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Participatory landscape sustainability assessment: where do we stand? A systematic literature review

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Abstract

Context

In line with interdisciplinary and transdisciplinary principles of Sustainability Science, Participatory Landscape Sustainability Assessment (PLSA) studies are developing. These studies make the paradoxical promises to standardize observations to obtain robust and comparable data, while including a diversity of case studies, stakeholders and viewpoints.

Objective

The purpose of this paper is to highlight the diversity of perspectives on PLSA, arguing that the lack of coherent framing and a poor substantive theorization can limit the development of PLSA studies.

Methods

We conducted a systematic literature review on a corpus of 425 publications by combining bibliographic mapping on the full corpus and a content analysis on a sub-corpus of 138 full-texts.

Results

Our results showed that (i) this field is at the crossroads between ecology, landscape planning and sociocultural approaches, (ii) indicators combine on average 4.7 categories of sustainability, but are most applied at a local level and in a snapshot perspective, (iii) stakeholders are rarely involved in the choice of indicators (28.9% of studies) or in the assessment design (7.2%), and are mostly only asked to populate pre-identified indicators (63.9%), and (iv) viewpoint diversity is taken into consideration mainly by using indicators (67.3%) rather than by promoting deliberation (39.8%). In sum, we distinguish the *participation-oriented approach*, the *contributive approach* (anchored in positivism) and the *collaborative approach* (anchored in constructivism).

Conclusion

We advocate that future studies should be more explicit on the perspective they adopt in order to improve consistence between PLSA objectives, methods, and theoretical anchorages. This clarification might ultimately avoid confusion about the different regimes of participation and their respective contributions to Landscape Sustainability Science.

1. Introduction

Public participation in decision-making is widely promoted as a cornerstone in landscape planning and it is seen as a precursor to landscape sustainability (Roe, 2013; Calderon and Butler, 2020). One might define landscape sustainability as “the capacity of a landscape to consistently provide long-term, landscape-specific ecosystem services essential for maintaining and improving human well-being” (Wu, 2013). In a perspective of post-normal science, landscape sustainability is generally considered as a wicked problem, in which facts are uncertain, values in dispute, stakes are high and decisions are urgent (Funtowicz and Ravetz, 1993). In this case, expert-based decisions show their limits while participation is prone to be both more ethic and effective (Funtowicz and Ravetz, 1993).

From an ethical point of view, participatory landscape sustainability assessment (PLSA) fosters the empowerment of communities, it satisfies the rights of stakeholders to participate in decision-making processes, in particular the stakeholders who are usually absent from non-participatory assessment (i.e. the ones with low access to socio-political or economic capital) (Roe, 2013). It also recognizes the knowledge and values of everyone who experiences a landscape (Roe, 2013; Calderon et al., 2017). From a pragmatic perspective, public participation in general and participatory assessment in particular are advocated because (i) it is strongly grounded in local contexts, (ii) it is likely to provide concrete information for policy and development projects and (iii) the produced assessment indicators are likely to better fit with local stakeholders’ visions (Reed et al., 2006; Sébastien et al. 2017).

In sum, PLSA is one of the ways to satisfy the objectives of sustainability science, which defines itself as a problem-driven, solution-oriented science towards sustainable development that relies on an interdisciplinary agenda (i.e. collaborations between multiple scientific disciplines) and a transdisciplinary approach (i.e. a nourished participation of non-academic spheres in research) (Brandt et al., 2013; Clark and Dickson, 2003; Kates, 2011). As such, sustainability science echoes with calls for a landscape sustainability science (LSS) where landscape scientists are seen as having a pivotal role in the understanding of sustainability issues, due to their multi-scale perspective, spatially explicit approach and inter- and transdisciplinarity tradition (Wu, 2013).

One of the knowledge gap of LSS today is the development of a set of standards, methods, and tools to evaluate the current state and trajectory of landscapes and guide landscape trajectories towards desirable, sustainable futures (Wu, 2021). To do so in a consistent way, a key preliminary step is to choose appropriate principle, dimensions, criteria and indicators. The principle is a fundamental rule or law, formulated as an ideal serving as a basis for reasoning and action (van Bueren, 1997); in our case, landscape sustainability. The dimensions are narrower fields of the principle, such as the ‘three pillars of sustainability’, inspired by the Brundtland report (economy, society and environment) (Wu, 2013) or the five dimensions set by Selman (2008) (environment, economy, society, politics, and aesthetics). The criteria are intermediate points to which the information provided by indicators can be integrated and where an interpretable assessment crystallizes (van Bueren, 1997). For example, Dale and al. (2019) divide the environmental dimension of landscape sustainability in six criteria: soil quality, water quality and quantity, greenhouse gas emission, air quality, biodiversity and productivity. At last, indicators are qualitative, quantitative or descriptive variables periodically measured or tracked to indicate the trend of

the criteria (van Bueren, 1997). For instance, three indicators can inform the soil quality: the total organic carbon, the total nitrogen and the extractable phosphorus (Dale et al., 2019).

The very principle of PLSA seems to be an oxymoron, as it navigates between two contradictory ambitions (Sébastien et al., 2017). In the one hand, assessing means standardizing and normalizing observations; in the other hand, participation means opening the perspectives by including a diversity of case studies, stakeholders and their viewpoints (Sébastien et al., 2017). As a result, tensions can arise at three steps in the assessment process: in the choice of scale, in the choice of indicators and in the inclusion of the diversity of viewpoints.

First, PLSA studies are supposed to link stakes at different scales, from local to global. Indeed, indicators are taken from the field and context-dependent, while assessment generally aim at standardization to guarantee comparability between study sites (Sébastien et al. 2017). The landscape approach seems particularly pivotal to address these tensions between scales. In a landscape ecology perspective, the landscape level enables to articulate data and results across several scales (Englund et al., 2017; Termorshuizen and Opdam, 2009; Vallés-Planells et al., 2014; Wu, 2021) and to link social and ecological issues (Vialatte et al., 2019). From a governance point of view, the landscape scale enables to deal with power issues (Roe, 2013) and allows gathering stakeholders from the same inter-knowledge network, professional solidarity or by geographical proximity (Lepart and Marty, 2013). The first objective of this article is to highlight the contributions of the PLSA to the 'scale debate' in landscape sustainability assessment.

Second, PLSA involves integrating a diversity of stakeholders and perspectives, while maintaining a standardized assessment process to ensure scientific rigor, reproducibility and comparability. Regarding the choice of the indicators, in theory, stakeholders should be a part of every step of landscape sustainability assessments, from the definition of principle to the choice and the information of the criteria and indicators (Reed, 2006; Dale, 2019). However, in practice, many studies are framing the process with a structured discussion based on a pre-formatted list of indicators (Sébastien, 2017). Finally, intensity of participation can vary from information to empowerment (Brandt et al., 2013), or to contribution to co-creation (Bonney et al., 2009). The second objective of this article is to highlight the various role of stakeholders in the production of indicators in PLSA and to highlight this diversity by exploring the theoretical anchorages of these studies.

