

A bibliometric review of stakeholders' participation in sustainable forest management

Irene Dobarrio Machado Ciccarino ^a and Maria Eduarda da Silva Teixeira Fernandes ^b

^aBusiness Research Unit, University Institute of Lisbon (BRU-ISCTE-IUL); ^bSchool of Technology and Management, Centre of Applied Research in Management and Economics of Polytechnic Institute of Leiria (ESTG/CARME/IPLeiria), Campus 2 - Morro do Lena, Alto do Vieiro, Apt 4163, Edifício D, Leiria, 2411-901, Portugal

Corresponding author: Irene Ciccarino (email: irene.ciccarino@iscte-iul.pt)

Abstract

Although stakeholders' participation in forest management helps overcome problems and conflicts that prevent sustainable solutions, different approaches and nomenclature for similar contents in the literature hinder theoretical progress on the topic. This study organises existing information through a bibliometric analysis of scientific papers from the last 30 years (1991–2021) on sustainable forest management, focusing on the stakeholders' participation. Results demonstrate that stakeholders' participation in sustainable forest management gained relevance from 2017 onwards. Case studies are predominant (66%) and six major trends were identified. The first emphasises a systemic approach to participation. The second updates the community management discussion. The third studies historical problems related to the use of resources, rights, and services. The fourth focuses on regional assessments and studies. The fifth concerns assessment, decision-making, and planning, including issues related to certifications and policies. The sixth discusses innovation related to adaptation, climate change, equity, and resilience. The studies included in this last classification are problem-solving-oriented and seek new forest management. Although important, the role of innovation in stakeholders' participation in sustainable forest management is overlooked, which constitutes an avenue for future research.

Key words: sustainable forest management, stakeholders' participation, sustainability, bibliometric analysis, thematic analysis

1. Introduction

The international political agenda has already acknowledged forestry relevance in past decades. Forests play an important role in sustainable development (Högbom et al. 2021), mainly because forests cover more than 30% of Earth's land area and contribute in several ways to value creation (FAO 2020). Forests are complex ecosystems that provide economic, environmental, and social benefits ranging from food security, energy supply, preservation of water resources, soil protection and desertification prevention, rural development, and poverty reduction, to name just a few (FAO 2005). Measuring forests' total economic value to guarantee their sustainable management should thus include both use and non-use values, as well as market and non-market values (Pearce 1993; Pak et al. 2010; Taye et al. 2021; Takahashi et al. 2022). However, not a straightforward task, measuring the economic value of forests is crucial to defend their relevance for the sustainability of the Planet (Croitoru 2007; Loomis et al. 2019).

Sustainable forest management (SFM) is a paramount challenge to maintain forest productivity and renewal capacities, as well as its contribution to biodiversity and ecology

(Högbom et al. 2021; Martinho and Ferreira 2021). The importance of stakeholders' participation in SFM is much recognised yet underdeveloped. Existing studies on forest sustainability highlight the need for management to address several variables but not stakeholders' engagement (Martinho and Ferreira 2021). Research on bottom-up forest management strategies through participatory processes is mainly based on dispersed case studies (Fraser et al. 2006; Valente et al. 2015), which compromises the generalisation and identification of critical issues. Stakeholders' participation in forest management has been studied differently since the 1960s in a transdisciplinary and multidimensional way (Romanelli and Boschi 2019). In this sense, the integrative stakeholder theory can provide epistemological guidance to systematise evidence from theory and practice, as mentioned by Johnson-Cramer et al. (2021) and Kujala et al. (2022), benefiting from new insights bound to pragmatic aims (Pouryousefi and Freeman 2021) instead of the typical institutional standpoint.

