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Towards a practical guideline for regional sustainability assessment using composite indicators - a literature review

La mise en place d'un guide pratique pour évaluer la durabilité régionale à travers les indicateurs composites – une revue de littérature

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Abstract

Regional sustainability assessment has become increasingly important for both scientists and policy-making decisions, as evidenced by the rising amount of academic literature dedicated to this topic. Composite indicators (CI) have remained an assessment tool that is highly appreciated by decision-makers for its ability to summarize a set of indicators into a single index. However, the lack of a unanimously accepted theoretical framework makes the process of composite indicator construction dependent on multiple contextual variables such as the geographical context (national or sub-national), stakeholders' priorities and data availability. This review paper aims to describe the state of the art in the literature regarding the construction of composite indicators measuring sustainable development at the regional scale and deduce a practical guideline. The review is structured by a set of criteria, derived from the literature, which we consider mandatory for setting up relevant, useful, and meaningful composite indicators at the regional scale that might be adopted by stakeholders. Our main finding is that a CI's relevance depends not only on its robustness but also on the assessment context and the stakeholders' involvement. Moreover, we argue for including "governance" as a dimension of sustainable development.

Keywords : Sustainability assessment; Composite indicators; Participatory approach; Governance; Regional sustainability.

Résumé

L'évaluation de la durabilité régionale est devenue de plus en plus importante pour les scientifiques et les décideurs, comme en témoigne la quantité croissante de articles scientifiques consacrés à ce sujet. Les indicateurs composites (IC) sont demeurés un outil d'évaluation très apprécié des décideurs pour leur capacité à synthétiser plusieurs indicateurs en un seul indice. Toutefois, en l'absence d'un cadre théorique unanimement accepté par la communauté scientifique, le processus de construction d'indicateurs composites dépend de multiples variables contextuelles, comme le contexte géographique (national ou infranational), les priorités des parties prenantes et la disponibilité des données.

Cet article vise à décrire l'état de l'art dans la littérature concernant la construction d'indicateurs composites mesurant le développement durable à l'échelle régionale et à en déduire un guide pratique à utiliser par les parties prenantes locaux. Cette revue est structurée autours d'un ensemble de critères, tirés de la littérature, que nous considérons comme des pré-requis pour construire des indicateurs composites pertinents, utiles et significatifs à l'échelle régionale qui pourraient être adoptés comme outils de prise de décision. Notre principale conclusion est que la pertinence d'un indicateur composite dépend non seulement de sa robustesse, mais aussi du contexte de l'évaluation et de la participation des acteurs locaux ; ainsi que nous recommandons l'inclusion de la « gouvernance » comme dimension du développement durable.

Mots clés :L'évaluation de la durabilité; Indicateurs composites; Approche participative; Gouvernance ; la durabilité régionale.

Introduction

Regional sustainability assessment using indicators has become extremely important for science and policymaking, as confirmed by the increasing number of academic publications dedicated to this topic. Moreover, composite indicators (CIs) have remained a highly appreciated assessment tool by decision-makers for their ability to summarise a set of indicators into a single index. However, the lack of a unanimously accepted theoretical framework makes the CI construction process depend on multiple contextual variables and stakeholders' priorities, such as the geographical context (national or sub-national).

This review aims to analyse technical steps to build CIs and investigate the preconditions to design and implement these evaluation tools.

For proceeding this paper aims to answer the following question: **What are the prerequisites conditions and steps to build a composite indicator to assess regional sustainable development?**

Firstly, we introduce two concepts: governance and participatory approach, as a cornerstone of each evaluation procedure.

Governance is the process by which public policy decisions are made and implemented. It results from interactions, relationships and networks between the different sectors (government, public sector, private sector and civil society) and involves decisions, negotiation, and different power relations between stakeholders to determine who gets what, when and how (UNDP, 2009). The relationships between government and different sectors of society determine how things are done and how services are provided.

On the other hand, Participatory approaches have grown in popularity over the past 30 years and are now commonplace in development projects (Bruges and Smith 2007). Participation assumes the involvement of stakeholders in the decision-making process to design, plan and implement SD projects.

Building CIs at the regional scale cannot be achieved without combining local stakeholders' knowledge with researchers' team expertise. Local stakeholders (e.g. policy-makers, civil society, private sector are the best positioned to understand the population needs and requirements; they can depict regional issues, development priorities, and data availability. Good governance implies a participatory approach that cannot be achieved without good regional governance.