A third challenge for PLSA is to integrate the variety of viewpoints, in a normalized assessment process (Sébastien et al. 2017). Research on landscape has a long tradition of dealing with representations and variety of viewpoints. Indeed, as stated by the Landscape European Convention (Council, 2000) landscape is "an area, as perceived by people". Many concepts, such as local and indigenous knowledge, identities or traditional values, are meant to capture this diversity of viewpoints (Roe, 2013). In an assessment process, the variety of viewpoints can be included through specific indicators (aesthetics for example) or through deliberation (putting in debate the contribution to each indicator to landscape

sustainability). The third objective of this article is to highlight the strengths and limits of both approaches.

While several literature reviews have been undertaken on landscape sustainability (Cohen, 2017; Gibbes et al., 2020; Huang et al., 2015; Liao et al., 2020; Medeiros et al., 2021; Oudes and Stremke, 2020; Puskás et al., 2021; Sheikhejad and Yigitcanlar, 2020; Yang et al., 2021; Zhou et al., 2019), none specifically addresses PLSA. The overall goal of this article is therefore to fill this gap, and to help scientists and practitioners to better understand the multiple forms that PLSA studies take in research as well as the different theoretical anchorages that these forms underlie. In this respect, we contribute to the development of participation in landscape planning from a substantive standpoint, in line with Calderon and Butler's (2021) argument.

This paper emphasizes five major results relative to (i) the variety of scientific anchorages and methods, (ii) the use of indicators, which are mostly localized and snapshot, (iii) the variable intensity of participation; (iv) the contrasting role of stakeholders in the coproduction of indicators, and (v) the inclusion of the viewpoint diversity. We then discuss the contribution of participatory studies in the issue of multi-scalar landscape sustainability assessments and highlight the importance for researchers to be explicit on their theoretical anchorage.

2. Materials And Methods

2.1. Literature search strategy

In order to provide a transparent, reproducible, and robust literature review, we followed ad-hoc international standards (Haddaway et al., 2018; Pullin and Stewart, 2006).

We first built a search string that aimed at identifying the literature on PLSA (Fig. 1). The search string included four sets of keywords that respectively aimed at capturing publications dealing with (i) participation, (ii) sustainability, (iii) landscape, (iv) assessment (Table S1). No restriction on language or publication year was applied, but we included only articles, journals, book chapters, and books. The search string was submitted on August 23th 2021 on Scopus, and returned 496 records. While we chose to work with Scopus rather than Web Of Science to benefit from a larger journal coverage (Mongeon and Paul-Hus, 2016), we note that both databases over-represent publications in English language as well as Biomedical, Engineering and Natural Sciences to the detriment of Social Sciences and Arts and Humanities (Vera-Baceta et al., 2019). Our choice for Scopus was also motivated by the exhaustive metadata provided for each record that allows in-depth bibliographic mapping.

Second, we screened all publications' titles and abstracts to exclude non-relevant records. More precisely, studies were excluded if the word 'landscape' was used as a metaphor (e.g. 'commercial landscape') and/or if the word 'participate' was not concerning humans (e.g. countries). After screening, we obtained a literature corpus of 425 records that we analyzed with scientometric techniques (see Section 2.2). Then,

we performed a content analysis based on a literature sub-corpus of 138 publication full-texts (see Section 2.3).

2.2. Bibliographic mapping from the entire literature corpus

First, we relied on the R statistical software (Team, 2021) to analyze the evolution in the annual number of publications. Second, we used the VOSviewer software (van Eck and Waltman, 2011) to analyze keyword co-occurrence in order to highlight the main topics (and their interrelations) addressed in the literature corpus (thesaurus were used to merge synonyms in keywords and in journals; see Tables S2 and S3). We also computed a co-citation analysis to evaluate the scientific anchorages of the publications composing the corpus. Co-citation analysis also processed at journal level to assess the scientific linkages between journals.

2.3. Content analysis from the sub-corpus

We randomly selected 33% (N = 141) of the corpus' records. We could not have access to three publications so we performed content analysis on a sub-corpus of 138 records (Fig. 1).

We designed an analytical grid containing a total of 53 variables (Table S4). For each individual publication in the sub-corpus, we extract and code data on (i) information of the study (1 categorical variable); (ii) the studied landscape(s) (2 categorical and 1 Boolean variables); (iii) the approaches and methods (9 Boolean variables) ; (iv) indicators used (3 categorical, 14 Boolean, 1 quantitative variables); (v) the implementation of the participatory process (15 Boolean and 1 quantitative variables); (vi) the outputs of the participatory process (6 Boolean variables). The first author filled in the grid for the 138 studies to avoid bias due to multiple operators.

Once completed, the grid was imported into R for quantitative analyses, with the *tidyverse*, the *ggplot* *FactoMineR* packages (Lê et al., 2008). To navigate the publication diversity, we processed two Multiple Correspondance Analyses (MCAs), followed by Hierarchical Clusterings on Principal Components (HCPCs), on the basis on case studies (N = 127). The HCPCs allowed to identify clusters of publications by relying on the squared Euclidean distance associated with the Ward's agglomeration method (Husson et al., 2017). The number of clusters emphasized in the results was automatically calculated as the one with the higher relative loss of inertia, and we applied 1,000 iterations for the k-means consolidation. The first MCA/HCPC was based on indicators characteristics as active variables (N = 18 variables), plus two supplementary variables to help for interpretation. The second MCA was based on active variables on methods, indicators, role of participation in the studies and the involvement of stakeholders (N = 20 variables), plus 7 supplementary variables.

3. Results

3.1. A field at the crossroads between ecology, landscape planning and sociocultural approaches

The identified literature corpus has been constantly increasing from 1992, with an inflection from the years 2004–2006 (Fig. S1). Co-citation analyses at journal level allowed us to identify three main scientific anchorages, with strong interlinkages between them (Fig. 2). First, the “ecology” anchorage (red cluster) was represented by journals in conservation ecology (*Conservation Biology, Biological Conservation, Biodiversity and Conservation*), sometimes in an applied perspective (*Environmental Management, Ecology Application*). Second, the “landscape planning” anchorage (blue cluster) gathered journals dedicated to landscape governance and planning (*Landscape and Urban planning, Land use policy, Journal of Environmental Management*), and some journals with an integrated approach (*Geoforum, Sustainability*). At last, the “social-ecological” anchorage (green cluster) fitted with a socio-ecological system approach (*Ecology and Society, Ecosystem Services*), with various disciplinary anchorages: economics (*Ecological Economics*) or ecology (*Ecological indicator, Journal of Applied Ecology*).

The analysis of author keywords co-occurrence further depicted four clusters on biophysical dimension of landscape, cultural approach of landscape, political dimension of landscape, and landscape as a development tool (Fig. S2).