Despite a practice-oriented focus that links SFM to stakeholder engagement through their definition, theoretical patterns, and challenges (Fraser et al. 2006; Miller and

Nadeau 2020; Kujala et al. 2022), studies focused on stakeholders and forest management are still lacking (Romanelli and Boschi 2019). For example, Johnson-Cramer et al. (2021) performed a bibliometric study focused on stakeholder theory in general instead of stakeholders' involvement in SFM. Thus, the need for reviews narrowing the scope to specific domains is a gap in the literature that Johnson-Cramer et al. (2021) identified. Deepening existing knowledge about the literature intersecting stakeholders' theory and sustainable forest can shed light on the most relevant issues and help develop both theories. However, if stakeholders' engagement in SFM is epistemologically manageable and desirable in practice, identifying studies on the subject is not straightforward. This situation is not due to a lack of studies but because of dispersed literature utilising different approaches and nomenclature for similar content and hindering theoretical progress. Therefore, knowledge must be systematised and framed, highlighting patterns and creating the basis for further development (Venkatraman and Ramanujam 1986; Johnson-Cramer et al. 2021; Kujala et al. 2022).

Agreed-upon definitions and methods are needed to increase these studies' analytical capacity (Mackenzie and House 1978), namely bibliometric studies. Bibliometric studies have received considerable attention in recent decades due to their capacity to systematise dispersed concepts, highlight latent issues, and explain how knowledge evolves (Villas et al. 2008; Romanelli and Boschi 2019; Johnson-Cramer et al. 2021). The results must guide future research by summarising current trends and clustering them in a conceptual framework. That is the aim of this study for the case of stakeholder participation in SFM. The paper starts by presenting the theoretical background of the evaluated topics before detailing the methodology, discussing the results, and concluding.

2. Theoretical background

2.1. Stakeholder theory and engagement

Stakeholder theories vary from the seminal concept of stakeholders as individuals, groups, or organisations that affect or are affected by some initiative (Freeman 1984) to the instrumental perspective, which focuses on the benefits of considering and involving them in the initiative (Jones 1995). Although stakeholder theorists have been studying these complex multilevel interactions since 1984 (Kujala et al. 2022), it is still mainly institutional work that analyses relationships from an organisational standpoint even when examining stakeholders' wills and behaviours (Jones 1995; Johnson-Cramer et al. 2021; Kujala et al. 2022). An emerging answer to this issue is the stakeholder engagement concept, which also appears like collaborative, participatory, and co-creation practices. Stakeholder engagement is yet an unclear construct that has gained increasing attention in the 2000s, but it is also a heterogeneous or fragmented research subject (Kujala et al. 2022).

The lack of a shared understanding and the variance to related constructs hinders theoretical progress. Knowledge

must be systematised and framed, highlighting patterns and creating the basis for further development (Venkatraman and Ramanujam 1986; Johnson-Cramer et al. 2021; Kujala et al. 2022). Since 1995, to address this issue, many literature reviews and meta-theoretical analyses of stakeholder theory have been performed (Johnson-Cramer et al. 2021), but as far as we know, only Kujala et al. (2022) drew on stakeholder engagement, stating: "Stakeholder engagement refers to the aims, activities, and impacts of stakeholder relations in a moral, strategic, and/or pragmatic manner" (p. 4). Therefore, pragmatic pieces of evidence are still lacking in the research field because empirical studies on practice are less developed than those on the premises that support practice (Pouryousefi and Freeman 2021).

There is a stakeholder theory, but numerous studies often apply its constructs without proper rigour (Johnson-Cramer et al. 2021). One example comes from environmental management and policy literature that has developed a distinctively practice-oriented approach to stakeholder engagement despite a weak effort in theoretical development (Kujala et al. 2022).

"(...) research has focused on explaining the processes through which various stakeholders can be included and acknowledged in decision-making and policy-making processes, especially related to environmental and sustainability issues. Furthermore, much of the environmental management and environmental policy research does not explicitly refer to stakeholder theory or stakeholder engagement research" (Kujala et al. 2022, p. 6).