The review purpose is to set whether the governance as an SD dimension was considered through the CIs construction steps; also how the stakeholder's participation has taken place, and throughout which stage of the CI construction.

In addition, we aim to describe the literature review on the CI construction method to measure sustainable development on a regional scale and derive practical guidelines. We structured this review using a set of steps resulting from the literature review. These steps are necessary for setting up relevant, helpful, and meaningful CIs on a regional scale that stakeholders might adopt. As a result, we set up a guideline composed of the prerequisite steps and conditions for creating CIs to measure regional sustainability. Our main finding is that a CI relevance depends on its robustness, assessment context, and stakeholders involvement. Moreover, we highlight the need to include the governance dimension in creating CIs.

For proceeding, we conducted a literature search using three bibliographical databases: Scopus, Google Scholar, and Web of Science. The terms of research were "regional sustainable development", "sustainable development & region", "regional sustainable development assessment", "regional sustainable development assessment & indicators", "regional sustainable development assessment & composite indicators", "regional sustainable development & composite indicators", "sustainable development & governance", "regional governance & sustainable development". This query resulted in about 120 articles published between 2004 and 2020.

We have reviewed this literature and identified 55 articles analysing the assessment of RSD using indicators. Finally, we narrowed this set down to 11 articles (regional and local cases) which describe the composite indicator construction processes. We kept only articles that explained the different steps of creating the composite indicator. Based on this review (Table 1), we present our findings using two levels of analysis (indicated by Roman numerals) that comprise five components (indicated by Arabic numerals):

- (i) CI construction process: (1) The theoretical framework, (2) the criteria for selecting indicators, and (3) the technical steps of constructing the CI.
- (ii) The prerequisites conditions for leading the assessment process: ((4) regional governance and (5) the participatory approach (PA)).

The order in which the various components are presented follows the logic behind the construction of the CI. For proceeding, we will present the subsequent steps to build the CI, and then, analyse the conditions to build a thriving regional CI. Finally, we summarise our findings in the form of a guideline for building CI for assessing regional sustainability.

1- The composite indicator construction process for measuring regional sustainable development: the literature review

1.1 The theoretical framework

The starting point of the composite indicator construction procedure is setting up the theoretical framework. This section analyses the relationship between CI's theoretical framework and the four dimensions of SD.

We analysed the following questions related to the theoretical framework to structure the review of the selected papers: 1) What is (are) the CI goal (s)? 2) Which activity sectors were evaluated by the CI ? 3) Which stakeholders were involved during the construction process ? 4) How many dimensions compose CIs?

Based on the literature review, three goals underpin the creation of CI to assess RSD:

- Supporting policy-makers in planning and monitoring SD policies (Yang et al. 2014);(Clerici, Bodini, and Ferrarini 2004);(Shaker and Sirodoev 2016);(Kondyli, 2010);(Floridi et al., 2011);
- Assessing the contribution of various activities to RSD (Chopin et al., 2017), (Pérez et al., 2013), (Blancas et al. 2011), (Roberta Arbolino, 2015), (Ernest Reig-Martınez, 2010);
- Measuring regional sustainable well-being (Ciommi et al., 2017).

One of the missing points in the literature review is explaining criteria based on activity sectors are selected as a scope and goal of the assessment. Table (1) shows that almost half of the cases studied in this review assess SD without indicating which activity the evaluation concerns. The other half has restricted evaluation to specific activity sectors. The characteristics of each region, the economic and social weight of each activity, environmental pressures, and SD goals may influence the choice of the assessment scope

Following this, we investigated the CI structure and components. Table (1) presents the dimensions forming CIs for each case studied and the CIs assessment goals. Most of the cases studied in this review assess economic, environmental, and social dimensions. However, only two cases included the governance dimension as a component of SD. The following section will detail the criteria used to select indicators forming the CI.