Among the sub-corpus, 127 publications were case studies, 10 were conceptual or methodological studies and one was a literature review. Case studies were mainly located in Europe and central Asia (N = 52), followed by East Asia and Pacific (N = 19), and Latin America and Caribbean (N = 17). Studied landscapes were mainly rural (N = 66), followed by urban landscapes (N = 25). Finally, 78 studies were outside protected area contexts, while 52 studies focused on a landscape with a PA.

The content analyses revealed three ways to approach participation. First, in 15% (N = 21 studies) of the sub-corpus, participation was not concretely mobilized but only mentioned as a matter of introduction or discussion. Second, about 70% of the sub-corpus (N = 97 studies) were concretely using participatory methods, while 14% of the articles (N = 20) considered participation as a research object (for example by analyzing the public participation in urban planning), without initiating a participatory process.

Second, a diversity of participatory methods was observed (Fig. 3). Qualitative methods were the most frequent, including for example semi-structured interview and field observation (Vallet et al., 2019) and photo elicitation (Altaba Tena and García-Esparza, 2019). These were closely followed by collective assessments relying on focus groups (Chakraborty et al., 2018) or collective workshops (Sapkota et al., 2021), and quantitative methods based, for instance, on surveys and household level socio-economic assessments (Sharma et al., 2016). Scenario-based approaches such as scenario analysis (Bohnet et al., 2011) or scenario planning (Karjala and Dewhurst, 2003), and modeling approaches such as agent-based modeling and Bayesian network (Shaaban et al., 2021) were the least frequent. Less than a third of the studied mobilized spatially explicit approaches through the use of remote sensing and GIS analysis (Kivinen, 2015) or participatory mapping (Bélisle et al., 2021).

Many studies combined several approaches (Fig. 3). Collective and spatially-explicit methods were more frequently combined with qualitative than quantitative evaluation methods. For example, Baumann et al.

(2020) used a 'tricot approach' that associates participatory sketch mapping; transect walks, and semi-structured interviews, while Abeywardana et al. (2019) combined semi-structured interviews, field observations and participatory mapping.

3.2. Landscape sustainable indicators are mostly punctual, localized and combined

Short-term, or even snapshot, and local-level studies were over-represented in the literature (Fig. 4a). Results effectively showed that 54% of the sub-corpus articles focused on local scale, while multi-scalar approaches only represented 5% of them. Yet, among local studies, some of them adopted a multi-scalar approach by taking into account several local levels; e.g. from architectural level to public space and urban planning level (Wulff Barreiro and Brito Gonzalez, 2020) or from farm to municipal level (Gullino et al., 2018). Regarding temporal patterns, we found that 46% of the sub-corpus articles were snapshot studies and we did not evidence any study that articulated several temporalities.

The most frequently-used assessment indicators were related to biodiversity, agricultural outputs and land use, as well as physical and psychological experiences (Fig. 4b). In most studies, several categories of indicators were used, with an average of 4.7 (± 2.6) categories/study. Furthermore, the MCA and HCPC based on the nature and characteristics of assessment indicators allowed us to identify three clusters of studies with contrasted characteristics (Fig. S3, and Table S5 for full cluster description): the first cluster (N = 53 studies) gathered studies that mostly relied on qualitative indicators. The second cluster (N = 24) was associated with the use of the indicators related to air (54.2% of the cluster while this indicator was present in only 11.0% of the sub-corpus), water (87.5% in the cluster vs. 51.2% in the sub-corpus), biodiversity (91.7% vs. 56.7%) and physical & psychological experiences (83.3% vs. 49.6%). Urban landscapes were over-represented in this cluster (41.7% vs. 19.7%). At last, the third cluster (N = 50) gathered studies that were using indicators of land use (88.0% of the cluster vs. 48.0% of the sub-corpus), agricultural outputs (94.0% vs. 58.2%), soil (70% vs. 38.6%), biodiversity (84.0% vs. 56.7%). We observed a continuity rather than a sharp separation between the three clusters, suggesting a gradient between them.

3.3. The variable intensity of participation

We show three levels of intensity in participation, according to (i) the fact that stakeholders are effectively involved or not in the assessment process and (ii) the earliness in the involvement process (Fig. 5).

The MCA and HCPC analyses revealed three clusters, that corresponds to three levels of intensity in participation (Fig. 5, see Table S6 for cluster description). In the first cluster (51 items), the coproduction type is entitled 'co-data': stakeholders only inform indicators (86.3% of the studies while this modality was present in 48.8% of the sub-corpus). This cluster is also characterized by the use of quantitative methods (74.5% in the cluster vs 36.2% of the sub-corpus), the use of subjectivity-based indicators (80.4% vs 55.1%) and the absence of deliberation (96.1% vs 74.0%). The second cluster (45 items), gathers two types of coproduction: the 'co-indicators' type, in which the indicators are chosen with stakeholders (42.2% of the cluster vs 20.5% of the sub-corpus), and the 'co-design' type, in which stakeholders are

involved in the design of the assessment (13.3% vs 5.5%). In this cluster, the specificities are the use of collective methods (77.8% vs 35.4%), scenario-based methods (33.3% vs 13.4%), qualitative methods (60.0% vs 41.0%), and the use of deliberation (64.4% vs 26.0%). At last, the third cluster (31 items) consists of non-participatory studies (96.8% vs 24.4%).

In the two following section, we deepen two variable of the intensity of participation, namely the earliness in the involvement of stakeholders and the integration of the diversity of viewpoints.

3.4. Coproduced indicators are a minority

Our analysis revealed that the early involvement of stakeholders in the PLSA process was applied only in a minority of studies. Out of the 97 studies that involved stakeholders, three types of research practices were identified (Table 1).

Table 1
Coproducton type in participatory landscape sustainability assessments

Coproducton type	Nb. of studies	Part
Co-data	62	63.9%
Co-indicators	28	28.9%
Co-design	7	7.2%

The first type of co-production, ‘co-data’, was represented by 62 studies in which stakeholders are only ‘informants’: they populated indicators’ values, but they were not involved in the choice of the indicators themselves nor in design process. These studies were dominated by quantitative approaches, participants being asked to provide data to calculate pre-established criteria and indicators. In addition, selected criteria were generally derived from major international classifications or standardized methods, such as the ecosystem services framework (Bachi et al., 2021; Boafo et al., 2014; Palacios-Agundez et al., 2015), livelihood studies (Baral and Heinen, 2007; Chakraborty et al., 2018.; Sharma et al., 2016), farm typology (Gullino et al., 2018; Vaca et al., 2019) or monetary valuation methods (Fischer, 2005).

The second type of coproduction, ‘co-indicators’, gathered 29 studies in which stakeholders are both ‘indicator coproducers’ (they participated in the choice of indicators) and ‘informants’. Among them, some studies compared stakeholders’ representations and standardized assessment frameworks, such as the Montréal Process Criteria and Indicators (Bayne et al., 2015) or Canadian or American national framework of criteria and indicators (Karjala and Dewhurst, 2003). Other studies enriched existing frameworks, such as the ecosystem service framework (Bélisle et al., 2021), with contribution of stakeholders’ representations. At last, other studies combined different frameworks, such as Bravo-Monroy (2021) who mixed the Lefebvre’s social theory and the Nature’s Contribution to People concept to approach farmers’ perceptions of space in Colombia.

