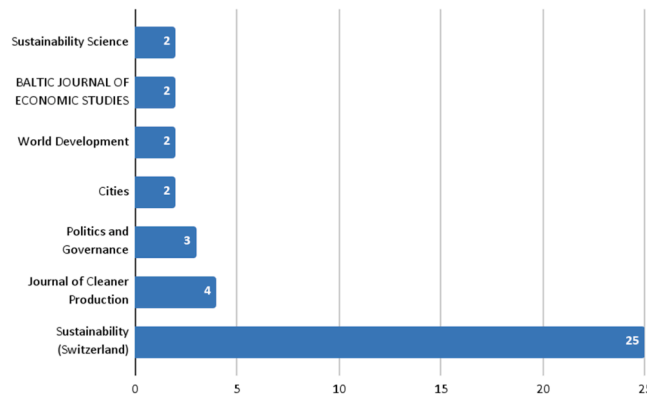


Fig. 7. Journals with at least two published works.

enable it to reach the objectives effectively, to carry out appropriate monitoring of the gap between the status quo and the target objectives and, also, to evaluate the achieved, and to be achieved, sustainability performances.

The analysis of the integration processes of sustainability in the strategic planning of public administration is a young field of research in which there is a lack of conceptual systematization; in this first phase of research, scientists promote a local/regional focus that allows them to observe and describe the processes more effectively. Consequently, the prevailing research methods used in the analyzed literature respond mainly to exploratory and descriptive purposes, typical of the early stages of knowledge development within a research study. The literature also promotes interdisciplinary approaches to the topic, which derive from the issue of sustainability in the public sector itself (Tommasetti et al., 2020).

The analysis of the results achieved by the literature on planning showed some areas of similarity; in particular, the lack of financial explanation in support of planning choices is the common denominator of almost all the studies, which are more concentrated on the analysis of the initiatives implemented in Europe, especially with an environmental perspective.

From a strategic point of view, the common thought concerns the current lack of an overview of public policies and the need to define an integrated and coherent framework for the implementation of the SDGs, avoiding stand-alone or linear approaches for sustainable development, which had limited success in the past (Allen et al., 2018). Furthermore, it is necessary to consider that an inefficient public policy, for example, oriented to the total financing of a specific sector without additional evaluations, impedes sustainable development: the achievement of the SDGs must be supported by local interventions with strategic planning that act as a starting point for the implementation of partnerships at the vertical and horizontal levels of the public administration system.

Many studies underline the usefulness of adopting a bottom-up approach for the definition and evaluation of policies relating to sustainable territorial development to give practical knowledge of the resources used and the results obtained and to favor policy-makers in defining policies for achieving a balance between the different dimensions of sustainability. This approach is also suitable for optimizing budgeting policies at the national level: most of the authors confirm the close link between the financial situation and the level of sustainable development of a local authority; moreover, the preparation of an evaluation model at the local level makes it possible to consider the work of governance, which is often ignored when measuring environmental or social performance.

Some authors explain the need to adopt an integrated vision of sustainability in planning sustainable development projects since, although they are designed to achieve a given goal (social, environmental, etc.), they cannot neglect the chain impacts they will have on other dimensions of sustainability. The European policies, for example, want to pay attention to the environmental issue. At the same time, in practice, this aspect is overshadowed, as projects are mainly focused on economic criteria: often, the mentioned goals in



the Action Plan to finance sustainable growth still need to be met.

From an operational point of view, the planning tools presented and analyzed by the literature - numerically very limited - tend to neglect some aspects of sustainability and not to adopt a general vision in favor of more specific and specialized arguments, such as, for example, a single SDG or a single target of an SDG (Table 6).

#### 4.1.2. Second cluster analysis: sustainability accounting

The second identified cluster includes studies related to sustainability accounting concerning two specific topics: sustainability reporting and the relationship between public spending and sustainable development.

The debate on these aspects is very active in this historical moment: most national and international institutions are promoting efforts to ensure that public accounting gives importance to the sustainability-oriented path undertaken by the institution.

On the other hand, the literature still has little interest in these issues, focusing more on the historical analysis of public budgets to understand the effects on the community and the environment from public investments. Furthermore, most of the analyzed documents adopt a "standard" methodological approach, which does not include suggestions for innovative analysis but focuses on classic statistical reports to define the direct effectiveness of the environmental policies undertaken. Alongside this, some authors adopt qualitative approaches - such as interviews and surveys - to collect suggestions and reflections on the inclusion of sustainability in the accounting world, focusing on the issue of sustainability reporting (also called "non-financial") in the public sector.

The analysis of the results of the collected literature shows how all the authors agree that traditional accounting should be integrated with sustainability and become part of the planning and reporting procedures of the local authority jointly.

The highlighted criticality concerns the need for more transparency and clarity caused by the absence of universal reporting standards: the tools and suggestions for integrated accountability will likely become redundant and create confusion due to many labels that do not match any concrete alternatives. For this reason, in the literature, there is a widespread practice of considering the SDGs as a reference framework when drafting the public budget. Another recurring theme concerns the orientations and considerations made when creating the sustainability reporting: the studies show how, for example, the choice of most local authorities not to draw up a sustainability report is not based on assessments of usefulness of the reporting tool, but instead on economic and budget issues; the disclosure of non-financial information should be promoted as a tool to legitimize the action of the local politician, given its prediction in political and electoral programs as a result of a commitment to sustainable development, and should therefore be mandatory or encouraged.

Finally, the historical analysis of public spending, carried out by the literature in different geographical and temporal contexts, shows in almost all cases that, despite allocating resources to critical environmental and social issues, the implemented policies could be more effective. This demonstrates that, when defining environmental policies, local governments should move towards a strategic approach, structuring interventions based on the objectives to be achieved rather than based on past spending for the environment. Secondly, local governments should focus on more than short-term results. However, they should define policies that can create the conditions for solving critical issues in the medium-long term: it is not enough to provide the necessary infrastructure, but it is necessary to develop a culture of sustainability in the community that leads to the understanding of the value of the environment and the usefulness of using the available infrastructures.

Furthermore, the implemented analysis shows that the financial policies implemented by the individual local authorities are separate from the real social needs of the community: it is, therefore, necessary to develop ad hoc indicators capable of reflecting these needs (Table 7).

#### 4.1.3. Third cluster analysis: measurement tools

The third cluster identified includes studies relating to measurement tools concerning two specific aspects: multidimensional indicators and SDGs. The distinction between the two categories is to be found in the methodological process implemented to create the indicators: the first category includes *tailor-made* tools developed ad hoc by the institution/researcher to capture one or more aspects of sustainability; the second category includes studies in which SDGs indicators are used as tools for measuring, monitoring or guiding policy choices.

There are E.U. countries, such as Italy and Poland, which have developed a set of national indicators to measure the well-being and sustainability of their territories inspired by the SDGs indicators. The advantage of this choice consists in the possibility of comparing the results within the national territory; on the other hand, a shared framework of indicators - or underlying variables - should be developed, such as, for example, the parameters provided by Eurostat, to ensure transparency and international comparability.

However, some experts underline that the choice of the indicators/measurement framework employed to measure sustainable development is also a political issue; therefore, while adopting a consolidated standard, politics can influence the achievement of individual SDGs; his political ideology influences each perception of government, implies a different selection of public policies that favor his success. Furthermore, public policies and project proposals tend to enhance impacts relating to the areas of job creation and economic development; on the contrary, some indicators are under-valued, as in the case of biodiversity protection indicators, which would substantially contribute to multiple international obligations, given the strong interconnections between biodiversity and public health, water and soil conservation and climate change mitigation.

The example is also helpful to explain a further aspect shared by most authors: the need to consider the correlations between SDGs and optimal use of public resources; this would facilitate the definition of public actions inspired by an overall vision. A significant portion of the sample of studies concerned the development and analysis of the existing interconnections and synergies between the SDGs at an international level and between the various indicators at a national level.

From an operational point of view, some authors suggest indicators created concerning a single aspect of sustainability and others,