Table 1: Goals, activity sectors, and dimensions assessed by the CI

Reference	Composite Indicators	CI goals	Activity sectors	Dimensions	Variables	Nb. Of Ind.
(Yang et al. 2014)	Coordinated Development Index	Assessment of the RSD	All activity sectors	Environmental	Sources – Sinks	8
				Social	Demographics - Quality of life	7
				Economics	Economic development - Green economy	5
(Chopin et al., 2017)	Dashboard of regional indicators	Assessment of the contribution of agriculture on the RSD	Agricultural sector	Economics	Improving agricultural income; decreasing dependence on subsidies; achieving food self-sufficiency; contributing to employment	4
				Social	Ensuring the safety of locally produced foodstuffs	3
				Environmental	Improving biodiversity; enhancing water quality; reducing the contribution to climate change; preserving non-renewable resources; improving the diversity of agricultural landscapes	9
(Pérez et al., 2013)	Composite indicator for the assessment of sustainability: The case of Cuban nature-based tourism destinations	Assessment of the regional sustainability	Touristic sector	Economics	Quality of tourist stay (restaurant, hotel)	14
				Social	Transportation infrastructure; gender approach; quality of public service; employment of local residents	11
				Patrimonial	Energy; waste; water; pollution; patrimonies	14
(Ciommi et al., 2017)	Composite index of well-being	Measuring regional well-being	All activity sectors	Economics	Research and innovation;	3
				Social	Health; education; work and life balance; Economic well-being; social relationship; security; landscape and cultural heritage	24
				Environmental	Environment	4
				Governance	Quality of service; politics and institutions	10
(Clerici, Bodini, and Ferrarini 2004)	Aggregated indices for assessing environmental performance	Assessment of the environment at the local scale	All activity sectors	Economics	Economic issues	2
				Social	Social issues	2
				Governance	Administrative issues	3

				Environmental	Waste; air quality; resource consumption;	13
(Shaker and Sirodoev 2016)	Local sustainable development index	Assessment of the national SD strategy at the local scale	All activity sectors	Economics	Income; technology;	2
				Social	Household abundance; structural composition; public health; psychology; education	7
				Environmental	Goods production; transportation; utility services	6
(Blancas et al. 2011)	DPC (Distance–Principal Components) composite indicator	Assessment of the sustainability of touristic activity at rural destinations	Touristic sector	Economics	Infrastructure; creation of tourist itinerary and the route; destination competitiveness; transport-related to tourism; tourism employment; tourist activity seasonality; tourist offer — providing a variety of experiences; development control; sustaining tourist satisfaction; economic benefits of tourism for the host community and destination	37
				Social	Social-cultural effects of tourism on the host community; local public safety; conservation of the cultural heritage; effects on the local population structure; social-carrying capacity of the destination; effects on levels of well-being among the local population;	26
				Environmental	Protection of the natural ecosystems; energy management; water availability and conservation; solid waste management; wastewater treatment; atmospheric pollution; management of the visual impact of facilities and infrastructure; use intensity; environmental management	29
(Roberta Arbolino, 2015)	A composite indicator called "industrial environmental sustainability index" (IESI	Measuring ecological industrial policies	Industrial sector	Natural resources; management		19
(Ernest Reig-Martınez, 2010)	Composite indicator based on 12 indicators (	Ranking farms with a composite	Agricultural sector		The income of agricultural producers; the contribution of agriculture to GDP; insured area	3

	farm sustainability)	**index of sustainability**		**Social**	**Agricultural employment; stability of workforce; risk of abandonment of agricultural activity; economic dependence on agricultural activity;**	**4**
				Environmental	**Soil cover; nitrogen balance; pesticide risk; energy balance; agro-environmental subsidy areas**	**5**
(Floridi et al., 2011)	**The sustainability index**	**Assessing the relative sustainability of the Italian Regions**	**All activity sectors**	**Economics**	**GDP; income; R&D; labor productivity; employment;**	**12**
				Environmental	**Climate change and energy; sustainable transport; sustainable consumption and production**	**13**
(Kondyli, 2010)	**Regional composite indicator**	**Assessment of RSD**	**All activity sectors**	**Economics**	**Size of an economy; the productive structure of an economy; the degree of specialisation of an economy**	**3**
				Social	**Population size; population structure; the degree of cohesion of a society**	**11**
				Environmental	**Quantity and quality of environmental resources**	**6**

Source: Author

1.2 Criteria for selecting indicators

Selecting indicators is a challenging task. They should be associated with policy goals resulting from stakeholder input, rational decision-making, and compromise (Visvaldis, Ainhoa, and Ralfs, 2013). In addition, experts are responsible for ensuring their scientific validity (measurable, relevant, and specific) and providing policy-makers with answers about different sustainability issues (Shaker and Sirodoev 2016).

Each CI comprises several single indicators covering at least one SD dimension. The choice of indicators can be contested if the selection method is not transparent or not set based on accepted criteria. Moreover, indicators need to be SMART (specific, measurable, attainable, relevant, and time-scaled). Thus, several attempts have sought to set up a theoretical framework for selecting SD indicators.