The last type is the ‘co-design’ coproduction, in which stakeholders are both ‘indicator coproducers’ and ‘assessment designers’. This type was represented by 7 studies that. Some of these initiatives were led by leaders at the national level, as in the study of Pistorius et al. (2017) on Forest Landscape Restoration in Ethiopia, while other were led by local people, as in the study of Metallinou (2020) on prescribed fires in Norway. In these studies, researchers seek to accompany, rather than lead, a process driven by local or national stakeholders.

3.5. Two ways of representing the viewpoint diversity

Two ways of approaching viewpoint diversity on landscape sustainability were identified in the sub-corpus studies: with indicators and with deliberation.

In 52% (N = 73) of the sub-corpus studies, viewpoint diversity was only addressed by so-called ‘subjectivity-based indicators’, encompassing ‘physical and psychological experiences’, ‘identities’ and ‘learning and inspiration’. The use of subjectivity-based indicators was meant to achieve three main purposes. First, it allowed to study the intangible dimension of landscapes based on scientific concepts such as attachment and identity (Bayne et al., 2015), sense of place (Urquhart and Acott, 2014) or forest feeling (Korpilo et al., 2018). Second, it was meant to approach landscape intangible dimension through local concepts such as the ‘resourcing’ concept held by first Nations in boreal Quebec (Bélisle et al., 2021). Third, subjectivity-based indicators were used to jointly investigate the tangible and intangible dimension of landscapes in a materialist perspective. For instance, Tekken et al. (2017) developed a ‘portfolio of indicators’ showing a negative correlation between the cultural ecosystem services provided by rice systems and the land use intensity; Dobbie (2013) identified correlations between perception of aesthetics and the presence of landscape elements; and Huang and Sherk (2014) compared sustainability performance and visual preference of landscape elements.

In 25% of the sub-corpus (N = 35 studies), viewpoint diversity on landscapes was only addressed with deliberation, for example during collective workshops or focus group. For example, Bohnet et al. (2011) developed a landscape toolkit through which they proposed three scenarios to stakeholders based on biophysical data, and accompany discussions among stakeholders on the trade-offs between the scenarios and on the priorities for the territory. Similarly, Moraine et al. (2016) implemented participatory modeling with farmers and technical advisors to design integrated agriculture-livestock systems. Other initiatives were conducted in similar approaches, relying on serious games (Speelman et al., 2014), participatory scenarios (Karner et al., 2019; König et al., 2015), or multi-criteria decision processes (Terêncio et al., 2021). Finally, these initiatives showed that even when the landscape is approached in its materiality with biophysical indicators, the link between the indicators’ values and sustainability need to be debated.

Finally, it is noteworthy that 20 studies (14% of the sub-corpus) used both subjectivity-based indicators and deliberation, whereas in 51 studies (36%), the issue of the divergence or convergence of viewpoints on landscape sustainability was not addressed.

4. Discussion

4.1. The multiple ways to foster participation

Our bibliographic mapping shows that PLSA studies feed a cross-disciplinary agenda and are mobilized by diverse scientific communities, mainly from ecology, landscape planning and socio-ecological approaches. This result echoes with Wu (2006), who affirms that there are two traditions in landscape ecology: the European versus the North American one, the former being characterized by a society-centered holistic view that focuses on solution-driven research, whereas the latter is dominated by a bioecology-centered spatial view that focuses on question-driven studies.

Moreover, based on our results and in echo with the typology proposed in Bonney et al. (2009), we can establish a gradient of participation in PLSA. The first type of studies, that corresponds to the first cluster of the MCA (Fig. 5) is the *contributive approach* type where stakeholders are involved to inform indicators that they did not choose. Variety of points of view is addressed through indicators, but the link between measured indicators and sustainability is not debated. The second type (corresponding to the second cluster in the MCA) is a *collaborative approach*, in which stakeholders can choose indicators and inform them. Qualitative and collective methods allow both the coproduction of original indicators with stakeholders and deliberation. The last type of studies (third cluster), belongs to the *participation-oriented* type, and considers participation as an element of context, a perspective and/or object of study.

If the diversity of approaches and methods can enrich the scientific field of PLSA, there is a risk that the lack of coherent framing and the lack of clarity around the term 'participation' create confusion. Thus, it is instrumental to elicit the theoretical anchorages underlie landscape participation. In the following section, we focus on the differences between the *contributive approach* and the *collaborative approach*.

4.2. Two theoretical anchorages underlie landscape participation

The *contributive* and the *collaborative approaches* differ in their methods, the indicators they use and the way they involve stakeholders and the viewpoints integration, but also in their theoretical anchorages (Table 2). We argue that the *contributive approach* is anchored in a positivist perspective whereas the *collaborative approach* is rooted in a constructivist perspective. Both approaches have strengths and limits; but we advocate for more clarity on the theoretical anchorage of PLSA studies, so researchers can ensure that their objectives and methods are in coherence with their theoretical anchorage.

Table 2
Summary table: two approaches of PLSA, characterized by their methods and their theoretical anchorages

Participation approach (in reference to Bonney et al. 2009)	Contributive	Collaborative
Theoretical anchorage (in reference to Kühne, 2019)	Positivist	Constructivist
Mode of coproduction (in reference to Chambers et al., 2021)	Researching solutions	Navigating differences
Methods	Quantitative	Collective Scenario-based
Coproduction type	Co-data	Co-design and co-indicators
Integration of divergence on viewpoints	Subjective-based indicators	Deliberation

About 40% of the sub-corpus (51 studies) dealt with viewpoint diversity through specific indicators, such as aesthetics or experiences, and through quantitative methods. We argue that this approach is rooted in a positivist perspective, as theorized by Comte, which seeks to generate verifiable certainties with the help of empiricism (Kühne, 2019). In this perspective, landscape are understood as material objects that result of a set of observable, measurable, and countable quantities, or in other words are composed with different analyzable 'layers' that can be unpacked by disciplines such as ecology, GIS, geography but also psychological landscape research, that analyzes landscape perception in a dissecting way (Kühne, 2019). This approach goes general in hand with a consequentialism, which relies on the idea that a good decision is one that best improves the well-being of affected agents by optimizing the trade-offs between relevant indicators (O'Neill et al., 2007). It is there coherent that studies rooted in a positive and consequentialist perspective use a *contributive approach* for participation, in which stakeholders are mobilized to fill pre-identified indicators. In doing so, these studies effectively set aside the normative issues associated with the choice of indicators and manipulate indicators as tools able to objectivize a reality independent from human eyes. The use of standardized framework answers the need for comparability between case studies, while reflecting context-specific dimensions as indicators are populated by stakeholders (Sébastien et al. 2017). In reference to Chambers et al. (2021) who proposed a typology of coproduction regimes for sustainability, the *contributive approach* would fit in the 'researching solutions' mode, in which researchers and decision makers employ 'realist' methods to produce practical scientific knowledge in order to influence policy and interventions.