**Table 5**  
Sustainable Finance in Public Administration: Main Lines of Literature.

Cluster	Sub-cluster	Author
<b>SUSTAINABLE DEVELOPMENT PLANNING</b>	<i>Sustainable development strategy</i>	Marchi, M., Capezzuoli, F., Fantozzi, P. L., Maccanti, M., Pulselli, R. M., Pulselli, F. M., & Marchettini, N. (2023); Bornemann & Christen (2021); Cherp, George & Kirkpatrick (2004); Guarini, MoriIcona & ZuffadaIcona (2021); Kovalivska, Shcherbyna, Nikolaiev. (2020); Allen, Metternicht, Wiedmann (2018)
	<i>Planning tools</i> <i>Sustainable development policy</i>	Allen, Metternicht & Wiedmann (2017); Cruz & Marquez (2014); Neamtu (2012) Albrecht, Grundel & Morales (2021); Hickmann (2021); Standar & Kozer. (2019); Zolin, Ferretti, Grandi (2020); Leal Filho, Platje, Gerstlberger, Ciegis, Kääriä, Klavins, Kliucininkas (2016); Bornemann & Weiland. (2021); Suditu, Nae, Negut, Gheorghilas.(2014)
<b>SUSTAINABILITY ACCOUNTING</b>	<i>Public spending and sustainable development</i>	Borghesi, S., Castellini, M., Comincioli, N., Donadelli, M., Gufler, I., & Vergalli, S. (2022); Cardillo, E.; Longo, M. C. (2020); Bednarska-Olejniczak, D.; Olejniczak, J.; Svobodová, L (2020); Florea, Meghisan-Toma, Puiu, Meghisan, Doran, Niculescu (2021); Dascalu & Predescu (2016); De Matteis, Preite,Striani & Borgonovi (2021); Tafuro, Mattei, Preite, Costa, Mariella & Treviso (2019); Sisto, García López, Quintanilla, de Juanes, Mendoza, Julio
	<i>Sustainability report</i>	Lumbreras & Mataix (2020); Soukopová & Bakoš (2013); Becchetti, Corrado & Fiaschetti. (2017); Hege & Brimont (2018) Nicolò, G., Andrades-Peña, F. J., Ferullo, D., & Martínez-Martinez, D. (2023); Biondi, L.; Bracci, E. (2018); Giacomini, Rocca,Carini, Mazzoleni. (2018); Tommasetti, Mussari, Maione, Sorrentino (2020)
<b>MEASUREMENT TOOLS</b>	<i>Multidimensional indicators</i>	Balaras, C. A.; Droutsas, K. G.; Dascalaki, E. G.; Kontoyiannidis, S.; Moro, A.; Bazzan, E. (2019); Arbolino, De Simone, Carlucci, Yigitcanlar & Ioppolo (2017); Bonnet, Coll-Martinez & Renou-Maissant (2021); Braulio-Gonzalo, Bovea & Ruá (2015); Van Zeijl-Rozema & Martens. (2010); Marszalek-Kawa & Siemiatkowski (2020); Chelli, Ciommi, Emili, Gigliarano & Taralli (2016); Porreca, Rambaud, Scozzari & Di Nicola (2019); Jelinčić&Tišma. (2021); Monte & Schoier (2020); Bova & Śleszyński. (2020); Rösch, Bräutigam, Kopfmüller, Stelzer & Fricke. (2018); Urbaniec (2015); Pulselli, Ciampalini, Tiezzi & Zappia (2006); Ramos & Caeiro (2010); Mazziotta & Pareto (2016); Bellantuono, Lagrasta, Pontrandolfo & Scozzi (2021); Miola, Borchardt, Neher & Buscaglia. (2019); Onori & Jona Lasinio (2020); Davino, Dolce, Taralli & Esposito Vinzi. (2018)
	<i>SDGs</i>	Guerrero, O. A., Castañeda, G., Trujillo, G., Hackett, L., & Chávez-Juárez, F. (2022); Álvarez & García-Fernández (2020);Ionescu, Firoiu, Tănăsie, Sorin, Pîrvu and Manta (2020); Raszkowski & Bartniczak (2019); Janoušková, Hák, Moldan. (2018); Coscieme, Mortensen & Donohue (2021);Martínez-Córdoba,Amor-Esteban,Benito, García-Sánchez. (2021); Martínez-Córdoba, Raimo, Vitolla, Benito. (2020); Ramos & Laurenti. (2020); Staszkievicz (2019); Strologo, D'Andrassi, Paoloni, Mattei. (2021); Asadikia, Rajabifard, Kalantari. (2020); Biggeri, Clark, Ferrannini, Mauro. (2019); Schipper, Dekker, de Visser, Bolman, Lodder. (2021); Koch & Krellenberg (2018); Spaiser, Ranganathan, Swain & Sumpter (2016); Cling, Eghbal-T é hérani, Mathieu & Plateau. (2020); Pradhan, Prajal; Costa, Luis; Rybski, Diego; Lucht, Wolfgang; Kropp, Jürgen (2017)
<b>PPP</b>	<i>Partnership policies</i>	Alińska, Filipiak & Kosztowniak (2018); Horan (2019); Ferrer-Roca, Guia & Blasco (2020); Grotenbreg & Buuren (2018); Kamphof & Melissen (2018)
	<i>Sustainable development projects</i>	Bossink (2002); Chaves-Avila, R.; Gallego-Bono, J. R. (2020) Moreno-Serna,Purcell,Sánchez-Chaparro,Soberón, Lumbreras, Mataix. (2020); Stafford-Smith, Griggs, Gaffney, Ullah, Reyers, Kanie, Stigson, Shrivastava, Leach, O'Connell. (2017); Koscielniak & Gorka (2016)
	<i>PbR</i>	Kabli, Rizzello,Trotta. (2021); Rizzello & Kabli (2020); Fraser, Tan, Lagarde & Mays (2018)

**Table 6**  
Cluster 1 - Planning for Sustainable Development.

SUB-CLUSTER	AUTHORS	METHODOLOGY	ANALYSIS UNITS	SEARCH RESULTS
<i>Sustainable development strategy</i>	Cherp, George & Kirkpatrick (2004)	Qualitative analysis. Case studies with interviews with the main actors	National strategy and sustainable development (SNSD) of Belarus and Slovakia	The observed strengths of strategic planning: recognition of the social pillars, environmental and economic aspects of the ss, a high level of government ownership, a strong analytical basis for developing strategies. The weaknesses: lack of integration between different themes and sectors, as well as between local, regional and national planning levels, the absence of the ability to compromises and setting priorities, and ineffective public participation. Challenges in strategic planning for ss: possible tensions between the need for political commitment at the national level and the implementation of internationally defined sustainable development principles, between government ownership and the participation of non-governmental stakeholders, and between the need for political consensus and support and broad participation.
<i>Sustainable development strategy</i>	Guarini, Morilcona & Zuffadalcona (2021)	Creation of a planning guide through defined theoretical processes	Urban cities	Incorporating SDGs into city strategic plans can improve both the functioning of the strategic planning process and operational performance. The dimensions suggested in this article refer to each of the main phases of the classic strategic planning and control cycle and consist of political vision, identification of relevant SDGs, gap analysis, setting the local SDG agenda, measurement and reporting.
<i>Sustainable development strategy</i>	Allen, Metternicht, Wiedmann (2018)	Systematic literature review. Analysis of national documents available.	25 papers, case studies from 26 countries and further documents	An effective approach for the implementation of the SDGs requires prioritizing objectives to focus on low, interrelated priorities, relying on analytical approaches and tools that help countries evaluate interactions and interconnections, to optimize the systemic impact of different actions. The review highlights significant gaps in practice in both developed and developing countries that undermine the effective implementation and transformative potential of the SDGs. While progress has been made in some early planning stages, there are still key gaps in terms of assessing the interconnections, trade-offs and synergies between goals (evident gaps in terms of adopting systems thinking and integrated analytical approaches and models). Countries paid more attention to the SDGs, but it is important to underline that they could risk to pursue the same stand-alone approaches to sustainable development that were not very successful in the past. Furthermore, the review of national experiences in the implementation of the SDGs highlights a significant gap between steps and approaches recommended by the community of experts and those recently put into practice.
<i>Sustainable development strategy</i>	Kovalivska, Shcherbyna & Nikolaiev (2020)	Use of Excel functions. SWOT analysis	Accommodation in Ukraine	A multi-stage methodology has been proposed for the selection of investment projects for budget support and the development of recommendations, in order to further explore the formulation and analysis of methods to achieve SDG 11, according to a program-oriented and funding mechanism approach, using PPPs. Stages: 1. Selection of projects for budget support (cost-benefit analysis and choice of the most efficient way to implement it); 2. Evaluation of the impact of the project on the SDGs; 3. Determination of the amount and type of budget support (assessment of the state quota to finance the project based on the SDG rating of the investment; evaluation of the commercial, budgetary and social efficiency of investments with indicators); 4. Development of recommendations for project implementation (action plan to support project implementation in accordance with the SDG).

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Table 6 (continued)

SUB-CLUSTER	AUTHORS	METHODOLOGY	ANALYSIS UNITS	SEARCH RESULTS
<i>Sustainable development strategy</i>	Bornemann & Christen (2021)	Qualitative empirical analysis	4 Swiss cantons	Using four ideal / typical sustainability governance arrangements (SGA) resulting from an analysis of the Swiss cantons; the five specific governance requirements of the 2030 Agenda match or challenge these 4 ideal-typical arrangements and their respective governance relationships: none of the four ideal-typical SGAs meet all five requirements. The provisions have several possibilities and limitations compared to the governance requirements associated with the changes concepts of sustainability that emerge in the wake of the 2030 Agenda.
<i>Sustainable development strategy</i>	Marchi, M., Capezzuoli, F., Fantozzi, P. L., Maccanti, M., Pulselli, R. M., Pulselli, F. M., & Marchettini, N. (2023)	multi-faceted methodology to assess greenhouse gas (GHG) emissions	Municipality of Grosseto	The study found that the Municipality of Grosseto in central Italy had gross greenhouse gas (GHG) emissions of 395,558.59 tons of carbon dioxide equivalents, exceeding CO2 absorption by a factor of five and leading to a 17.09 % abatement target. The major sources of GHG emissions were road transport (47.57 %), heating (15.01 %), and imported electricity consumption (14.57 %), with GHG action zones identified through GIS-based mapping to guide local environmental policies.
<i>Planning tools</i>	Cruz & Marquez (2014)	Theoretical metrics	Municipality of Lisbon	An ideal scorecard model applied to the municipality of Lisbon is presented, in which the municipality sets very ambitious ex ante objectives and consistent levels of performance, together with quantitative and qualitative indicators and an action strategy.
<i>Planning tools</i>	Neamtu (2012)	Semi-structured interviews	28 to function the public of the municipalities of Romania	Most interviewed believe they are familiar with the topic of sustainability and agree that performance evaluation is an important activity that should be undertaken by all public organizations. Most believe that the public sector should pursue social objectives, while the private sector should focus on the environmental aspect, whose criticalities mostly depend on companies. Furthermore, they all believe that public organizations, even in big cities, have very little experience with measuring performance in general and even less with measuring sustainability. For this reason, Romanian municipalities should borrow and adapt sets of indicators developed by other cities at the international level.
<i>Planning tools</i>	Allen, Metternicht & Wiedmann (2017)	Critical review of the literature	22 national case studies of modeling scenarios	The modeling scenario has become a commonly used method to explore plausible future planning strategies and to provide analytical evidence and input for national development planning; however, there isn't a direct link to the SDGs that includes of all objectives and does not focus on just one aspect. A framework has been developed from the literature analysis, and it should be implemented ex ante for the national planning of the SDGs, which consists of 4 steps: (1) definition of the program, including the identification of priorities, objectives and indicators / variables, ( 2) development of an analytical framework and selection and definition of appropriate models and tools, (3) projection of the baseline scenario and (4) identification and analysis of intervention options, formulation and simulation of credible paths towards goals.
<i>Sustainable development policy</i>	Albrecht, Grundel & Morales (2021)	Semi-structured interviews. Observation of the participants. Analysis of secondary sources.	3 forest-based regional bioeconomy in Finland , Sweden and Spain	The areas of public financing of green / bioeconomic developments are: job creation, consistency with European policies, sector innovation, rural economic development. European policies suggest focusing on the climate issue and biodiversity while in these cases these aspects have not been considered: the mentioned commitments in the Action Plan to finance sustainable growth are absent. The directives used by local operators to promote public funds only concern economic growth; this has a direct effect on the type of policies that are mobilized and, consequently, on the learning