(Kibert, 1998) proposed thirteen criteria for selecting indicators: 1) Community involvement: were they developed and acceptable by the "stakeholders" related to the problem handled? 2) Linkage: do they link environmental, economic, and social issues? 3) Valid: do they measure something related to the system status? 4) Available and timely: can the data be collected annually? 5) Stable and reliable: compiled using a systematic and fair method? 6) Understandable: simple enough to be interpreted by laypersons? 7) Responsive: do they

respond quickly and measurably to changes? 8) Policy relevance: relevance to public or corporate policy? 9) Representative: as a group, do they cover the main dimensions of the focus area? 10) Flexible: are they essential to use regardless of whether data is not readily available, considering the data might be available in the future? 11) Proactive: do they act as a warning rather than measure an existing state? 12) Long-range: do they focus on the long-term? 13) Act locally, think globally: do they promote sustainability at the expense of others?

(EEA, 2005) considered nine criteria for selecting indicators: 1) Policy relevance, 2) progress towards policy targets, 3) understandability of the indicator, 4) and part of EU priority policy issues, 5) availability of routinely collected data, 6) spatial coverage of data, 7) temporal coverage of data, 8) national scale and representativeness of data, and finally, 9) an indicator needs to be methodologically well-founded (Niemeijer and de Groot, 2008).

Other authors highlighted the necessity of involving stakeholders in selecting indicators and promoting the PA (Kurka and Blackwood, 2013). Whatever criteria are considered, they must meet regional policy-makers goals, be meaningful, non-redundant, and relevant to the end-user. Many criteria have been identified through this review, such as relevance for regional policy-makers, data availability, and scientific validity (appendix 1). However, in most cases studied, two criteria are regularly considered: data availability and relevance for policy-makers.

Once the criteria are selected, experts and scholars must determine how many indicators will encompass the CI. (Kibert, 1998) suggests a list of 100 indicators to set 15 or 20 final indicators; (Visvaldis, Ainhoa, and Ralfs, 2013) consider that the number of indicators should be practical and applicable in addressing and identifying the region's policy goals and development priorities; (Morse, 2003) suggests using 21 indicators to resonate with Local agenda 21.

We conclude a lack of standard guidelines for selecting indicators; they range from 12 (Ernest Reig-Martınez, 2010) to 92 (Blancas et al. 2011) or 100 indicators (Kibert, 1998) depending on each context and the CI theoretical framework. The following section describes the technical steps for building CI.

1.3 Composite indicator construction: The technical steps

A composite indicator (CI) is an aggregation of indicators or sub-indicators with no standard unit of measurement and no obvious way to assign weights to them. Every CI can be considered as a model, and such as it is created for a specific purpose. Its construction must follow a series of steps to be valid and generally accepted" (Kondyli, 2010). CIs should provide information on the interaction between the SD dimensions and their impact on sustainability; this interaction results from the absence of boundaries between dimensions. CIs can summarise and simplify a

complex reality by combining variables from different dimensions and units into a single index. Table (2) summarises the advantages (pros) and possible drawbacks (cons) of CIs (Michela Nardo, 2005).

Table 2: Pros and cons of composite indicators

Pros	Cons
- Can summarise complex, multi-dimensional realities to support decision-makers - Are easier to interpret than a battery of many separate indicators. - Can assess progress, regions, and countries over time. - Reduce the visible size of a set of indicators without dropping the underlying information base. - Facilitate communication with the general public (e.g., citizens, media) and promote accountability. - Help to construct/underpin narratives for lay and expert audiences.	- May send misleading policy messages if poorly constructed or misinterpreted. - May invite simplistic policy conclusions. - May be misused (e.g., to support the desired policy) if the construction process is not transparent or lacks sound statistical or conceptual principles. - The selection of indicators and weights could be the subject of political dispute. - May lead to inappropriate policies if dimensions of performance that are difficult to measure are ignored.

Source: OECD, *Handbook on Constructing Composite Indicators*. 2008

We can apply a similar procedure to build a CI, whether on a national or regional scale. However, the main difference is how indicators are selected, weighed, and aggregated. On the regional scale, stakeholders are more involved in the different phases of the indicator's construction; they bring their knowledge to set the assessment goals and select indicators. As a result, RSA is a more bottom-up construction process than the national scale, which is generally top-down and led by the central government.