The *contributive approach* is instrumental as it is solution-oriented and aims at produce practical scientific knowledge with the goal to influence policies and interventions (Chambers et al., 2021). From a pragmatic perspective, proposing an initial list of indicators to the participants with the objective of

having a basis for discussion and avoiding fragmentation (Sébastien et al., 2017). However, this approach comes with several limitations. First, this approach may use indicator that do not fit with stakeholders' representations, as some papers alert on the discrepancy that exist between stakeholders' representation and standardized indicators (Karjala and Dewhurst, 2003; Balfour et al., 2021; Bélisle et al., 2021). Second, it poorly addresses power asymmetries among stakeholders, and between stakeholders and researchers. Among others risks, decision makers can be more receptive to knowledge that helps rather to oppose their plans Chambers et al, 2021). Another risk is that the assessment process leads to reduce lack of knowledge but also to empower scientific knowledge, which risks to marginalizing the voices and knowledge systems of others actors, who were excluded from the process but who can be affected by the resulting recommendations (Chambers et al, 2021). Third, the *contributive approach* tends to reduce PLSA process to a technical process, thereby minimizing its normative and political significance. Excluding stakeholders from the choice of indicators means that only a small group of people (i.e. the researchers or the decision makers) choose what landscape characteristics of functions should be optimized. Ignoring (or pretending to ignore) the normative nature of assessment causes ethic problemsby imposing a single vision of what is the desirable future for our landscape (Lepart and Marty, 2013).

In contrast, 35% of the sub-corpus (45 studies) dealt with viewpoint diversity through deliberation, and involved stakeholders in the choice of indicators and use collective and scenario methods. We argue that such a *collaborative approach* is rooted in a constructivist perspective, in which landscapes are understood as individual or social constructs. Among the most significant authors in constructivist perspective, we can cite Schütz, Habermas, Latour, or Callon (Kühne, 2019). Contrary to positivism, constructivist approach considers landscape as a result of socially formed patterns of interpretation and evaluation, with an internal synthesis between material objects and symbolic meanings (Kühne, 2019). Deliberative and collective methods are preferred because, in a constructivist perspective, decisions are not considered as discrete events, but as processes subject to constraints independent of the realization of total well-being. As a consequence, achieving landscape sustainability is not seen as a matter of indicator optimization, but rather as a matter of establishing a deliberative process that would ensure distributive justice and account for plural and incommensurable values (O'Neill et al., 2007). In other words, constructivist studies applied to landscape do not focus on " 'what-is' questions, but [on] questions of who constructs the world and how, how world interpretations and world evaluations differ, and how they acquire social commitment" (Kühne, 2019). This explains why constructivist approach involves stakeholders in the choice of indicators and engages a reflexive process on the strategical interest of indicators and on what would 'landscape sustainability' mean in this specific context. For example, Karjala et al. (2003) compared the values attributed to the forest by the Tl'azt'en Nation with two generic frameworks (Canadian Council of Forest Ministers' national level; Land Unit Criteria and Indicators Development of United States Forest Service), and show that the criteria defined by the Tl'azt'en are highly interdependent, which is not the case in national frameworks. They also identify locally relevant and managerially acceptable sustainability thresholds to be incorporated into management plans (Karjala and Dewhurst, 2003). Balfour et al. (2021) used a standardized framework (ecosystem services)

also new indicators, such as desirability (which includes animal welfare and land use intensity) or viability (financial, but also consumption behavior or reputational benefits). According to Chambers et al (2021) typology, the *collaborative approach* would fit in the 'navigating differences' mode, which emphasizes managing processes of relating together, learning and empowering. In this mode, researchers held less power, and use facilitation techniques and boundary objects to explore conflicts and reframe perspectives.

Some limitations are yet associated to the *collaborative approach*. First, coproducing the assessment process with stakeholders means a high variability from one site to another, which reduces the possibilities to compare case studies. Furthermore, some high-level actors can block the participatory process (Chambers et al., 2021). Lastly, soliciting individual actors to collect data is one thing; facilitating discussions between actors with different representations, interests, and levels of power is another. When the researcher becomes a facilitator, the question of his/her posture and the management of power asymmetries becomes central, which requires specific skills to be consistently addressed (Barnaud and van Paassen, 2013).

The fact that the positivist approach appears majoritarian in the PLSA literature is far from neutral regarding the issue of landscape participation. Some see in the spreading out of participatory assessments the promise of citizen empowerment and the decrease in the domination of participatory processes by experts (Sébastien et al. 2017). However, according to some authors, behind this empowerment display, participatory processes on landscape perpetuate the expert dominance (Calderon et al. 2017). Finally, our results points to a paradox between, on the one hand, a reinforcement of discourses on the importance of participation in landscape sustainability assessment and, on the other hand, a predominance of expert view on what are the appropriate criteria and indicators to assess landscape sustainability.

4.3. Relevance and limitations of the landscape scale for addressing sustainability issues

PLSA studies postulate that landscape approach is instrumental to better address sustainability issues thanks to its place-based and a multi-scalar perspective (Wu et al. 2021; Sébastien et al. 2017). In the following, we confront theses ambitions with our main results.

In the literature corpus we identified, and in the subsequent randomly-selected sub-corpus, case studies were a majority and conceptual and methodological studies papers were particularly poorly represented. In this regard, the PLSA body of literature seem similar to the LSS one, which has been labelled as a 'place-based' scientific field (Wu et al. 2013, 2021; Liao et al. 2020) that suffers from a lack of coherent framing and substantive theoretical developments (Zhou et al. 2019). Such critics have been also addressed to other research fields, in particular transdisciplinary research (Brandt et al. 2013) and landscape participation (Calderon and Butler, 2020).

Second, landscape has been advocated for being the most appropriate level to assess sustainability (Lepart and Marty, 2013). In our analysis, the landscape level corresponds to the 'local scale', which represented 53% of the sub-corpus. This result therefore confirms the importance of the landscape level in PLSA, but it also emphasizes that a substantive share of this literature (almost half of it) does not concentrate on this level. This observation might be linked to an advocacy of landscape scientists related to multi-scalar perspectives and the articulation of several spatial, but also temporal levels (Wu, 2021). This multi-scalar approach is particularly put forward to justify the utility of participatory indicators, as these are seen as a way to connect context-specific dynamics (brought by local stakeholders knowledge and perceptions) with more generalizing phenomena (thanks to a certain of indicator standardization across case studies; Sébastien et al. 2017). Yet, our results showed that only 5% of studies combine several spatial levels, while no studies from our sub-corpus addressed multiple temporal scales. This result echoes with other recent literature reviews that pointed to the lack of multi-level and spatio-temporal approaches in ecological research on human-dominated landscapes (Blanco et al. 2022).