2.2. Stakeholders in sustainable forest management

SFM signals a change in forest management policy and practices, moving from maximising the sustainable yield of forests to ensuring its multifunctional role. It is geared towards a bottom-up outlook in the decision-making process, assuming that people, who deal with most of the burden of ecological problems, should be empowered (Valente et al. 2015).

Environmental management and policy literature developed a distinctively practice-oriented approach (Kujala et al. 2022), including forestry studies with stakeholders' participation prior to stakeholder theory (Romanelli and Boschi 2019). Stakeholders and forestry share challenges and can benefit from dedicated studies (Romanelli and Boschi 2019; Johnson-Cramer et al. 2021).

Forestry is generally orientated towards sustainability (Högbom et al. 2021; Martinho and Ferreira 2021), as it is about balancing different goals to achieve optimal ecosystem services, empower stakeholders, and avoid adverse environmental effects (Högbom et al. 2021). Like sustainable development, SFM is a process rather than a punctual accomplishment (Valente et al. 2015).

Forest studies are frequently included in the ecological and social research areas, although these have developed independently and are not easily articulated (Romanelli and Boschi 2019). Forestry includes dimensions that can be as specific as soil characteristics or as broad as ecology,

ecosystems, biodiversity, or climate change. It also deals with socioeconomic frameworks, public policies, institutional context, and new technologies (Martinho and Ferreira 2021). There are also many forest-decision levels and various property rights to consider (Valente et al. 2015; Romanelli and Boschi 2019). As pointed out by Högbom et al. (2021): “Routes towards integration and synergy between different land-use modes and interests have to be mapped and promoted.” (p. 8).

Considering stakeholders and SFM together can help deal with complexity and identify insights, methods, and practices to comply with current social and environmental challenges (Fraser et al. 2006; Valente et al. 2015; Högbom et al. 2021).

As a benefit broadly acknowledged in stakeholder theory, social participation in decision-making to mitigate conflicts and misunderstandings and increase trust is also valued in SFM (Johnson-Cramer et al. 2021; Kujala et al. 2022). This premise is part of widespread international agreements and guides several forest policies, which recognise that the contributions of all relevant stakeholders are essential for an effective SFM (UN 2017).

Stakeholder engagement literature overemphasises positive issues, whereas its dark side is overlooked, according to Kujala et al. (2022). Stakeholder engagement is associated with responsible leadership and management, considered a moral and democratic way to pursue goals, with the potential to bring together different perspectives in an innovative way, building bonds and solving problems. However, as Kujala et al. (2022) also point out, stakeholder engagement can lead to ill-intended goals. It can also be superficial or deceptive, as occurs in greenwashing (Lyon and Montgomery 2015), either intentionally or not. Although using adequate methodologies for stakeholders’ engagement can reduce the negative aspects (Fraser et al. 2006; Romanelli and Boschi 2019; Fernandes et al. 2021; Johnson-Cramer et al. 2021), the risk of overstated stakeholder expectations or prolonged decision-making processes exists and need to be considered.

On the contrary, forestry studies focus more on the negative aspects and problems concerning stakeholders’ engagement in forest management. From issues related to the recruitment and involvement of the right participants in the process, with the proper dynamics (Egunyu et al. 2020), allowing clear communication and fair chances for all to speak and be heard, controlling for power abuses (Miller and Nadeau 2020), to the need for a more systemic engagement of stakeholders in forest management (Ciccarino et al. 2023), forestry literature indicates this is not a successful process. The current paper intends to increase knowledge about trends in the literature discussing stakeholder engagement for SFM through a bibliometric study. Targeting additional information about stakeholders’ participation in SFM, thus narrowing the analysis from stakeholder theory to specific domains, such as SFM, the current paper responds to a need identified in previous studies (Fraser et al. 2006; Romanelli and Boschi 2019; Johnson-Cramer et al. 2021). The following section details the methods and procedures used to achieve that goal.