In this context, the (OECD, 2008) produced a handbook on constructing CIs that details steps and methods for producing this evaluation tool, summarised as follows:

1. A theoretical framework provides the basis for selecting variables for the CI; stakeholders should be involved in setting up the CI goal;
2. Appropriate indicators must be selected based on specific criteria; we can use proxy variables or impute data when it is scarce or missing;
3. The Multivariate analysis investigates the dataset's overall structure, assesses its suitability, and guides subsequent methodological decisions;
4. Indicators are normalised to be comparable;

5. Weighting reflects the importance given to indicators and SD dimensions in the CI structure;
6. Aggregation compiles indicators into a single index;
7. Analysing the CI robustness regarding the various choices made in the construction procedure.

Although, four steps require detailed consideration and analyse during this review:

- **Normalisation:**

Normalisation is required to ensure the comparability of indicators despite their different units of measurement. However, selecting a suitable normalisation method is not a simple task and requires special consideration, such as data proprieties and availability. The most used methods are standardisation (z-scores) (transforms the indicators into variables with zero mean and standard deviation equal to one) (Ciommi et al., 2017) and the Min-Max method (changes the range of variation of the indicators into the interval [0,1]) (Ernest Reig-Martınez, 2010).

Moreover, experts can combine various normalisation methods such as Z-scores with the "Borda count" method by setting the regional performance on an ordinary scale, giving (n) points to the best performance and (1) points to the worst.

(Floridi et al., 2011) used the "Min-Max" method, "distance from the leader," and "distance from the mean" to normalise indicators. (Kondyli, 2010) used the "distance from the best and worst performers" method that positions each area concerning the global maximum and minimum; the index created takes values between (0) and (100).

- **Weighting:**

Weighting reflects the importance given to single indicators into the composite indicator structure. According to the (OECD, 2008), the most used weighting methods are 1) the equal weight, 2) the principal component analysis (PCA), 3) the benefit of the doubt, 4) the regression analysis, 5) the unobserved component models, and 6) the participatory-based methods such as budget allocation, public opinion, analytic hierarchy process (AHP), and conjoint analysis.

The simplest method is the equal weight between indicators, which considers all indicators equally important. This method is used for building many indices, such as the Human Development Index (HDI, UNDP, 1990) and the Genuine Saving Index (GSI, World Bank, 1999). However, weighing indicators with statistical methods aims to reduce subjectivity, determine whether a correlation exists between indicators, and reduce the double weighting among indicators. Finally, participatory-based methods aim to involve public opinion (e.g.,

local stakeholders) to give their preferences of indicators based on their knowledge of local concerns and priorities in SD policies.

- **Aggregation:**

Aggregation methods compile the weighted indicators into a single index following mathematical procedures. We identified three main aggregation methods: 1) additive aggregation methods, such as the arithmetic mean (Shaker and Sirodoev 2016, Floridi et al., 2011), 2) geometric aggregation methods for avoiding compensability between indicators (Floridi et al., 2011), and 3) non-compensatory aggregation methods by using multi-criteria approaches (OECD, 2008).

The aggregation method may impact the outcome and influence the end user's decisions (e.g., policy-makers) because it directly impacts the CI score. Therefore, an appropriate aggregation method should be selected carefully depending on the dataset structure, the theoretical framework, and whether compensability (partially or entirely) among dimensions or indicators is allowed or not.

- **Robustness analysis:**

The robustness test analyses the choices carried out during the CI construction procedure; the quality of a ranking system depends on its assumptions' soundness. Good practices require assessing the development process uncertainties (Munda and Saisana, 2011). CI robustness refers to two analysis levels:

  - Uncertainty analysis (UA): UA focuses on how uncertainty in the input factors propagates through the CI structure and affects its value.
  - Sensitivity analysis (SA). SA studies how much each source of uncertainty contributes to the output variance (M. Saisana, 2005). It studies how the output variation can be apportioned to different sources of variation in the assumptions and how the composite indicator depends on its information (OECD, 2008).

When to use what?

The choice of normalisation, weighting, and aggregation methods has to be well-founded because producing CIs is inherently a subjective procedure (Morse, 2003) and selecting appropriate methods is a big challenge (Gan et al., 2017), (Tarantola, 2002). Aggregation methods may impact the relationship between indicators. For example, arithmetic aggregation allows full compensability between indicators and offsetting a deficit in some dimensions with an outstanding performance in others one (e.g. the substitutability between dimensions allows

us to use, for example, an economic indicator instead of an environmental one in the weighting system).