Filling this gap in fostering multi-scalar PLSA would appear a key priority for future research given the valuable insights provided by the minority of studies that implemented this approach. For example, Karner et al. (2019) conducted a multi-scalar participatory process to compare land sharing and land sparing approaches in Europe. To do so, they developed a global scenario that they scaled down to five case studies. Global scenarios were designed by an expert advisory board, but the authors note that mobilizing the expertise of local stakeholders would have been beneficial. Another study conducted by Marques et al. (2016) explored the role of stakeholders in the dissemination of the assessment outputs, and showed that farmer-to-farmer imitation is an important lever for the adoption of sustainable practices. These two examples show the interest of multi-scalar approaches to better address sustainability issues, but they also illustrate that, reversely, the challenges related to upscaling and downscaling can be better addressed through participatory processes. In other words, there seem to be a synergy between two key research challenges in LSS that would need to be tackled simultaneously: developing multi-scalar analyses and fostering people's participation in research.

5. Conclusion

Beyond the diversity of the fields, methods and indicators used in our corpus, we found that studies on PLSA can be divided into three groups: *participation-oriented studies*, *contributive studies* and *collaborative studies*. These last two are distinguished by their theoretical anchorages; the contributive approach stemming from positivism, the *collaborative approach* being rooted in constructivism.

Thanks to this systematic literature review, we were able to identify two pitfalls that should be avoided in future PLSA. First, we identified a lack of clarity regarding the goals of PLSA and the posture of researchers. Indeed, despite an apparent consensus on broad concepts such as transdisciplinarity (Brandt et al., 2013) or landscape participation (Calderon and Butler, 2020), we evidenced a large variety of methods and scientific anchorages. Beyond the banner of participation, it is therefore essential that researchers make their theoretical anchorage more explicit, in particular about the role they assign to

scientists vs other stakeholders in the assessment process, and the way they handled (or not) their own subjectivity and their representations. Doing so, they will ensure that their methods attune to their theoretical anchorage.

The second pitfall we identified is related to the risk of falling into a so-called "tyranny of indicators", that is, to confuse sustainability with its indicators (Brédif and Arnould, 2004). Evaluating means translating a complex reality into a simplified and measurable reality, and therefore operating methodological but also ideological choices (Brédif and Arnould, 2004; Sébastien et al. 2017). Presenting assessment as a technical and objective operation and claiming for a technoscientific rationality tend to silence its political and normative dimensions (Sébastien et al. 2017). While we do not argue that all evaluations should involve stakeholders in the choice of indicators, we stress the need for better clarity about how, and by whom, indicators were selected. On this condition, far from being reduced to a series of technical measures or an expert debate, the assessment of landscape sustainability can fully play its political role and contribute to landscape democracy.

Declarations

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tables

Table 1: Coproduction type in participatory landscape sustainability assessments

<i>Coproduction type</i>	<i>Nb. of studies</i>	<i>Part</i>
<i>Co-data</i>	62	63.9%
<i>Co-indicators</i>	28	28.9%
<i>Co-design</i>	7	7.2%

Table 2: Summary table: two approaches of PLSA, characterized by their methods and their theoretical anchorages

<i>Participation approach</i> (in reference to Bonney et al. 2009)	Contributive	Collaborative
<i>Theoretical anchorage</i> (in reference to Kühne, 2019)	Positivist	Constructivist
<i>Mode of coproduction</i> (in reference to Chambers et al., 2021)	Researching solutions	Navigating differences
<i>Methods</i>	Quantitative	Collective Scenario-based
<i>Coproduction type</i>	Co-data	Co-design and co-indicators
<i>Integration of divergence on viewpoints</i>	Subjective-based indicators	Deliberation