3. Methodology

3.1. Research design

A bibliometric study should highlight changes and trends in the course and content of scientific research, measure researchers’ contributions to the literature, and favour a transdisciplinary approach (Donthu et al. 2021), which is the main goal of our study: analysing the intersection of stakeholders’ theory with SFM literature. In this sense, the current study is exploratory and descriptive research developed through an organised process for selecting and describing peer-reviewed papers dealing with stakeholders’ participation in SFM (Ciccarino and Fernandes 2023). This paper covers studies published in the last 30 years (i.e., 1991–2021) through a bibliometric study, analysing the following aspects: (1) the main topics and concepts addressed by the retrieved literature, (2) timeline evolutions, (3) topic relevance measured by citations and scientific index (h-index from Scimago Journal & Country Rank), (4) status of the literature considering the methodology used in the studies, (5) authors contribution, (6) countries (or regions) where the studies were conducted, (7) funding support, and (8) leading journals. Besides offering comprehensive and relevant coverage of the available literature and providing a theoretical and empirical description of its past and current state, the results from this analysis highlight patterns and trends based on clusters of co-citations.

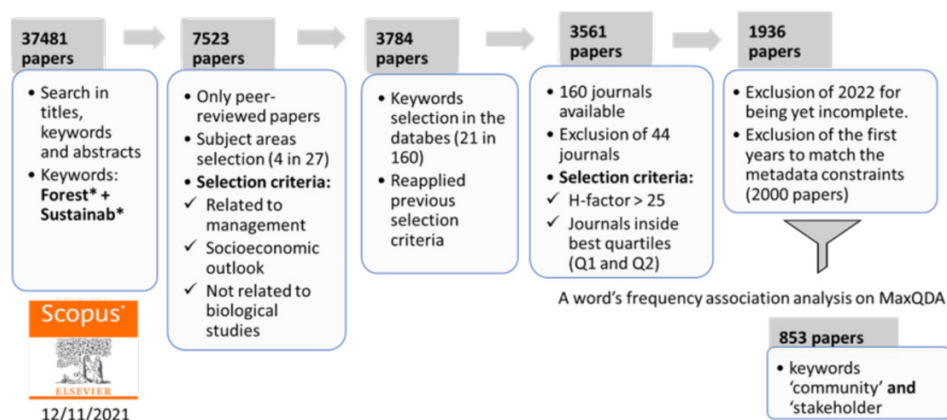
Data were retrieved from Scopus and Web of Science (WoS), the two most comprehensive, credible, and relevant scientific search engines and databases (Klenk et al. 2010; Pranckutė 2021), widely used in bibliometric studies. The analyses occurred between October and December 2021 and used the typical software for this type of study: VOSviewer vs1.6.17, MaxQDA vs22, EndNote 20, databases’ analytical tool, and Excel. All analysis discarded “stopwords”, i.e., repeated words or terms and meaningless/irrelevant words for the study.

The papers’ quality was assessed using Scimago Journal & Country Rank, with the journal’s impact factor and quartile also considered. The thematic analysis was performed using VOSviewer, namely the co-occurrence matrix used to highlight networks and discriminate mutually exclusive clusters. It distributes items in clusters through colours, node size, and lines. The cluster density relies on the items’ distance. The line’s thickness sets the strength of the relationship between two items (i.e., links). The absence of links means non-co-occurrence. The node’s size is proportional to the number of items and the thickness of the links. Finally, the size of the item’s name expresses its frequency. An item may identify papers, authors, keywords, journals, cited references, organisations, or countries. Descriptive statistics complemented the analyses.

3.2. Sample selection

Stakeholder participation in SFM literature could be addressed from different perspectives, but when performing a bibliometric study, some delimitation criterium must be used. For instance, the initial search terms used for sample selection consist of a methodological choice that inevitably

Fig. 1. Paper selection process. Source: Authors



influences the study results. In this sense, to guarantee the initial database was as comprehensive as possible, the current study started defining the search domain by using the keywords "Forest*" and "Sustainab*" in the titles, abstracts, and keywords. Considering the conceptual variance in the papers retrieved, mainly due to using two different databases, only Scopus results were retained. This decision is a methodological issue acknowledged in other bibliometric studies (Donthu et al. 2021) and may be justified by two main reasons. First, Scopus' database offers better filters and a sample more aligned with the research goal. Second, the added complexity of WoS enlarged the sample with papers beyond the delimitation range.