As a result, weighting and aggregation methods impact the CI results. Consequently, the ranking of regions or countries depends on which methods are used (Dialga and Thi Hang Giang, 2016). Moreover, the CI score will not be the same using arithmetic or geometric aggregation. The aggregation method choice also depends on the end-users (e.g., researchers or the general public) (Matteo Mazziotta 2013). It can be simple (e.g., HDI) or complex using multivariate methods (e.g., PCA).

The following section presents the prerequisite conditions for building CIs and analyses the impact of regional governance and participatory approaches on sustainability assessment.

2- The prerequisite conditions for building regional composite indicators

This section analyses two factors that can positively or negatively affect the result. Our finding is that the CI construction should not be limited to technical methods but consider the assessment context and stakeholders' commitment.

2.1 Regional governance

2.1.1 Definition of the governance concept

Governance is like sustainability, a highly contested concept (Hezri and Dovers, 2006), yet supported by the WB (World Bank) and the Local Agenda 21, which recognise governance as a fundamental condition for achieving development programs worldwide. First, we must explain why we prefer using the concept of "governance" instead of "institutional" as a dimension of SD. According to economic and social sciences, the institution concept refers to the interaction between an organisation and humans and includes decision-making conditions inside an organisation (Thomas Halk, 2007). As an institution, the State can plan global strategies of SD on a national scale. However, it cannot do so without the participation of other stakeholders, such as private and civil societies. These stakeholders work together with policy-makers in regions to plan, implement, and monitor policies. Therefore, governance requires stakeholders participation in the decision-making and implementation of regional policies (Sobol and Platje, 2008).

Governance has no single meaning. In the literature, definitions range from the very broad (encompassing a plethora of stakeholders) to the ones more focused on the behaviour of public agents (or how power is exercised) (Da Cruz, 2016). Governance encompasses several topics, like transparency, accountability, justice, decision-making processes, gender approach, stakeholders participation in political life.

Regional governance for SD is popular in territorial management. It enables local stakeholders to set up and monitor development strategies. Hence, policy power needs to be decentralised from the national to the regional level. Decentralisation means the partition of power between particular government levels and inhabitants participation in decision-making and the implementation of SD projects (Sobol and Platje, 2008). Local actors are best equipped to set up plans that integrate the three dimensions of SD because of their knowledge of regional issues, setting goals that meet citizens' expectations, access to the information system, assessment, and monitoring by local electors.

This review does not provide much information about the role of good governance in the regional assessment process. However, we identified two examples illustrating its importance in the local context. The first case concerns the Italian regions where regional policy-makers have set up legislation adapted to environmental issues and support sustainability performance in the industrial sector through fiscal incentives (Roberta Arbolino, 2015). The second case concerns the Campos County region in Spain where policy-makers implement agricultural policies to impact farms sustainability and directly influence their strategic orientation toward sustainability. Good governance should not be reduced to administrative efficiency; it has to question which mode of governance may lead a region to achieve sustainability (Shipley and Kovacs, 2008).

However, weak governance leads to failing local sustainability assessments. Moreover, governance is impacted by the weak political commitment of decision-makers, the lack of stakeholders involvement, the bureaucracy of local authorities, and the weak coordination between the central government and regional policy-makers in SD assessment (Moreno Pires and Fidélis 2015). The unavailability of financial resources may also cause problems in assessing RSD (Zilahy and Huisingh 2009).

Good governance of the regional policies aims to implement a decision system that involves stakeholders and promotes the PA (Zilahy and Huisingh 2009). In addition, it implies that policy-makers have to be conscious of SD issues, set up sustainable policies, integrate local priorities, and provide adequate tools to evaluate them. Therefore, SD strategies require good governance, institutional reforms, and citizen involvement.

2.1.2 Governance connection with SD dimensions

Various scholars hold opposing views on the impact of good governance on economic growth. Nevertheless, a significant number of econometric analyses reveal a strong correlation between long-term economic performance and good governance (SK., 2001). Furthermore, WB studies

show that good governance is essential for SD measured by per capita income (Grindle, 2004). However, empirical evidence confirms that good governance is fundamental for sustainable economic growth in less-developed countries. For example, countries with better governance profiles attract higher foreign direct investment levels and faster economic growth (Chowdhury, 2013); China, Vietnam, and Cambodia are known for their profitable economic growth but lack good governance (Stojanovic, 2016). Suppose this relationship can be measured on a national scale because of the data availability and international organisations commitment to improving governance around the world; on a regional level, this connection between governance and development is more apparent but hardly measured, mainly because of the data scarcity at this scale.