Figures

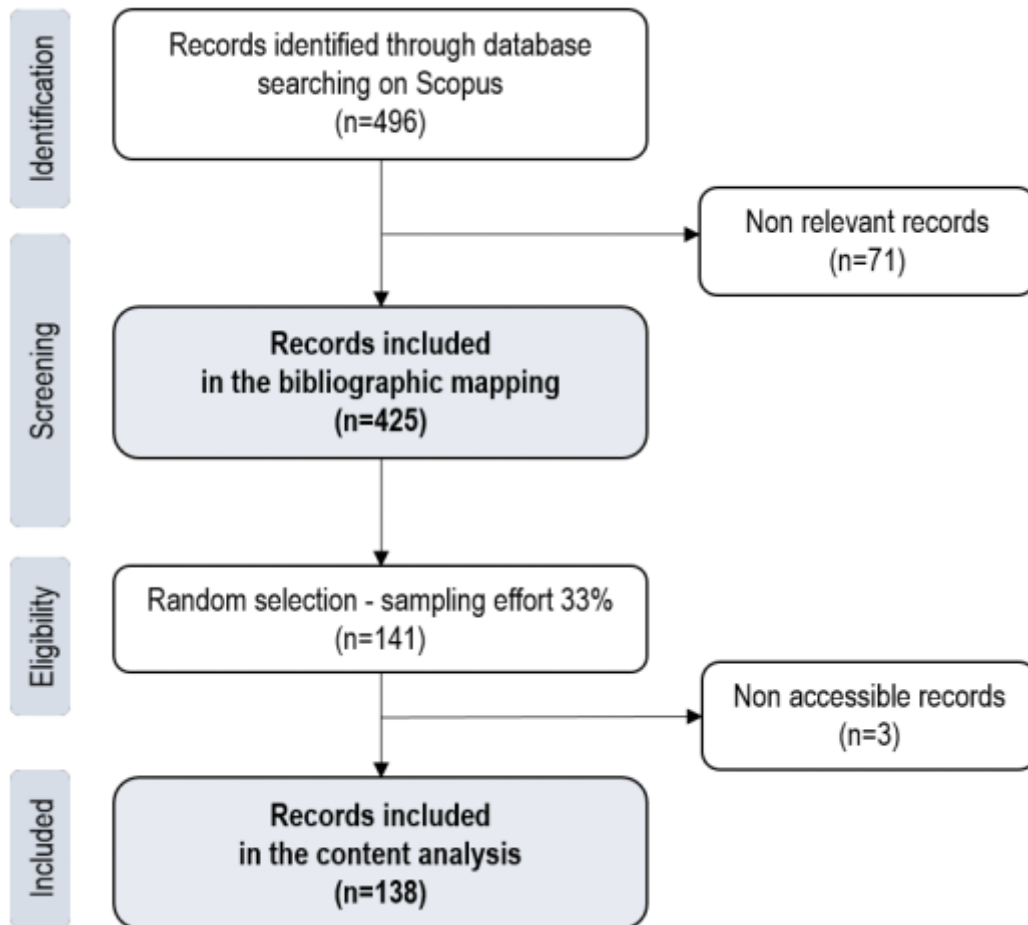


Figure 1

Main steps of the corpus identification

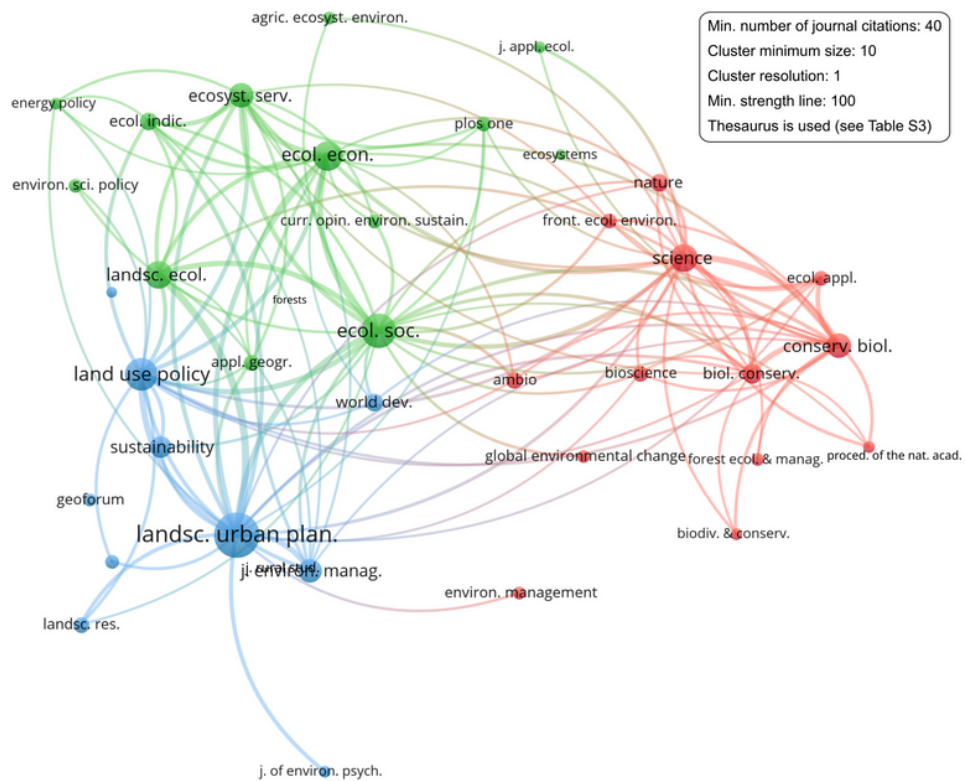


Figure 2

Clustering of the journals co-citation links, identified with VosViewer

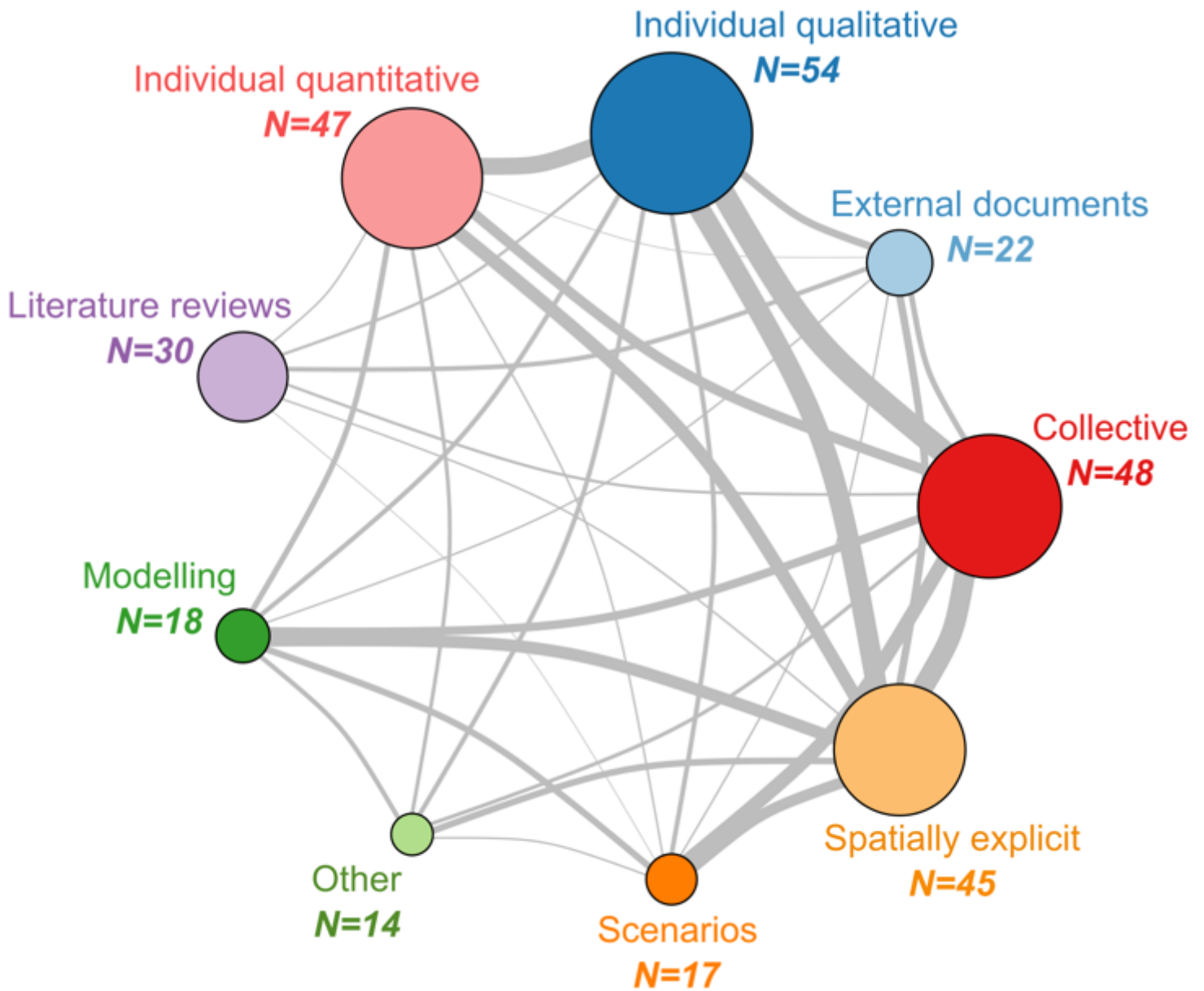


Figure 3

Network of the methods used in the sub-corpus studies (N=138). Circle sizes are proportional with the number of times the method was used. Edge sizes are proportional with the co-occurrence of two methods in the same study