After the exploratory analyses, 37 481 papers were retrieved from Scopus, illustrative of the transdisciplinary characteristics of forest-related studies. These articles were published in journals classified in 27 thematic areas defined by Scopus, as distinct as Engineering, Mathematics, or Psychology. Therefore, to specifically examine stakeholders' participation in SFM, articles included only in four thematic areas were selected, adding to the generic query "limited to subject areas: environmental science, social science, business and economics". Only full papers were selected at this stage.

According to the retrieved papers from the databases (Scopus and WoS), combining forest management and sustainability started in the 1970s. We took three steps to ensure the use of the correct keywords in this study: (1) exploratory analyses in each database, (2) exploratory analyses in MaxQDA by word frequency, and (3) search for bibliometrics studies (generic query + bibliometric). The search retrieved only six bibliometric studies in line with the current paper's research goal, but none specifically targeted stakeholder participation in SFM (see Appendix A, Table A2). Bibliometric articles were published less than 10 years ago, suggesting a maturation point of epistemology by the effort towards systematisation and consensus (Flick 2014; Villas et al. 2008). Keyword selection for the current study considered the keywords listed in these bibliometric papers but also relied on the MaxQDA words frequency tool to highlight the most frequent combinations considering three blocks: (1) forest*; (2) sustainab*;

and (3) manage*. As shown in Table A1 in Appendix A, the keywords "community" and "stakeholder" stand out as the most representative for narrowing the sample. The selection of keywords linked with these two was performed using pivot tables to combine the frequency information from MaxQDA and Scopus. Twenty-one keywords from 160 available in the Scopus engine database were selected (Appendix A, Table A1). Figure 1 summarises and illustrates the stages of the sample selection process until it becomes manageable.

The final sample was downloaded in 28 November 2021 and consisted of 853 papers published from 1991 to 2021. The bibliometric indicators examined were: (i) 2841 authors, (ii) 10 261 authors' keywords, (iii) 211 journals, (iv) 108 countries, (v) 159 funding sponsors, and (vi) 160 universities. Data were analysed and considered stable, cohesive, or homogeneous if the variation coefficient was less than or equal to 15%, moderate between 15% and 30%, and highly dispersed or heterogeneous when greater than 30% (Black 2010).

4. Results

4.1. Topic analysis

The 100-paper milestone was reached in 2004, 10 years after the general theme had matured (i.e., Forest*+sustainab*). Figure 2 shows both queries' timelines and highlights that stakeholders' participation is underrepresented in the SFM topic. On average, there are 28 publications per year, and 2007 was the first time the annual publication was higher than the historical average. From that year onwards, publications begin growing steadily (coefficient of variation = 19% < 30%). Following the trend of the general theme, publications doubled in 2017 and became stable after that year (above 60 publications per year, coefficient of variation = 12% < 15%). Before 2007, studies about stakeholder participation in SFM represented 15% of SFM literature, and after that 23%.