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SUB-CLUSTER	AUTHORS	METHODOLOGY	ANALYSIS UNITS	SEARCH RESULTS
Sustainable development policy	Zolin, Ferretti, Grandi (2020)	raw set theory (RTD); ROSE2 software (Rough Sets Data Explorer)	peripheral and ultra-peripheral Italian municipalities of Sicily and Sardinia	and translation of policies which is contrary to the broader bioeconomy policies in the EU. Due to the vast heterogeneity, national policies cannot be adapted to the specificity of each territory: each local decision-maker must identify the current situation of the municipality and the most appropriate part of the national legislation to refer to. The results of the analysis show the importance of differentiating action plans also between the different internal areas, focusing resources on the most important pillar of sustainability in that area. The identification of sustainability at the different territorial levels allows policy makers to direct policies and strategies in order to achieve a balance between the different dimensions of sustainability.
Sustainable development policy	Hickmann (2021)	Document analysis	Cities and governments	Pioneering sustainability initiatives in urban areas underline the great potential of local authorities to contribute to global sustainability. However, some limitations for local authorities in conducting effective urban sustainability actions tend to be neglected: cities and local governments depend on the regional and national PA and international bodies to initiate and maintain large-scale urban sustainability initiatives; local authorities face structural barriers when designing innovative urban sustainability actions that bring together different local actors; the impact of transnational city networks and alliances on local sustainability initiatives is rather low.
Sustainable development policy	Bornemann & Weiland. (2021)	Systematic review of the literature.	Final sample of 22 papers	1. The integration of policies is considered a crucial prerequisite for the successful implementation of the 2030 Agenda. It is necessary to integrate the sustainability into policies because there are numerous interconnections (trade-off and synergies) between sectors and if we do not take them into account, we could have ineffective policies. 2. Either the objectives (SDGs as an indivisible whole, interconnected SDGs), or the objectives and targets must be integrated into specific contexts. 3. The literature largely converges on a
Sustainable development policy	Suditu, Nae, Negut, Gheorghilas. (2014)	Cartographic representations	Local budgets of Romania	"Whole-of-government" approach in which each goal should be an integral part of any attempt at policy integration. This implies that no goals should be excluded from the remarks on policy integration. This general trend agrees with the idea that the SDGs are "indivisible". There are strong disparities in the distribution of financial resources which are reflected in the ability of administrative territorial units to fulfil their responsibilities, to ensure sustainable territorial development. These disparities are determined by several factors, including economic underdevelopment and the unemployment rate; moreover, the distribution of state budget revenues also reveals regional differences and disparities: underdeveloped areas have the smallest share of income in total income.
Sustainable development policy	Standar & Kozera . (2019)	TOPSIS method; descriptive statistics; Pearson's linear correlation coefficient	113 rural municipalities located in a Polish region (Wielkopolskie voivodeship)	In the analysed period, there has been the development of the registered rural municipalities and also a reduction of the socio-economic development gap between them; however, there are differences in the levels of socio-economic development between the rural municipalities located in the eastern part (high, medium-high levels) and western part (low, medium-low levels) of the Polish region. Furthermore, there is a strong relationship between the financial situation of rural municipalities and their level of development in the region considered: the level of development is particularly correlated with the potential income of rural municipalities and with their potential investment.

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SUB-CLUSTER	AUTHORS	METHODOLOGY	ANALYSIS UNITS	SEARCH RESULTS
<i>Sustainable development policy</i>	Leal Filho, Platje, Gerstlberger, Ciegis, Kääriä, Klavins & Kliucininkas (2016)	Comparative qualitative analysis of sustainability governance based on a selected set of indicators	Data taken from official sources	Comparative analysis of sustainability governance in the Baltic Sea countries: the countries studied were divided into three groups: 1. Denmark and Finland: countries with the highest level of real GDP per capita and the lowest inequalities. They are characterized by a high level of good governance, trust and significant scientific and innovative efforts. This should support transitions in sustainability and good practices that can be imitated by other countries. 2. Germany: characterized by a relatively high level of good governance, while trust is at an average level. The level of real GDP per capita is lower than that of the Scandinavian countries and the distribution of income is less equal in some extent. Another problem is the administrative structure. 3. Former socialist countries have relatively low indicators of good governance, lower real GDP per capita, higher unemployment levels and higher income inequalities, and this leads to a reduction of the social cohesion. A significant problem is the emigration of relatively well-educated labour to Western Europe due to high salary difference and social security levels.

**Table 7**

Cluster 2: Sustainability Accounting.

SUB- CLUSTER	AUTHORS	METHODOLOGY	ANALYSIS UNITS	SEARCH RESULTS
<i>Public spending and sustainable development</i>	Hege & Brimont (2018)	Semi-structured interviews; analysis of the voluntary national reviews submitted	Administrative representatives from: Colombia, Mexico, France, Finland, Norway, Sweden, Slovenia, Afghanistan, Assam.	Countries integrate the SDGs into their budgeting processes in several ways: most of the studied countries map their budgets against the SDGs or include qualitative reports in their main budget document, providing an overview of how the budget is linked to the different SDGs. Others use the SDGs to improve their budget performance appraisal system or as a management tool for allocating and managing budgetary resources. Proposals on the methods of integration: 1) universal system of classification of the financial statements of the SDGs; 2) introduction of individuals and definition of budget labelling systems for transversal SDGs; 3) publication of indicators showing the state of the country based on a few SDGs.
<i>Public spending and sustainable development</i>	Tafuro, De Matteis, Preite, Costa, Mariella & Treviso (2019)	Spearman's correlation coefficient. semi-structured interviews	Social expenditure of 116 Italian provincial capitals and 22 ISTAT social indicators	The financial policies implemented by the individual municipalities are not linked to the real social needs measured by the indicators used. This shows that the social expenditure of the Italian capitals does not seem to be based on a sustainable approach, as there is no positive relationship between the social indicators and the financial resources allocated by the municipalities to social issues. Local authorities allocate financial commitments of a social nature on the basis of a traditional spending criterion, centred on historical social spending rather than on future social objectives.
<i>Public spending and sustainable development</i>	Cardillo & Longo (2020)	Interviews, direct observation and documentary analysis.	Accounting system of a medium-sized Italian local authority located in eastern Sicily; Analysis of planning and budget accounting documents.	There is a complex relationship between the accounting system and social reporting (SR). The SR is an institutionally recognized tool that work as an internal and external means of communication for the sustainable territorial development of a public body, in terms of objectives, actions and planned and achieved results. The structure of the accounting system is sometimes not suitable for developing a complete accountability and sustainability process in the public organization; the informative and economic data, resulting from the reporting system, are not always fully usable and comprehensible externally and therefore they do not represent the results in the best possible way. SR is essential in promoting social sustainability and in evaluating the effects of the choices made and therefore the accounting system should be able to detect and represent the management phases and the performances achieved according to a logic of interdependence.
<i>Public spending and sustainable development</i>	Becchetti, Corrado & Fiaschetti. (2017)	Online survey and sample weighting; OLS model	2605 Italian citizens	The BES area for which Italians are willing to pay the most is the health care (17.4 % of total financial resources). Below are education and training (12.8 %) and work-life balance (about 10.7 %). All other areas are between 8.9 % (economic well-being) and 6.6 % (security), except for politics and institutions where it drops to 3.8 %. Preferences depend on 5 socio-demographic discriminations: political orientation on the left (greater importance to education and the

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SUB- CLUSTER	AUTHORS	METHODOLOGY	ANALYSIS UNITS	SEARCH RESULTS
<i>Public spending and sustainable development</i>	Bednarska-Olejniczak, Olejniczak & Svobodova (2020)	Analysis of the creation process of the Soleki Funds, the directions of expenditure and the amount of expenditure	Reports provided by the Ministry of Finance on the participatory budgets of the municipalities of Poland	environment; more oriented towards achieving the SDGs) or right-wing (greater importance to economic security and well-being), gender, education, the income and the north / south geographic position. The number of municipalities using this form of participation in the citizens' budget is increasing. The analysed directions of spending indicate that the SF are consistent with the linked SDG objectives to improve the quality of life of residents. The study shows that the SF is part of the target 16.7 of SDG 16 and target 11.3. The study also shows that the potential of the SF has not been fully used: the projects are presented but are not then implemented, however it serves as an information to the municipality on the latent needs for better strategic spending planning.
<i>Public spending and sustainable development</i>	Soukopová & Bakoš (2013)	Survey. Weighted techniques of multi-criteria analysis. MS Excel.	Expenditure on environmental protection of the municipalities of the Czech Republic	A methodology and information system for municipalities have been developed, both approved by the Ministry of the Environment of the Czech Republic as a voluntary tool for municipal officials. The aim is to evaluate the municipal Environmental protection expenditures (EPE) in terms of 3E (economy, effectiveness, efficiency) with 2 levels of evaluation. The result is a rating that contains the scores of each pillar of sustainable development and the assessment of the actual budget. The EPE Information System (IS-EPE) aims to evaluate the effectiveness of the current EPE and budget planning.
<i>Public spending and sustainable development</i>	Florea, Meghisan-Toma, Puiu, Meghisan, Doran, Niculescu (2021)	Definition of a representative equation; stationarity test; Augmented Dickey – Fuller Phillips and Perron test; cointegration and causality test (Granger)	Greenhouse gas emissions; Total revenue from energy taxes; Total revenue from transport taxes; Total expenditure of public administrations for environmental protection.	The analysis of the effort exerted by public authorities in Romania in mitigating climate change using fiscal and budgetary tools highlighted two bidirectional causal relationships (one in the short term between greenhouse gas emissions and revenue from taxes on pollution / resources and one in revenue from taxes on energy and revenue from taxes on pollution / resources), three short-term one-way causal relationships (from revenue from pollution / resource taxes to revenue from transport taxes; from revenue from taxes on transport to greenhouse gas emissions and from greenhouse gas emissions to energy tax revenues) and three long-term one-way causal relationships (from pollution / resource tax revenues to total government expenditure for the protection of environment; from government spending on