Ensuring viable and sustainable well-being depends on several institutional factors, such as a good business climate, incentive legislation for investment, political stability, and policy-makers capacity to set up mechanisms to fight tax evasion and promote sustainable consumption. Also, sound economic policies will not achieve SD if they are not well implemented through good governance (Roy and Tisdell, 1998). Meanwhile, social sustainability depends on the capacity of good governance (transparency, equity, and accountability) to ensure social justice, equitable distribution of income, and accessibility to basic needs such as education and health. Empirical studies in Africa confirm that good governance has led to the decline of poverty, infant mortality, gender inequality, and millennium development goals (Chowdhury, 2013).

Finally, the State can encourage companies to reduce their gas emissions or industrial waste through tax incentives or taxes on big polluters. Environmental sustainability is primarily dependent on the policy-makers ability to enact nature-protection laws. However, civil society can also play an essential role in promoting a culture of environmental protection and raising citizens awareness of related issues. In addition, policy-makers and civil society are responsible for defining rules and constraints to comply with when using available resources within the global environment (Scalia et al., 2018).

The participatory approach is a practical and relevant tool to enhance regional governance. Below, we will highlight the main features of PA from the cases studied in this review.

2.2 The participatory approach

For the last two decades, regional stakeholders have been increasingly involved in planning and achieving SD projects; they can be ranged into four types (Thomas Webler, 1995):

- The research team facilitates and coordinates the assessment procedure. Ideally, it should be neutral to the decision outcome.
- The experts bring their scientific and technical expertise.
- The political actors who are directly involved with the problem.
- Ordinary citizens who represent the population affected.

Sustainability assessment may involve other stakeholders, like the private sector (Pérez et al., 2013), universities, non-governmental organisations, and the media (Mascarenhas et al., 2010). PA must promote good governance of public policies on different scales (national or sub-national). Suppose this approach is commonly used for implementing policies or development strategies. In that case, it is increasingly used to control and assess these policies. Moreover, this approach attempts to involve diverse stakeholders in working together toward SD goals achievement. (Thomas Webler, 1995) identifies three main reasons to implement the PA in assessment projects:

- The outcome quality is higher when we combine local and expert knowledge.
- The outcome legitimacy is higher when potentially affected parties can influence the outcome.
- Public participation is recognised as an excellent example of democracy.

In this review, we have identified three participatory forms between stakeholders (Bottom-up) and experts (Top-down) (Appendix 1); some cases do not provide information on PA **(unidentified**):

- **Both** Bottom-Up and Top-Down participate together in the assessment procedure.
- The assessment is guided by Bottom-Up **(BU).**
- Top-down **(TD**) headed the assessment project without involving the **(BU)**.

The participatory method includes setting the CI goal, collecting data, selecting, and using indicators:

Goal setting: Generally, the indicators selected represent local problems. For example, the CI goal aims to assess agricultural systems contribution to SD in the Guadalupe region. For example, several stakeholders collaborated with a facilitator to identify the key regional issues (Chopin et al., 2017). PA may also take informal consultations or interviews with policy-makers.

Data collection comes from national and regional sources. However, the indicators selected generally depend on data availability in all cases reviewed.

The selection of indicators composing the CI is usually led by experts (TD) based on requirements expressed by the decision-makers and criteria such as data availability by using various participatory methods. For example, to assess Cuban nature-based tourism destinations, participants in a workshop had to rate a list of indicators scaled between (0) and (10), where (0) indicates that the indicator is not valuable for the study and (10) is highly relevant (Pérez et al., 2013). Therefore, indicators with a higher than or equal median score were selected.

The survey methods are also relevant for gathering stakeholders opinions on local indicators. Surveys can be conducted by the university and supported by local workshops involving various stakeholders. Policy-makers must be engaged from the first to the final step of the CI construction. However, normalisation, aggregation, and robustness analysis require technical and scientific knowledge and should be achieved by experts (TD).

The use of indicators: Indicators can be used in different fields, such as communication and awareness-raising, monitoring and evaluation of performance, engaging stakeholders, supporting policy evaluation, providing early warning functions, political advocacy, control and accountability, transparency, and improving the quality of decisions (Lehtonen, Sébastien, and Bauler, 2016). Policy-makers can use CI as decision support or an instrument of control; civil society can use it for political advocacy. PA allows BU and TD to work together during the index construction process. However, we conclude that there is no best way to establish PA. Several methods are regularly used, such as workshops, meetings, direct or semi-direct interviews, and surveys.