Of the sample's 211 journals, 93 have interrelated papers, demonstrating cohesion within the topics. The analysis showed that this topic is published in prestigious journals; hence, research on stakeholders' participation in forest management has a high capacity for dissemination. Regardless of the impossibility of identifying patterns that

Fig. 2. Timeline. Source: Scopus metadata in Excel**Table 1. Main journals.**

Journal	Citations account	Papers	H-factor	Quartile	Country
Ambio	121	7	127	Q1	Netherlands
Development and Change	371	6	93	Q1	United Kingdom
Ecological Indicators	487	19	127	Q1	Netherlands
Ecology and Society	748	27	141	Q1	Canada
Environmental Conservation	393	13	87	Q1	United Kingdom
Environmental Management	765	32	118	Q1	United States
Environmental Science and Policy	243	9	115	Q1	Netherlands
Forest Ecology and Management	1431	52	176	Q1	Netherlands
Forest Policy and Economics	1546	81	68	Q1	Netherlands
Geoforum	121	7	116	Q1	United Kingdom
Global Environmental Change	411	7	177	Q1	United Kingdom
International Forestry Review	674	50	48	Q2	United Kingdom
International Journal of Sustainable Development and World Ecology	213	13	43	Q2	United Kingdom
Journal of Environmental Management	1247	27	179	Q1	United States
Journal of Sustainable Forestry	392	49	29	Q2	United Kingdom
Land Use Policy	531	34	115	Q1	United Kingdom
Ocean and Coastal Management	266	12	84	Q1	United Kingdom
Society and Natural Resources	276	11	87	Q1	United Kingdom
Sustainability	200	23	85	Q2	Switzerland
World Development	186	9	175	Q1	United Kingdom
Total		488			

Source: VOSViewer 1.6.17, Co-occurrence analysis with Source as an analysis unit.

distinguish a specific journal's cluster, the data show strong links among some of the most important ones. That suggests cohesion in the research, despite the literature's diversity. Knowledge on this subject is not unrelated, and research gets easy once there is a roadmap. Table 1 shows the 20 most prominent journals representing 57% of the publications in the sample.

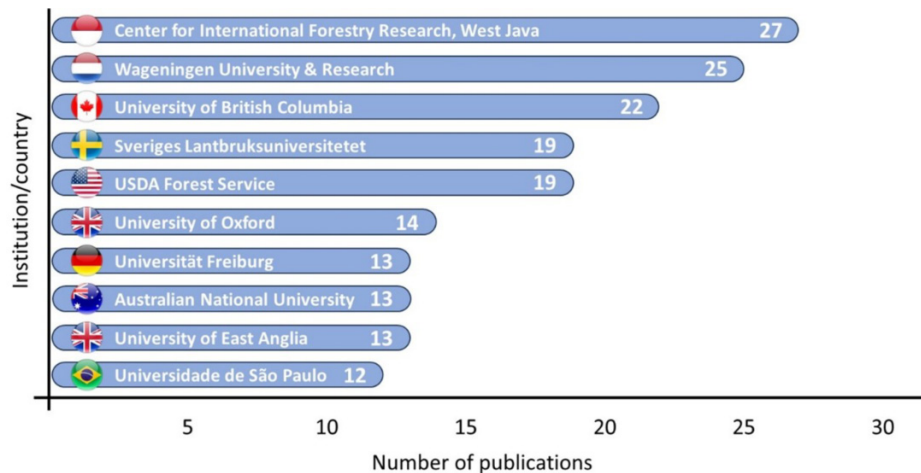
The selected journals also align with each country's production, as the Scopus analytical tool revealed. The United States, the United Kingdom, and Canada are the leaders in this scientific production. The Netherlands occupies the eighth position and Switzerland the 17th. However, considering funding expenditure, the European Union leads, followed close by Canada. The top 10 universities related to the sample production are shown in Fig. 3 and include new countries in the relevance list (i.e., Brazil, Australia, Germany, Sweden,

and Indonesia). The country analysis highlights the subject's relevance and helps outline research strategies.

4.2. Thematic analysis

Keyword analyses offer a synthesis of the research topic, highlighting important terms addressed by the authors, which may be a valuable contribution and guidance for those taking the first steps in studying stakeholders' participation in SFM. Figure 4 shows the 40 most frequent keywords. The bigger the word, the more relevant it is concerning its frequency and co-occurrence.