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SUB- CLUSTER	AUTHORS	METHODOLOGY	ANALYSIS UNITS	SEARCH RESULTS
<i>Public spending and sustainable development</i>	DASCĂLU & PREDESCU (2016)	ABC structural analysis method (Pareto diagram)	Budget of the city of Bucharest	environmental protection to greenhouse gas emissions and tax revenues on transport towards greenhouse gas emissions) The analysis of public expenditure shows that the efforts of the local administration have been concentrated towards the allocation of resources for "Education", which means that the decentralization process, as to education, from the central administration to the local one, has been completed. On the contrary, in the case of health care and public order, local authorities allocate less amount of public funds than in other activities, such as social assistance: this means that the decentralization process is not completed yet.
<i>Public spending and sustainable development</i>	De Matteis, Preite, Striani & Borgonovi (2021)	Regression (GLS method); t-test methodology	116 Italian cities	In general, cities direct public funds to implement environmental policies, but these turn out to be ineffective. In particular, the financial commitments of the cities that constitute the sample are closely linked to environmental criticalities: this situation occurs for all three environmental areas (Water, Urban waste, Air) and for all eight environmental indicators taken into consideration in the research. As regards the possibility that the environmental financial commitments of the local authorities in the sample will be able to solve or reduce environmental problems, both at national and sub-national level, this possibility is not confirmed or is only weakly supported. This evidence is found for all three investigated environmental areas.
<i>Public spending and sustainable development</i>	Sisto, García López, Quintanilla, de Juanes, Mendoza, Julio Lumbreras & Mataix (2020)	Correlation	Budget of the aggregated Spanish local administrations (SGFAL)	The research found that around 25 % of budget items have relevant statistical links with the SDGs: the least correlated are SDGs 11 and 15; the most connected are SDGs 1, 4, 7, 8 and 16. Research highlights the existence of more synergies with respect to trade-offs within and between the budget and the SDGs in most cities. Policy makers can no longer design strategies based on subjective assumptions, but they must also include in the decision-making process the necessary tools to achieve all sustainable development goals.
<i>Public spending and sustainable development</i>	Borghesi, S., Castellini, M., Comincioli, N., Donadelli, M., Gufler, I., & Vergalli, S. (2022)	event study analysis	stocks listed in the "STOXX 100 All Europe" index	Both green and brown sectors experienced positive cumulative abnormal returns (CARs) following green policy-related announcements (GPAs) made by European governments in 2020, with the positive sentiment effect being stronger in the green sector. Additionally, the analysis revealed that the positive sentiment was largely driven by announcements related to climate change mitigation policies, and certain sectors (energy, financial, and industrial) and countries (Switzerland, Spain, the UK, Ireland, and Italy) benefited significantly from GPAs, particularly within more sustainable portfolios.
<i>Sustainability reporting</i>	Giacomini, Rocca, Carini, Mazzoleni. (2018)	Survey	1300 Italian municipalities and 314 local authorities	The results confirmed the evidence in the literature on the lack of adoption of sustainability reports by municipalities without incentives or the mandatory adoption of reports, especially for smaller entities. Most of the municipalities agreed that the reduction of costs, linked to austerity, represented an obstacle to the preparation of the

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Table 7 (continued)

SUB- CLUSTER	AUTHORS	METHODOLOGY	ANALYSIS UNITS	SEARCH RESULTS
<i>Sustainability reporting</i>	Biondi and Bracci (2018)	Comparative analysis method (qualitative)	Official documents	sustainability report in terms of time and availability of staff. The second reason was the voluntary nature of the reporting tool, indicated by 39 % of the interviewed municipalities. Only 8 % of the municipalities have linked the SR to its usefulness. There are many elements in common between the different accountability tools that the public sector can use to report non-financial aspects (there is the risk of creating only new labels without real sustainability reporting innovation). The analysis discusses the proposal to merge two or all three reporting tools, but there is also the risk that a single reporting tool covers too much, and that is so broad in scope and content that it neutralizes its own purpose of being easy to read and accessible to non-experts.
<i>Sustainability reporting</i>	Tommasetti, Mussari, Maione, Sorrentino (2020)	Structured literature review (SLR)	31 documents relating to sustainability accounting and reporting (SAR) in the public sector	SAR is a young research area. Scholars are approaching SAR in the public sector by privileging the national and local / regional focus in their investigations, with an interdisciplinary approach. From a methodological point of view, prevailing research methods used in the analysed literature are primarily for exploratory and descriptive purposes. Future research on SAR in the public sector could head towards quantitative methodologies and the connection between co-creation of public value and SAR practices in the public sector.
<i>Sustainability reporting</i>	Nicolò, G., Andrades-Peña, F. J., Ferullo, D., & Martinez-Martinez, D. (2023)	Content analysis	local governments in two Mediterranean countries	Local governments in Spain and Italy have limited online disclosure of information related to the United Nations' Sustainable Development Goals (SDGs) on their official websites. It suggests that these governments have responded to the SDGs by adopting compromise and avoidance strategies, indicating a restrained approach to SDG-related disclosure rather than full alignment with the SDGs.

**Table 8**  
Cluster 3 – Measurement Tools.

SUB- CLUSTER	AUTHORS	METHODOLOGY	ANALYSIS UNITS	SEARCH RESULTS
<i>Multidimensional indicators</i>	Monte & Schoier (2020)	Multiple Factor Analysis (MFA)	BES indicators of the Italian provinces	The results of the analysis identify a main dimension that describes approximately 48 % of the total variability between provinces over time. The main dimension explains the socio-economic and environmental aspects: increasing the values of this dimension would have an improvement in Health, Education, Work and life balance, Economic well-being, social relations, Politics and institutions, Landscape and cultural heritage, environment and quality of services.
<i>Multidimensional indicators</i>	Bova & Śleszyński. (2020)	Surveys. Error test, adequacy test, subjective weight test.	700 people from the city of Ceccano.	The suggested model (B-BES) is based on the following assumptions: 1) the indicators must reflect the specificities of a given place; 2) the indicators must reflect the specificity associated with local aspirations and preferences (each place has its own objectives and priorities). Therefore, starting from the idea of the Italian Bes, the model assumes that the different public sectors need different levels of information. The involvement of the population is crucial for the local evaluation of the quality of life and sustainability and allows a deeper evaluation of the usefulness of the B-BES model. The empirical results of the case study showed that the B-Bes has a degree of adequacy of 84 %.
<i>Multidimensional indicators</i>	Urbaniec (2015)	Literature review	Key European and international strategic documents and statistical databases of Poland	The Polish monitoring system for sustainable development is based on numerous strategic documents but, as there is no ad hoc strategy for sustainable development, this system is based on socio-economic indicators which hinder the monitoring of sustainable development and its implementation. There is a strong predominance of social indicators, which may indicate the main priority in Polish politics. In any case, the lack of a strategy makes any evaluation difficult in terms of the achievement of sustainable development goals, progress and stability of the chosen indicators.
<i>Multidimensional indicators</i>	Pulselli, Ciampalini, Tiezzi & Zappia (2006)	Gini index. Adjusted private consumption.	Province of Siena	The application of the Index of Sustainable Economic Welfare (ISEWI) at the local level has been achieved. The greatest difficulty was the lack of an adequate statistical source to support the construction of indicators other than purely economic or demographic ones. The results for the Province of Siena show a large gap between local GDP and ISEW (about 37 % of GDP). The analysis shows that ISEW could integrate GDP in a society where environmental and social problems are becoming relevant.
<i>Multidimensional indicators</i>	Ramos & Caeiro (2010)	Meta-evaluation: set of key factors and meta performance indicators	Portugal's National System of Sustainable Development Indicators (SIDS).	A conceptual framework has been developed to design and evaluate the effectiveness of sustainability indicators: it is based on a list of key factors of good practice and on the selection of meta-performance indicators that will allow a more objective and transparent evaluation of activities and of the overall performance monitoring results. The involvement of the public and stakeholders is an essential component of the proposed framework. Despite the advantages of these meta-evaluation tools, they also have some drawbacks: practical difficulties in

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Table 8 (continued)

SUB- CLUSTER	AUTHORS	METHODOLOGY	ANALYSIS UNITS	SEARCH RESULTS
<i>Multidimensional indicators</i>	Davino, Dolce, Taralli & Esposito Vinzi. (2018)	Partial modelling	BES data of the 24 Italian provinces	their implementation due to the complexity of the sustainability evaluation processes. All the provinces below the first quartile of the BES are in the South and in the islands; 85 % of the provinces in the first quartile of the BES distribution are in the north-east or north-west of Italy. Context domains seem to be less discriminating between northern and southern provinces than the outcome domains.
<i>Multidimensional indicators</i>	Chelli, Ciommi, Emili, Gigliarano & Taralli (2016)	Factor analysis. Cluster analysis. Construction of composite indicators. Gini concentration index.	110 Italian provinces. Dataset of 70 indicators divided into 11 domains of well-being.	The factor analysis has enabled to synthesize the 70 BES elementary indicators into 28 factors, by facilitating the comparison of local performances. The indicator resulting from the combination of the factors is a useful tool for explaining and comparing the performance of the Italian provinces in relation to each domain and by highlighting in which BES domain a province reveals strengths or weaknesses. The output of the cluster analysis confirms the gap between central-northern and southern Italy in relation to the indicator of each BES domain. The differences and similarities in terms of welfare profiles between the Italian provinces clearly emerged.
<i>Multidimensional indicators</i>	Porreca, Rambaud, Scozzari & Di Nicola (2019)	Fuzzy k-mean algorithm. Principal component analysis	20 Italian regions. BES report 2016	There is a clear difference between the Northern and Southern regions (except for Lazio and Abruzzo, that are in an intermediate position). Trentino-Alto Adige and Valle d'Aosta have the best conditions, while Molise is the worst region. Some Italian regions are in a state of backwardness about health, environment, minimum economic conditions, subjective well-being, education, social relations and working conditions. Institutions should address these issues considering the local policies. This fuzzy approach provides policy makers with useful indications for planning targeted interventions to improve well-being conditions within the Italian regions and greater awareness of where to carry out these interventions to reduce costs and waste.
<i>Multidimensional indicators</i>	Jelinčić & Tišma. (2021)	Analysis of documents; interviews. focus group	13 heritage projects from 6 countries as best practice examples	The projects have shown a positive correlation with different aspects of sustainability but not all the aspects of sustainability are present in all projects. The research confirmed the complexity of ensuring sustainability due to the wide range of aspects of sustainability and its socio-cultural, environmental and economic sublevels. Sustainability is politically important to justify investment. To measure the sustainability of an asset, it is needed a broad set of indicators, to ensure long-lasting and sustainable projects. The indicators are divided into three groups 1) socio-cultural, 2) environment, 3) economic. The identified indicators could be useful to policy makers to prioritize the funding of cultural heritage projects.
<i>Multidimensional indicators</i>	Mazziotta & Pareto (2016)	Correlation analysis. Principal Components Analysis.	Bes composite indices	Almost all composite indicators are positively correlated with each other with particularly high values, with the exception of the "safety" index. The results of the analysis confirm that the main synthetic well-being indices can be explained by GDP while others, such as those relating to safety and the environment, are almost completely unrelated to this indicator.