3- Discussion and policy recommendations: towards a practical guideline for regional sustainability assessment using composite indicators

As a result, as shown in Table (3), we propose a guideline in the form of a grid of conditions supporting stakeholders and experts to build a valuable and accepted CI. The grid's purpose is to guide stakeholders in implementing and monitoring public action within the SD context. We consider this grid a governance tool for producing and using SD assessment tools such as CIs with the involvement of BU and TD stakeholders. Likewise, the CI design should follow conventional steps described by the (OECD, 2008) with careful consideration of governance issues and cooperation between stakeholders.

This grid comprises five components divided into eight components that should be met to guarantee building a sound CI. Good governance ensures the use of the CI as an RSA tool; the PA enhances its acceptance by stakeholders because subjectivity is unavoidable during this construction process.

Once we meet these two conditions, the CI construction procedure must respect three other conditions: 1) defining a theoretical framework that reflects local stakeholders priorities, 2) selecting indicators that satisfy stakeholders priorities and acceptance criteria, and 3) applying conventional steps of normalisation, weighting, aggregation, and robustness analysis.

Table 3: Prerequisites conditions and steps to build a composite indicator to assess regional sustainable development

	Grid components	What	Who	How
Prerequisites conditions	Regional governance	A favourable political context to set up and assess SD projects and strategies	BU -TD	Good governance / participatory approach
	Participatory approach	Goal setting	BU-TD	Workshop, survey, meeting, interview
		Collecting data	BU-TD	
		Selecting Indicators	BU-TD	
		Construction indicators	Experts	
		The use of indicators	BU-TD	
CI construction steps	Theoretical framework	Set up the goal of assessing the SD	BU-TD	Integrate the fourth dimension in the goal-setting of the CI
	Selecting indicators criteria	Relevance - availability of data - Measurability – priority of the decision-makers with regards to the local problems – scientifically validated - etc.	BU-TD	Workshop, survey, meeting, interview
	Normalisation	Make indicators comparable	TD	(z-scores) method -
				re-scaling method -
				"Min-Max" method -
				Borda Count
	Weighting	Selecting the weight of each indicator in the CI – analyses the compensability and correlation between indicators	TD-BU	Equal weighting method, statistical-based methods – participatory-based methods.
	Aggregation	Compiling indicators into a single index	TD	Arithmetic and geometric aggregation methods - multi-criteria methods
	Robustness	Analysing the CI uncertainty and sensitivity	TD	Changing aggregation and weighting methods

Source: Author

Conclusion

Building a CI cannot avoid subjective choices, such as selecting indicators, weighting, and aggregation models. Despite the numerous methods available, it is tough to deal with this abundance of tools and reduce subjectivity.

Governance is not systematically seen as a dimension of SD despite the fundamental role in achieving regional sustainability strategies by providing good governance practices (e.g. democratic participation of citizens, transparency, accountability, and responsibility). We suppose that for developed countries, good governance principles are implicitly integrated by governments in all development strategies, unlike in less-developed countries when the governance should be explicitly displayed as a cornerstone of these strategies.

The SD dimensions as presented in the Brundtland report or academic research on SD do not systematically include governance as one SD pillar. In developed countries, governance is implicitly integrated into public policies. However, in less-developed countries, we consider governance a pillar to achieving SD; the WB focuses on good governance principles that guarantee the rational use of funds and development aid. In less-developed countries, governance issues lead to the failure of development strategies.

We conclude the need for a guideline to support stakeholders and experts in building practical and accepted CIs. This guideline comprises steps and conditions required to implement CIs based on conventional methods such as those proposed by (OECD, 2008), integrating a participatory approach and good governance. This review brought best-practice of building CIs together, synthesising the methods used, ranging phases of building the CI based on the literature findings, and summarising all these subsequent steps into a unique grid.

Finally, researchers and practitioners should be aware of three main points debated in the literature review: 1) the capacity to involve stakeholders during the index construction steps; their involvement guarantees the use of the index, 2) data gathered is usually a challenging step, mainly at the under-national scale (e.g., regions, municipalities), that is why we recommend using some techniques such as proxy data or the imputation of missing data, 3) selection and weighting indicators have to meet stakeholders priorities and criteria such as data availability.

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