Keyword co-occurrence analyses conducted with VOSViewer considered authors in the sample with five or more citations, as represented in Fig. 5. Seven highly connected clusters were found, suggesting cohesion in the scientific production related to forest, sustainability, and

Fig. 3. Top 10 universities and research units. **Source:** Scopus analytical tool.**Fig. 4.** Main keywords. **Source:** Authors.

stakeholder participation. Thus, sustainability, SFM, and forest governance are central themes, putting their clusters in a central position (i.e., Clusters 4, 5 and 1, respectively). As expected, keywords related to sustainability, forest conservation and management, and stakeholder participation are present in all clusters due to the research delimitation during the sample extraction. Figure 5 shows that although the clusters have many interactions, these can be clearly defined.

The keywords' co-occurrence analysis also allows us to track the literature evolution over the years. The analysis chart in Fig. 6 ranges from dark blue to yellow to illustrate the evolution from the oldest to the newest trend. Figure 6 depicts the topic maturation in the previous two decades in the small networks and the synthesis of the past 30 years in the larger network.

Co-occurrence gained importance from 2000 onwards in line with the timeline analysis (Fig. 2). Until 2006, research stream is towards the keywords: community-based, clean development mechanisms, and illegal logging. From 2006 until 2011, the research evolved to use of wide-concept keywords such as collaboration, participatory research, participatory

management, ecosystem management, and sustainable management. At the same time, concerns about evaluation also emerge, as becomes apparent through the keywords "criteria and indicators." Additionally, keywords such as Mexico and Costa Rica reflect the presence of case studies, thus highlighting the type of study available.

The current literature state is settled from 2010. Nowadays, the research is moving into a more systemic approach with keywords like ecosystem services, socio-ecological systems, landscape approach, forest landscape restorations, and trade-offs.

As older papers tend to have more citations because they have been available for longer, citation analysis was normalised, allowing newer high-relevant papers a chance to stand out. The VOSViewer analysis retrieved 27 most prominent papers (Fig. 7 and Table A3 in the Appendix A).

Overall, only three papers tested hypotheses, most papers have a regional focus (41/51), and from the ten with a broader focus, seven are theoretical. The co-citation analysis, illustrated in Fig. 8, identifies papers referencing each other, an indicator of treating related subjects.

The number of clusters retrieved by keyword co-occurrence and co-citation analysis and their content were similar. The better-established trends are represented by clusters 1 and 2, the biggest and the densest. Cluster 1 (red) includes studies that emphasise stakeholder participation in contexts like biodiversity, bioenergy, landscape use, livelihoods, and resource management. In addition, papers in this cluster assume a systemic approach, in line with current changes in the topic from 2017 onwards, when the subject gains more relevance, frequency, and stability in its annual publications. Cluster 2 (green) maintains and updates the discussion about community-based (resource pool, land use, and rights) that began in the 1960s.

Cluster 3 (dark blue) and Cluster 5 (purple) are market-oriented, but the latter is slightly small, which can indicate recent trends. Cluster 3 studies historical problems such as resource use, illegal logging, agriculture, corruption, and indigenous issues. It also tackles some market solutions such as environmental services and REDD+ (Reducing

Fig. 5. Keywords network. **Source:** Own elaboration (VOSViewer 1.6.17, Co-occurrence analysis with Author's keywords as analysis unit)

Legend:

Cluster 1 (red; 21 keywords): stakeholder and NGO participation in contexts like biodiversity, bioenergy, landscape use, livelihoods, and resource management.

Cluster 2 (green; 21 keywords): community-based studies, collective actions, public participation in ecosystem management, rural contexts and ecotourism.