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Table 8 (continued)

SUB- CLUSTER	AUTHORS	METHODOLOGY	ANALYSIS UNITS	SEARCH RESULTS
Multidimensional indicators	Onori & Jona Lasinio (2020)	Use of Bayesian Networks	21 Italian regions	At the regional level, GDP fails to capture 30 % of information, i.e. GDP does not explain well-being for a percentage of 30 % (in terms of variance). Bayesian Networks can be considered as a class of models suitable for the study of multidimensional well-being as they are also able to incorporate geographic information. The analysis shows that almost all the domains are interconnected with geographic dependence (north / south). Only three areas (Health, subjective well-being, Safety) do not show a clear relationship with the geographic area. Furthermore, they are all directly connected with a number of areas between 0 and 4. Quality of work and environment are the most connected and play a central role in the BES system as they can influence many other aspects of well-being.
Multidimensional indicators	Braulio-Gonzalo, Bovea & Ruá (2015)	Literature review	786 indicators included	Definition of 73 indicators divided into 14 sustainability categories and 69 specific sub-categories
Multidimensional indicators	Marszalek-Kawa & Siemiakowski (2020)	Multidimensional taxonomic analysis methods: linear ordering method, Hellwig's method.	Districts of the Kuyavian-Pomeranian Province	To measure the level of local sustainable development, a synthetic indicator was developed that shows the degree of achievement of the SDGs objectives; this helps to show the differences in the implementation of development strategies between the districts. The relatively large taxonomic distances between the synthetic measures for the individual districts show a significant differentiation between the various parts of the analysed province in terms of local sustainable development. Although the examined parts belong to the same administrative unit, they do not develop at the same pace. The difference between the best and the worst district expressed in the value of a synthetic measure is 0.4165. As regards to the measurement of the level of sustainable development, the maximum value of the synthetic indicator is almost 0.48. This means that all the examined districts have a low or very low level of sustainable development.
Multidimensional indicators	Miola, Borchardt, Neher & Buscaglia. (2019)	Literature review. Linear regression (R) 2.	220 papers analysed relating to the Sustainable Development Goals	The nature of interconnections often depends on the context of each country, the level of development, geographic characteristics and other specific policies that define whether a given interconnection constitutes a trade-off or a connection. In general, the SDGs have far more connections than trade-offs. The implementation of the SDGs cannot be treated separately; it should be contextualized in the specific political context that integrates the priorities of the SDGs into a broader context of political priorities.
Multidimensional indicators	Balaras, Droutsa, Dascalaki, Kontoyiannidis, Moro and Bazzan (2019)	Process of normalization, aggregation and attribution of a total sustainability score by building or district.	14 EU projects and systems	The method, structured around the 17 SDGs, supports the efforts that municipalities must face to overcome the complexity of measuring urban sustainability; it helps throughout the process to initiate, organize, adapt, evaluate and identify the best sustainable renovation strategies for buildings or neighbourhoods and monitor progress towards achieving sustainability goals. It allows a diagnosis of local sustainability by selecting the most suitable indicators; it allows you to compare the assessments between cities, addresses 7

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SUB- CLUSTER	AUTHORS	METHODOLOGY	ANALYSIS UNITS	SEARCH RESULTS
<i>Multidimensional indicators</i>	Arbolino, De Simone, Carlucci, Yigitcanlar & Ioppolo (2017)	Normalization; Weighting (PCA); Aggregation; Standardization; Sensitivity analysis.	The original dataset is applied to 20 Italian regions.	sustainability issues that are described and quantified with 178 sustainability criteria / indicators of which 16 KPIs. The research developed an Industrial Environmental Sustainability Index (IESI), which is a composite index (CI), which includes both the activities of government institutions and those of the private sector. Two other sub-indices are also connected, which represent the strategy of public and private subjects and respond to the need of providing important information to the policy maker and represent a useful tool to contribute more to the achievement of the main green objectives in the industrial sector. The index represents the efforts of private and public actors in terms of financial / intellectual efforts related to ecological industrial policies; Subsequently, a comparative analysis between regions is presented that shows that the northern area ranks above the average of the country while the lowest positions are occupied by the southern regions. In general, the results show that in the regions where IESI shows a better performance, there is a connection between public and private action.
<i>Multidimensional indicators</i>	Bonnet, Coll-Martínez & Renou-Maissant (2021)	Construction of 6 variable selection indices; data normalization; weighting; aggregation. Spatial autocorrelation, multivariate analysis	96 French metropolitan departments. Sources: various French official institutes	(1) 6 composite indices have been created, relating to 6 domains: environment, sustainable development, energy transition, economic dynamism, social cohesion, governance. (2) Each index was analysed using a cartographic support to compare the performance of each department (spatial analysis); the existence of a spatial dependence in the performance of sustainable development in the French departments between the various indices has been confirmed. A clustering of the various departments into 5 categories based on the level of performance was introduced. In general, given that nearly 50 % of the 96 French departments exhibit low performance in all dimensions of sustainable development, policy makers should make every effort to gradually adopt a new production system based on new modes of production and consumption.
<i>Multidimensional indicators</i>	Rösch, Bräutigam, Kopfmüller, Stelzer & Fricke. (2018)	Definition of a system of ad hoc indicators. linear projection (distance to target approach). Comparison (distance-goal approach).	45 monitoring indicators	It has been developed the Sustainability Indicator System (SIS), consisting of 45 indicators to assess whether the policy measures implemented so far by the federal government are appropriate and sufficient to achieve the sustainability objectives defined for the German energy system. The results show that 24 % of the indicators are rated with green (no policy changes are required to achieve sustainability objectives), 45 % with red (political action required to achieve the objectives) and 24 % with a white traffic light (not data). This means that substantial changes in the policy strategies and measures implemented so far are needed to achieve the sustainability goals defined for the German energy system by 2020.
<i>Multidimensional indicators</i>	Bellantuono, Lagrasta, Pontrandolfo & Scozzi (2021)	Context analysis through Adjusted Mazziotta-Pareto Index and Adjusted Differences Mean Index.	Taranto BES indicators	The study shows that, although the BES framework detects some criticalities of the examined area, it does not identify a territory in crisis. In fact, the problematic situation is not always reflected in a lower territorial performance, neither at the level of individual indicators nor at the level of entire areas, with

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SUB- CLUSTER	AUTHORS	METHODOLOGY	ANALYSIS UNITS	SEARCH RESULTS
Multidimensional indicators	van Zeijl-Rozema & Martens (2010)	Qualitative analysis.	Limburg case study: ENSURE project	evidence in the economic sphere. The possible reasons can be traced back to the lack of data availability; the lack of specificity of some indicators; the low depth of available data. As proof of this, by comparing the regional data with that of the crisis area, no critical conditions emerge either at a indicators level or at domains level. The ENSURE project model demonstrates the importance of linking science and technical expertise to policy for integrated sustainability assessment. For the evaluation of regional sustainability, a multidisciplinary team composed of different groups of stakeholders need to design a general understanding of sustainability and regional dynamics. The indicators alone do not say anything but their reading must be made in relation to the objectives set and interpreted in the context of the system. The model combines the political vision of sustainability (expressed by a framework of indicators) with the systemic vision of sustainability (represented by a map of the region showing the relationships between regional elements).
SDGs	Janoušková, Hák, Moldan. (2018)	Review of the literature; comparative analysis between the various monitoring reports on the SDGs	Analysis of 4 reports on sustainability monitoring	The analysis of the different reports suggests that two similar indices show very different results. Only experts are generally aware of conceptual and / or methodological differences and therefore understand the differences in results. A striking example of inconsistent results is the SDG index: the EC report places it in 24th place (out of 34) in the ranking of OECD countries evaluated, i.e. among the worst thirds, while a similar SDG index places the same country in fifth. place - very positive - in global competition (among 157 countries evaluated). The SDGs are firmly embedded in a policy framework and their operation has been mainly carried out by indicators: it is necessary for the community of experts to reach full consensus on the framework of indicators and its use.
SDGs	Coscieme, Mortensen & Donohue (2021)	Principal components analysis	28 EU Member States	In the EU, environmental objectives are the most complex and least coherent of all SDGs, reflecting the disparate and often unrelated ways in which the environmental issue is defined. However, environmental goals show the fewest trade-offs between policy goals. This suggests that improving coherence within and between environmental objectives will have a very positive and rapid effect in terms of progress towards achieving the objectives versus the social and economic ones.
SDGs	Martínez-Córdoba, Amor-Esteban, Benito, García-Sánchez. (2021)	X-STATIS study technique with graphical representations in ADE-4	3480 observations referred to SDG11 relating to 58 Spanish municipalities	There is a positive trend for the achievement of SDG-11. Critical areas: urban safety, waste management, land use. The results show that there are important differences depending on whether the municipality is led by a mayor with a progressive ideology (more focused on inclusion, environmental issues and infrastructure) or conservative (focused on security and accessible housing). Finally, the impact of the ideological alignment of the local government with that of the Autonomous Community has been verified: the highest values of SDG 11 are obtained from those municipalities governed by the same political party at the regional level.