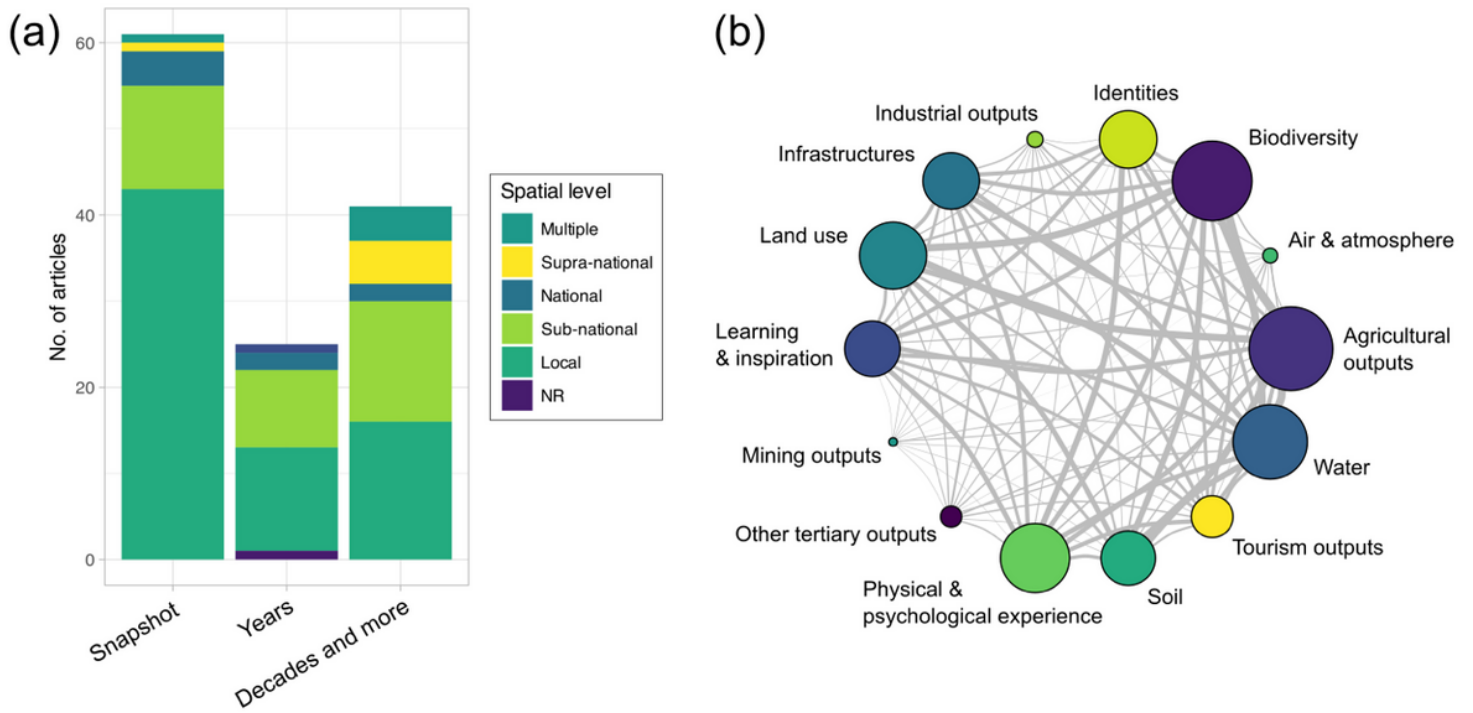
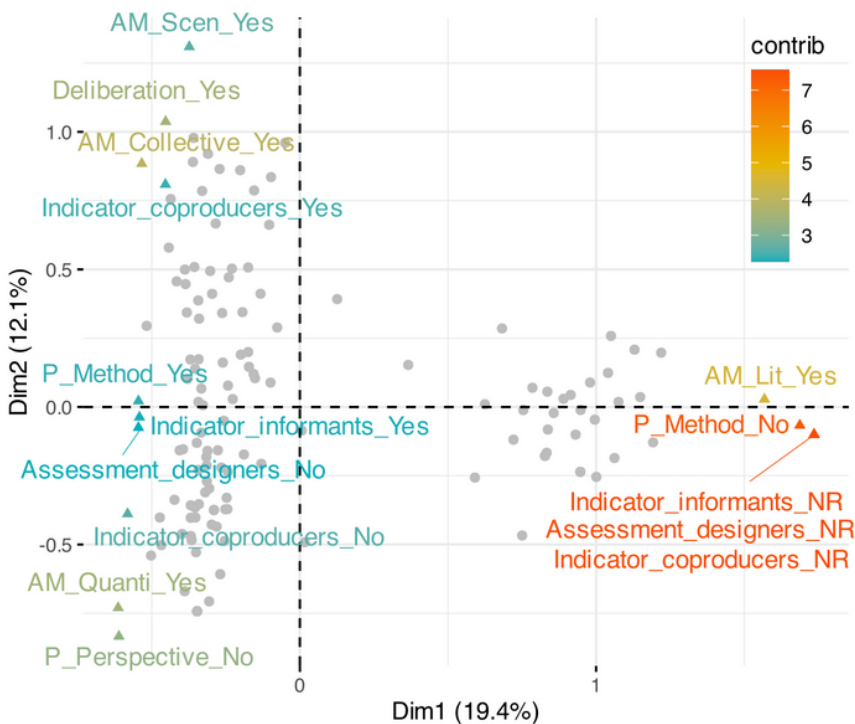


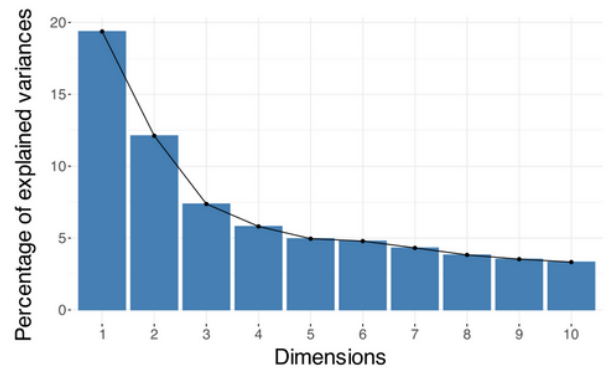
Figure 4

Characteristics of PLSA indicators. a) Number of case studies according to the indicators' spatial level and temporal scope. b) Network of the topics covered by indicators: circle sizes are proportional with the number of times topics were covered; edge sizes are proportional with the co-occurrence of two topics in the same study.

(a) MCA biplot



(b) Screeplot of the eigenvalues



(c) HCPC dendrogram

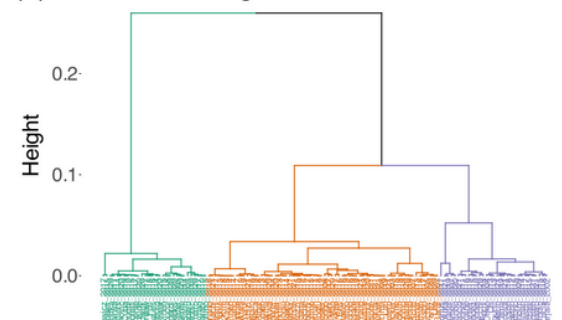


Figure 5

MCA and HCPC performed on the 127 case studies of the literature sub-corpus. (a) MCA biplot in the two first axes, including individual publications (grey points) and the 10 most contributing modalities (in color gradient). (b) Screenplot of the eigenvalues. (c) Dendrogram of the resulting HCPC with colors delimitating the three identified clusters

Supplementary Files

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