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SUB- CLUSTER	AUTHORS	METHODOLOGY	ANALYSIS UNITS	SEARCH RESULTS
SDGs	Martínez-Córdoba, Raimo, Vitolla, Benito. (2020)	Malmquist index and truncated regression model.	Variables referred to SDG6 relating to 356 Spanish municipalities	The evolution of efficiency to achieve SDG-6 has decreased in recent years. The implementation of the SDGs began in 2016, a moment in which local governments showed the worst efficiency performance. The factors that can improve the evolution of the efficiency of Spanish local governments, to achieve SDG-6 in 2030, are: tax increases, introduction of private management of services, higher population density, increase the government budget revenues of local government, increase the income of the inhabitants of the municipality and prevent the fragmentation of local government. That would mean offering more with the same inputs.
SDGs	Ramos & Laurenti. (2020)	Correlation; Linear regression analysis	34 indicators taken from the United Nations web page and related to the performance of the Spanish SDGs	Spain is conducting a major energy transition to greener and renewable sources, but its progress is slower than other northern countries. In general, almost 80 % of the significant interactions between SDGs are classified as synergies. SDG 4 (Quality Education), SDG 5 (Gender Equality) and SDG 7 (Affordable and clean energy) are those that contain the greatest number of positive interactions. Some inconsistencies and negative correlations have been found, for example between SDGs 1 and 4.
SDGs	Staszkiwicz (2019)	Regression	159 research papers	There is no applied or theoretical model available for an integrated measurement of the sustainable development of all UN goals. So, without a common measurement method, there is no possibility to compare the values created between different sustainable areas and the management of global human activities is subject to decision-making bias.
SDGs	Koch & Krellenberg. (2018)	Analysis of documents	SDG 11 developed in the project "SDG Indicators for Municipalities", in the German National Strategy for Sustainable Development (GSDS) and defined by 2030-watch.de	From the assessment of the implementation of the UN indicators at the national level, it emerges that all the three initiatives analysed seem to share a common vision of the priorities for sustainable urban development in Germany, which differs widely from the original indicators for SDG 11 established by the United Nations. The limit of the approaches used relates to the international comparability of the progress made in sustainable urban development, based on the indicators of the United Nations.
SDGs	Spaiser,Ranganathan, Swain & Sumpter (2016)	Factorial analysis; models of dynamic systems	Transnational data relating to the SDGs provided by the World Bank	Economic growth and low debt meet socio-economic objectives (poverty; inclusion) but at the same time hinder the achievement of environmental goals. Moreover, it seems to be only a weak relationship between the various environmental indicators. The results of the analysis suggest that it will be difficult to achieve the SDGs if we continue using the current development model
SDGs	Ionescu, Firoiu, Tănăsie, Sorin, Pîrvu and Manta (2020)	ETS model forecast statistical analysis: forecast analysis, dynamic indicators, trend definition	SDG indicators. Eurostat data	Major steps were taken towards the implementation of the 2030 Agenda in all EU Member States but no country is in the process of achieving all the goals relating to well-being and health. Research results indicate that, on average at EU level, no more than half of the proposed 2030 SDGs can be achieved if the same level of engagement is maintained. If we analyse the individual situation of each Member State, we can see how the percentage of achievement of the objectives varies.

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SUB- CLUSTER	AUTHORS	METHODOLOGY	ANALYSIS UNITS	SEARCH RESULTS
SDGs	Strologo, D'Andrassi, Paoloni & Mattei (2021)	Quantitative analysis. FORECAST.ETS function. Dynamic index methodology.	Eurostat, Istat data.	As part of the analysis aimed at determining the state of implementation of the SDGs in Italy, it emerges that the country must take urgent measures to fulfil its commitment to the 2030 Agenda. It will have to adopt measures and reforms aimed at reversing the trend of the results of many indicators which, based on the projections, will present negative data by 2030. The analysis conducted in Italy show that strong inequalities still exist throughout the national territory, and this could lead to an increase in social conflicts. The policies adopted to date are, in many cases, worsening the performance in terms of sustainability. From the comparison on the degree of implementation of Italy's SDGs with Poland, Romania and Spain, it emerges that Poland is the best in terms of achieving SDGs, while Romania, Spain and Italy are in a similar situation despite the differences in terms of area of intervention. The analysis showed that it is not enough to analyse the SDGs at the national level, but also at the local level.
SDGs	Asadikia, Rajabifard, Kalantari (2020)	Boosted Regression Trees Regression Model (Machine Learning and Data Mining Technique)	BS-SDSN (Bertelsmann Stiftung and Sustainable Development Solutions Network) dataset. SDGs scores and SDGs index of 157 countries in 2017, 156 in 2018, and 161 in 2019 (474 total observations)	The ENSURE project model (to develop a framework of adaptable indicators for integrated monitoring of sustainable development) demonstrates the importance of linking science and technical expertise to policy for integrated sustainability assessment. For the evaluation of regional sustainability, it is necessary to have a multidisciplinary team composed of different groups of stakeholders, to design a general understanding of sustainability and regional dynamics. The indicators alone do not say anything but their reading must be made in relation to the objectives set and interpreted in the context of the system. The model combines the political vision of sustainability (expressed by a framework of indicators) with the systemic vision of sustainability (represented by a map of the region showing the relationships between regional elements).
SDGs	Biggeri, Clark, Ferrannini, Mauro (2019)	Aggregation method based on the Multidimensional Synthesis of Indicators (MSI) approach	Dataset for the 2018 SDG Index provided by Bertelsmann Stiftung and SDSN	The article proposes an "Integrated Sustainable Development Index" (I-SDI), to overcome the limits of the SDG index (it does not consider the integrated nature of the 2030 Agenda). The article draft is accompanied by the comparison between the results of the I-SDI and those generated by the SDG Index, from which significant differences in the results emerge, highlighting the need for a more flexible and integrated measure capable of guiding policy makers and monitoring the general progress.
SDGs	Schipper, Dekker, de Visser, Bolman & Lodder (2021)	Statistical analysis of variability (ANOVA).	5 coastal and 5 sand strengthening cases (two groups of case studies)	Creation of the SDG-SIS assessment framework to support coastal policy starting from the 17 SDG. 4 Phases: Define the system characteristics related to the selected cases 2. Consider the 169 SDG targets based on the defined characteristics (selection of SDGs and targets that link to coastal characteristics). 3. Final and personalized selection of SDG-KPIs 4. evaluation based on numerical data, with the Sustainability Impact Score (SIS) as output. the Sustainability Impact Score is a percentage value which is then compared with the SIS "no impact" value, a fictitious benchmark that represents the ideal

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SUB- CLUSTER	AUTHORS	METHODOLOGY	ANALYSIS UNITS	SEARCH RESULTS
SDGs	Pradhan, Prajal; Costa, Luis; Rybski, Diego; Lucht, Wolfgang; Kropp, Jürgen. (2017)	Non-parametric analysis of Spearman's rank correlation	Official SDG indicators for 227 countries	<p>and most sustainable state of a case study. SIS = total sum of the individual SDG-KPI results. Potential limit: not certain availability of publicly available data relating to KPIs (data accuracy is required).</p> <p>For each SDG, the positive correlations between the pairs of indicators exceed the negative ones in most countries, and that indicates a solid basis for the successful implementation of the SDG agenda. The analysis shows that SDGs 1 and 3 are the most synergistic and SDG 12 is the goal most associated with trade-offs. Policies that promote synergistic inter-sectoral and goal-related relationships will play a crucial role in the operationalization of the SDG agenda. Furthermore, it emerged that the interrelationships of the SDGs behave differently between various countries: some of them are synergistic, others are in opposition.</p>
SDGs	Álvarez & García-Fernández (2020)	Comparative statistical analysis using the ETS model	SDG indicators. Eurostat data	<p>Spain needs to take urgent regulatory and public policy measures to honor its commitment to the 2030 Agenda. Otherwise, most of the Spanish indicators will not reach European average values in most objectives, including relevant areas such as the struggle for education or the environment.</p>
SDGs	Raszkowski & Bartniczak (2019)	Dynamic analysis methods. Individual dynamic indices.	73 national sustainability indicators provided by Statistics Poland	<p>There is an optimistic situation in terms of achieving the objectives of the 2030 Agenda in Poland. In the case of 57 indicators out of 73 in total, the direction of the expected changes was positive.</p>
SDGs	Cling, Eghbal-Téherani, Mathieu & Plateau. (2020)	Principal Component Analysis (PCA); hierarchical cluster analysis (HCA)	EU dashboard indicators - 2018	<p>The results of the analysis show that the interconnections between EU sustainable development indicators and the differences between EU countries for these indicators are both quite strong. There are strong interconnections between social and economic indicators, while the correlation between environmental indicators and the rest is weak. Finally, the clustering of European countries clearly reflects the differences between "rich" and "poor" countries.</p>
SDGs	Guerrero, O. A., Castañeda, G., Trujillo, G., Hackett, L., & Chávez-Juárez, F. (2022)	agent-based computational model	Country of Mexico and its 32 states	<p>achieving sustainable development relies on both subnational policy implementation and the effective allocation of resources across regions. It estimates the development gaps that are likely to persist in Mexico by the year 2030 and determines how these gaps can be minimized through an optimal distribution of federal transfers. Importantly, the distribution of these transfers depends on the specific development objectives set by the national government and on the interdependencies between the varying characteristics of the states.</p>

on the contrary, prefer the aggregation of a multitude of variables within a single index. This issue is particularly relevant concerning the location of the data: more fragile territorial areas coexist in the same State, characterized by specific/sectoral problems, concerning which the same indicators used to measure other territories could be more effective. Generic indicators should be declined or sub-segmented into more specific indicators to accurately detect the problems that affect a territory (i.e., we can think of the specific characteristics of coastal or mountain territories). In this way, territorial policies will be more calibrated, and there will be a more efficient use of public resources (Table 8).

#### 4.1.4. Fourth cluster analysis: public-private partnerships

The fourth identified cluster includes studies on Public-Private Partnerships concerning three specific aspects: partnership policies, projects for sustainable development and Pay by Result (PbR) tools. In particular, the "partnership policies" sub-cluster includes a discussion of the role of the public sector, the private sector and other possible actors within the partnerships, including their respective advantages and benefits for the community; the "projects for sustainable development" category includes documents focused exclusively on the description of PPPs implemented in Europe; finally, the third sub-cluster contains the works relating to the topic of social impact bonds and pay by result instruments, their functioning and the definition of their characteristics.

The most evident proof of the analysis of this cluster lies in the actual lack of innovative systemic results. Most of the material collected is related to the analysis of case studies and best practices implemented in Europe in recent years.

In general, all authors agree that individual institutions (public and private) and alliances play an essential role in shaping and stimulating sustainable development; however, while there is consensus on the importance of partnerships for achieving shared goals, there are few practical cases of multi-stakeholder partnerships aimed at strengthening the partnership capacity of a wide range of relevant stakeholders.

Alongside the analysis of the roles assumed by the protagonists of the partnership, i.e., the public sector as a promoter of a project and the private sector as the contributor, the literature emphasizes the importance of the presence of a third figure who acts as an operational arm in sustainability projects: the third sector. The third sector is a crucial partner because it has necessary and specific skills, especially in interventions dedicated to inclusion and improving social well-being.

From an operational point of view, there is great interest in pay-by-result instruments and, in particular, in social impact bonds (SIBs); public-private partnerships very often work through SIBs. The strengths identified in the literature mainly concern the measurability of the impacts generated, the replication of projects and the ability to attract different types of investors.

Some authors, after analyzing and comparing the characteristics of social impact bonds and PPPs, have shown that SIBs and the PbR model can be perfectly overlaid on other partnership architectures based on SDGs. However, this topic of literature needs further investigation (Table 9).

## 4.2. Green economy and public spending: emerging trends

The process that follows the clusterization of sustainability-related topics in the public sector in four categories was put into relation to semantic maps related to the environment.

The logic behind this analysis must be sought in the awareness that today, policymakers from all over the world are oriented toward the search for sustainable solutions mainly linked to environmental aspects, such as uncontrolled climate change (Zhang et al., 2021) because private capitals seem to be not enough to produce groundbreaking solutions (Wu et al., 2021).

In this context, researchers have shown that the development of green finance (Liu and Tang, 2022) and green financial policies and regulations (Lamperti et al., 2021) can promote the modernization of industrial structure and society by mitigating climate change.

The prevalence of green-focus words can shed light on the level of attention given to environmental issues in the literature on sustainability topics in the public sector.

Therefore, to understand the greenness of our sample, we develop a coverage per article analysis through the R software, with the packages "tm" and "quanteda" that provide functions useful for the preprocessing and analysis of text data, including the calculation of word counts and frequency distributions (Hart et al., 2020; Müller, 2020). The output allows an understanding of the intensity with which different thematic areas considered within each cluster are addressed. The R code is available upon request. Text mining approaches, aided by R software packages "tm" and "quanteda," were utilized to preprocess and analyze the text data, including calculating word counts and frequency distributions. The coverage scores were determined by counting the occurrences of specific green-related terms mentioned in each article. This approach enabled an understanding of the intensity with which different green thematic areas were addressed within each cluster.

To identify all topics related to green aspects in our sample, we followed the approach of Chinn et al. (2020), in which they defined some topic dictionaries (or topic areas) and some related words.

The total number of strings analyzed is 92, of which three simple strings cover environmental elements such as "environment", "emissions" and "green". These strings were further paired with other words to have greater semantic relevance, for instance, "green climate fund", "green investments", "green financing" and "carbon emissions". Single strings such as "green" could be used within a context not relevant to the analysis (such as the evaluation of a variable with color codes - green, yellow or red). Also, the word "environment" has a connotation related to "context" and not to "ecology".

Then, we resumed all 92 words in some thematic areas and listed every article in our sample in which at least one of the words from these topic areas occurs as belonging to that topic.

In particular, we defined six thematic areas related to the greenest trending topics analyzed by the literature:

**Table 9**  
Cluster 4: PPP.

SOTTO CLUSTER	AUTHORS	METHODOLOGY	ANALYSIS UNITS	SEARCH RESULTS
<i>Partnership policies</i>	Alińska, Filipiak & Kosztowniak (2018)	Linear Regression Model (CLRM). Vector Error Correction Model (VECM).	Poland	Individual institutions (public and private) and partnerships play an important role in shaping and boosting sustainable development, by using specific tools and funding. Economic growth is significantly influenced by government actions: research confirms that there is a public sector impact on sustainable economic growth through public policy tools aimed at GDP growth (significant factors are spending policy and investment spending). The policy of partnerships between financial institutions and the public sector can justify the need to integrate private and state spending. The model analysis indicates that in countries of systemic transformation, such as Poland, it is important to stimulate consumer spending, since it has a share of about 40 % of GDP and has a positive impact on sustainable development.
<i>Partnership policies</i>	Horan (2019)	Qualitative comparison between two partnership "portfolios"	PPPs registered on the UN Department of Economic and Social Affairs (UNDESA) online platform	It is important to implement partnerships between winners and losers, to create support and adopt appropriate policies, and to start the necessary transformation to achieve the SDGs. In addition, PPPs may be needed to facilitate transformation, for example to incentivize low-carbon technologies. Finally, long-term transnational partnerships may be needed, for example for wind and solar energy. An example of a partnership to support transformation is the Just Transition Fund, which aims to create economic opportunities for communities on the front lines and most affected workers by the transition from coal.
<i>Partnership policies</i>	Grotenbreg & Buuren (2018)	Semi-structured interviews; document analysis; direct observations	40 stakeholders and public documents related to 4 Dutch PPPs	The degree of success of the 4 PPPs is different: The Oosterscheldekering case is the most successful one and all administrative capacities have been used. The capacities employed by public authorities to support innovation and projects are: Financial contributions (The availability of a large grant was a success factor in the Oosterscheldekering case and the lack of public funding is a major obstacle in the other cases); data sharing; coordination skills; regulatory power.
<i>Partnership policies</i>	Kamphof & Melissen (2018)	Collection of feedback and recommendations. interviews. multi-stakeholder seminar.	Professionals, experts, policy makers and international academics	SDG partnerships acquire a greater diplomatic and qualitative dimension, compared to 21st century PPPs, as they are co-creations of governments and companies working towards commonly understood global objectives with defined roles: governance for the public sector and enforcement for the private sector. The findings suggest that more public sector effort is needed to achieve the SDGs in terms of empathy, understanding of corporate sector identity, concerns, norms and habits. Furthermore, it is important to consider that companies have profit-oriented business models and therefore long-term sustainability goals should not hinder short-term business goals. Finally, the time factor for companies is more relevant than for the public so "too much governance" could discourage them.
<i>Sustainable development projects</i>	Bossink (2002)	Literature reviews, interviews, case studies	Interviews with 62 sustainable building experts; Case study on 6 sustainable building projects	The elements of a sustainable construction government policy are: environmental policy plans, performance-based laws and regulations: the government defines the level of performance; local authorities and individuals must work in line with the defined level; public-private arrangements (guarantees; financial incentives). Sustainable construction projects are developed by multidisciplinary teams who are activated at the start of the project and are stimulated to brainstorm their contributions to the sustainable innovation process.

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Table 9 (continued)

SOTTO CLUSTER	AUTHORS	METHODOLOGY	ANALYSIS UNITS	SEARCH RESULTS
<i>Sustainable development projects</i>	Chaves-Avila, Gallego-Bono(2020)	Qualitative analysis	Key policy papers, experts, mail questionnaires and focus groups. 21 in-depth case studies of the "best public policy cases".	The new PPFSE policy model focuses on transformative change, it follows the governance approach of the public-community partnership, the mainstream approach in the sense of a broader political context, and it is innovative in terms of means and complex systematization of strategies. Differences in terms of different approach to the construction of ES policies, different policy tools used, different degree of integration of ES policies into general government policy. Critical factors in the implementation of these policies: difficulties in the implementation of the partnership approach; in the deployment of the policy-mainstreaming approach; in the acceptance of the SE by all policymakers.
<i>Sustainable development projects</i>	Moreno-Serna,Purcell, Sánchez-Chaparro, Soberón, Lumbreras, Mataix. (2020)	Analysis of documents; Interviews; workshop	Partnership "El día despues" formed: Iberdrola, itdUPM, ISGlobal and SDSN Spain	El día después is defined as a partnership incubator. The results reveal that to foster sustainability-oriented PPPs and fuel impact-oriented projects aimed at advancing the SDGs, it is necessary to have a very flexible collaborative agreement, with all partners acting as facilitators. The strengths of the project are: Evolutionary logic and facilitation function distributed among all partners; No tendency to formalization: governance or contributions based on trust, common culture but non-permanent work structures, interaction of new flexible and agile organizations; active participation of the private sector and policy makers, combined with academia and civil society.
29 <i>Sustainable development projects</i>	Ferrer-Roca, Guia& Blasco (2020)	Interviews; Multistakeholder workshop	51 Stakeholders in the cross-border region of the Cerdanya Valley	Cross-border partnerships for SDGs must be able to activate institutional similarities and they have to know the barriers created by institutional differences and the methodological nationalism of local administrations in border areas. SDG8 and SDG10 are prioritized by business-led partnership, which must seek collaborative extensions with other actors in both neighbouring countries (SDG17).
<i>Sustainable development projects</i>	Koscielniak & Gorka (2016)	Document analysis	35 PPP projects implemented in the Silesia region	From the analysis of the implemented PPPs, it seems that most of the resources have been used for the sports, tourism and recreation sector. Urban regeneration projects rank second, while transport and communications are third. The main problem encountered relates to the bureaucratic procedures necessary to conduct the entire project selection protocol. Furthermore, it is extremely difficult to prepare PPP projects within the defined frameworks and times, such as the EU Calls. Regarding cities implementing PPP projects, Częstochowa presented 6 projects, Żory - 5 projects and Katowice - 4 projects.
<i>Sustainable development projects</i>	Stafford-Smith, Griggs, Gaffney, Ullah, Reyers, Kanie, Stigson, Shrivastava, Leach & O'Connell. (2017)	Qualitative analysis approach.	SDGs	The article presents an integrated approach on the means of implementation of the objectives identified by SDG 17. It provides a synthesis of the 7 main means of implementation by associating each with the key challenges, the necessary link with one or more of three areas (sectors, country, actors), and related global and national recommendations. The 7 categories of means of implementation must form a virtuous system (implemented in an integrated way), in which all address integration issues in a coherent and self-reinforcing way. Both the objectives and the means of implementation themselves (global governance challenge) need to be integrated.

(continued on next page)

Table 9 (continued)

SOTTO CLUSTER	AUTHORS	METHODOLOGY	ANALYSIS UNITS	SEARCH RESULTS
<i>PBR</i>	Kabli, Rizzello, Trotta. (2021)	Document analysis	4 Impact Bonds: 1 DIB (Educate Girls) and 3 SIB launched in different geographical areas of the world such as USA, China, France and Russia	The paper analyses the opportunities related to the adoption of SIB in the field of education; First, the ability to measure results makes it possible to attract financial support; secondly, the replicability of the SIB structure makes it possible to attract different types of investors. More generally, the role of IBs in attracting private capital for the education sector could be the main alternative to the public budget. For these reasons, in a post-COVID world, they represent an essential tool for communities in mitigating the negative impacts produced by the pandemic.
<i>PbR</i>	Rizzello & Kabli (2020)	Document analysis	4 SIBs related to various social issues: London Homeless Social Impact Bond; DWP * Round II of the Innovation Fund; The Ashaninka DIB; Educating girls	The key processes through which SDG-based partnerships can create additional value are: defining and evaluating the collaborative advantage of the partnership; structuring of financing and implementation of the partnership; measurement and evaluation of the final value. The phases and activities of the SDG-based partnerships resulting from the literature match perfectly with those of each case study analysed. This allows SIBs to be included in the financial partnership schemes for the SDGs.
<i>PbR</i>	Fraser, Tan, Lagarde & Mays (2018)	Literature review	101 documents relating to SIBs	Three main themes have been identified in the literature: the first concerns public and private values competing with each other, i.e. the extent to which the public sphere should be influenced by the values of the private sector and vice versa; the second theme concerns the introduction and the importance of measuring the results in the contracting of public services thanks to financing mechanisms such as SIBs; the third theme concerns the transfer and calculation of risk between the different actors through SIB mechanisms and the ideological and practical implications that this can have for specific services and policies more generally.

- Green regulatory framework, in which words converge that refer to the semantic domain of policy or a specific regulatory framework, such as environmental policy (occurs 130 times) or UNEP (occurs 36 times);
- green project-specific, which includes all words that refer to specific projects aimed at promoting green change or mitigating and solving the most affected problems related to environmental issues, such as emissions (363 times) or energy (1621 times);
- green problem-oriented, in which all the more general terms related to environmental issues converge, such as climate change (which is used 211 times) or environmental (150 times);
- green accounting, budgeting and reporting, into which all terms related to operational, accounting and communication management of environmental issues fall, such as environmental reporting (used 87 times);
- green finance and products, in which all terms related to purely financial aspects are included, such as green investments (repeated 30 times);
- green indicators, in which all terms related to the evaluation and measurement of the adopted green solutions are grouped, such as environmental assessment (occurs 80 times) and environmental results (33 times).

Finally, we analyze the four main clusters through a green lens, trying to understand the relationship between each cluster and each green thematic area (Table 10).

The quantitative analysis identified the distribution of green focus in each cluster based on the frequency of specific green-related terms within the papers.

Papers that fall into cluster 1 have the most references related to the "green problem-oriented" thematic area since they first analyze and recognize problems related to the environment and then try to develop ad hoc policies. Cluster 1, focused on sustainable development planning, showed a higher emphasis on terms such as "environmental policies," "green economy," and "green policies" which underscores the commitment of these publications to finding solutions that balance economic growth with environmental protection. The authors discuss the need to prioritize green and sustainable policies that align with the SDGs, with particular attention to energy and climate change issues. Researchers have recognized the importance of integrating environmental policies and programs such as UNEP, the United Nations Environment Programme referenced in several studies, into planning processes to ensure effective measures to combat climate change and reduce emissions.

Cluster 2, which revolved around sustainability accounting, exhibited several publications discussing the allocation of resources and financial commitments by local authorities to address environmental issues. The studies explore the relationship between budgetary decisions and their impact on the environment, as well as the effectiveness of financial policies in mitigating climate change and reducing environmental impacts. Some researchers in this cluster have focused on analyzing greenhouse gas emissions and their connection to fiscal and budgetary measures. They investigate causal relationships between emissions and various fiscal tools, aiming to understand how countries can better address climate change through financial means (Florea et al., 2021). Moreover, several studies emphasize using social and environmental indicators to evaluate public spending. These indicators are often used to assess the effectiveness of budgetary allocations and to measure progress toward achieving sustainable development goals. One paper also provides a specific analysis of environmental accounting (De Matteis et al., 2021). Although insignificant in terms of frequency, Environmental accounting can offer valuable insights into the actual costs and benefits of policies and projects, leading to better-informed decision-making that supports environmental protection and renewable energy-related policies.

Cluster 3, dealing with measurement tools, showcased a prominence of green-focus words such as "energy", "green and public spaces", "renewable sources" and "environmental protection" highlighting the cluster's attention to green technologies and environmentally friendly projects. It suggests a commitment to finding solutions that support ecological balance, reduce emissions and minimize environmental degradation. Furthermore, the cluster's research encompasses comparative analyses between regions and countries, identifying variations in environmental project performance. Terms like "North/South divide" underscore the authors' interest in exploring regional disparities and proposing targeted interventions for achieving sustainable outcomes. In this cluster, references to the green indicators theme are present but not predominant: this means that the measurement tools developed by the public administration are mainly focused on the social pillar or comprehensive sustainability, not only the environmental aspect.

Cluster 4 centers the attention around sustainable partnerships and impact-oriented projects; it exhibits a higher prevalence of green-focus words such as "energy," "climate," "climate.change," "environmental.policies," "emissions," and "environmental.domain." The prominence of "energy" highlights the significance of sustainable energy solutions within the context of these partnerships and projects. The frequent mentions of "climate" and "climate.change" underscore the focus on addressing climate-related challenges and their impacts. Including "environmental.policies" and "emissions" emphasizes the integration of environmental considerations and efforts to measure and reduce emissions within the initiatives. These prevalent green-focus words align with the topics covered in this cluster's publications, indicating a strong commitment to addressing environmental and climate-related issues through collaborative and impact-driven approaches.

The observed emphasis on case studies related to stand-alone green projects may be attributed to their practicality and real-world applicability, making them more accessible for research purposes. Case studies provide tangible examples and outcomes of sustainability initiatives in public administrations. On the other hand, the relative lack of focus on financing methods such as green bonds or green finance could be due to challenges in obtaining detailed financial data, limited availability of case studies on such financing instruments in the public sector, or potential research interests that prioritize tangible project outcomes over financial mechanisms.

## 5. Conclusion

This work analyzed the main research trends on sustainable finance in the public sector, exploring the approaches and tools that

**Table 10**  
Coverage per article summary.

CLUSTER	GREEN REGULATORY FRAMEWORKS	GREEN PROJECT-SPECIFIC	GREEN PROBLEM-ORIENTED	GREEN ACCOUNTING, BUDGETING & REPORTING	GREEN FINANCE & PRODUCTS	GREEN INDICATORS	TOTAL
CLUSTER 1	87	123	147	11	17	33	418
CLUSTER 2	80	227	242	36	8	85	678
CLUSTER 3	74	1617	514	77	19	109	2410
CLUSTER 4	54	197	127	2	17	14	411
TOTAL	295	2164	1030	126	61	241	

can be adopted and adopted by the public administration in the last 30 years, with specific reference to the European context. The analysis was developed using a systematic literature review relating to a final sample of 82 works, appropriately constructed by defining a series of inclusion criteria.

The descriptive analysis shows how the interest of researchers towards these issues is a relatively recent phenomenon, prompted by the actions and pressures of the international and European community: in fact, most of the collected works were published after 2015, with a trend exponential in recent years. Furthermore, much of the material is of a technical/applicative nature, and, for the most part, oriented towards the definition of new measurement tools or the adaptation of existing frameworks.

The main perspectives on which the literature focuses can be traced back to 4 clusters: measuring tools (46 %), planning for sustainable development (19 %), sustainability accounting (18 %), and PPP (17 %).

The analysis of unexplored or unsolved research questions represents the main contribution of this work, helpful in orienting future research in a functional way to meet the needs of policymakers.

The conducted systematic review shows that the research is currently at an early stage of exploration; a more significant effort of analysis is needed, both from the perspective of measuring the impact of public policies and in the budgeting of public spending, also from a public-private partnership perspective.

In particular, the strategic planning process of the public administration does not support the substantial integration of sustainability aspects in land management; furthermore, there is no link between strategic planning of sustainability and financial planning of public spending; however, some pilot initiatives have emerged, developed mainly at the local level, which could lead the way, and be replicated at multiple levels in an integrated way, within a more structured framework.

From the accounting point of view, research analyses the efficiency of public spending, especially concerning defined environmental policies; in fact, there is a lack of analysis that integrates environmental and social accounting with financial accounting; the perspective regarding the measurement of the impacts generated by the public investments made and the transparent disclosure methods is also limited.

The literature tends to focus more on the topic of measurement and the definition of sustainable development indicators - or some individual aspects of sustainability; the opinions on the set of "ideal" indicators to measure and monitor the sustainability reached and pursued by the P.A. are very discordant: there are those who lean towards the construction of a few synthetic indicators and those who, on the contrary, believe in the need to have a multitude of indicators specialized in a single sector. Some promote the adoption of a national framework to be applied to different territorial levels, and those, on the contrary, tend towards the definition of specific measurement tools capable of reflecting the characteristics of the individual territory. There is a need to continue the studies aimed at defining a model that can anchor tailor-made indicators to universal frameworks that are comparable in time and space.

Finally, the literature on the strategic role of public-private partnerships and pay-by-result financial architectures is still young: most of the literature is conceptual and focused on cost-benefit theories and analysis. At the same time, other specific works for experiments lack in formulating models of universal validity.

A transversal reading of the evidence that emerged can be helpful in the development of the literature that can combine research needs - towards less explored perspectives - with those of policymakers - interested in finding new models and tools to integrate sustainability in public policies.

In this perspective, the indications of this study converge in a natural synthesis, highlighting the vital interrelationships between the various research clusters that have been identified. The common thread can be traced to the need to adopt a strongly holistic and transversal approach to the various fields of investigation; it is not possible to implement correct sustainability strategies without considering the financial planning of public expenditure; this approach, however, requires integrated accounting models which, to date, are lacking in the public administration; these models are an indispensable condition for a correct measurement of the impact and the measurement frameworks influence them; public strategies of sustainability, accountability, measurement and disclosure are the levers to establish credible and effective public-private partnerships.

The systematic literature review revealed the prevalence of environmental aspects in each cluster, with energy and climate change prominently mentioned across all clusters. The emphasis on case studies indicates the practical significance of green projects in public administrations. At the same time, the relative lack of focus on specific financing methods calls for further research and attention to innovative green finance instruments. Addressing the identified research gaps is crucial for advancing sustainability efforts in



European public administrations, promoting green investments, and fostering informed decision-making for a greener and more sustainable future. Finally, the literature review revealed several research gaps and limitations. One significant gap is the need for more comprehensive investigations into the effectiveness and impact of specific green finance instruments, such as green bonds, in supporting sustainability initiatives in public administrations. Additionally, there needs to be more research on integrating sustainability into overall financial management practices within the public sector. Further studies are essential to understand the potential risks and challenges associated with green finance implementation and to develop practical guidelines for policymakers and practitioners.

## Conflict of interest

None.

## Data availability

Data will be made available on request.

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