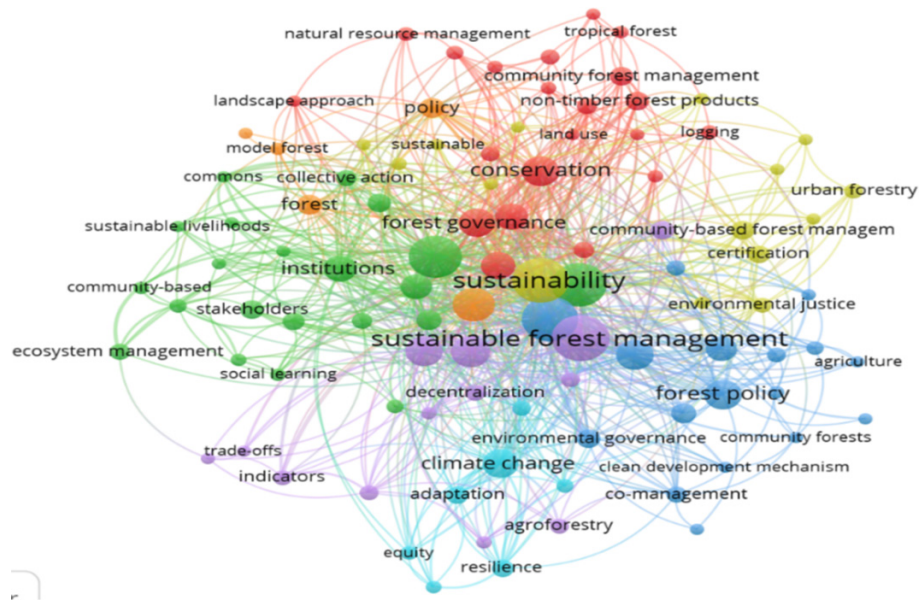
Cluster 3 (dark blue; 17 keywords): governance, illegal logging, REDD+, agriculture, corruption, indigenous

Cluster 4 (golden; 15 keywords): certification, environmental justice, evaluation.

Cluster 5 (purple; 13 keywords): criteria and indicators, ecosystem services, socio-ecological systems, trade-offs

Cluster 6 (turquoise; 7 keywords): adaptation, climate change, equity, resilience

Cluster 7 (orange; 5 keywords): forestry, model forest, policy



Emissions from Deforestation and forest Degradation), the sustainable management of forests, and the conservation and enhancement of forest carbon stocks. Cluster 5 emphasises evaluations and regional studies. Trade-offs, ecological perspectives, and ecosystem services are studied through a market-oriented perspective.

Cluster 4 (golden) is concerned with assessment, decision-making, and planning. Papers in this cluster study certifications, policies, and results. Finally, Cluster 6 (turquoise + orange) deals with innovation issues. Papers in this cluster include studies about adaptation, climate change, equity, resilience, adopting a problem-solving-oriented approach, and searching for new forestry and forest management policies.

5. Discussion

The results of the current paper contribute to the identified gap in the literature on the need for reviews narrowing the scope to specific domains (Johnson-Cramer et al. 2021), as is the case for stakeholders' participation in SFM. As illustrated in Fig. 2, stakeholders' participation in the SFM topic is an extremely small part of the research in the area. Similar to what happened with research for forestry (Romanelli and Boschi 2019) and stakeholders' engagement (Kujala et al. 2022), our results demonstrate that research on stakeholders' participa-

tion in SFM mainly relies on case studies (66%). This result suggests a pre-paradigmatic stage because agreed-upon definitions and methods are needed to increase the studies' analytical capacity (Mackenzie and House 1978). However, the data show a lag between both epistemologies, despite a continued increase from 2007, with research on stakeholders' participation in forest management being published in prestigious journals and cohesive links among notable publications.

According to the keyword co-occurrence analysis results, it was possible to identify sustainability, SFM, and forest governance as central themes. These results highlight the centrality of stakeholder and NGO participation in forest governance and suggest that literature is moving towards: (1) an evaluation process related to certifications and analysis concerning environmental justice and (2) an ecosystem perspective, corroborating previous studies (Högbon et al. 2021; Martinho and Ferreira 2021; Xu et al. 2021).

Considering the evolution of the topics over the years until 2006, illegal logging is one of the research streams that stands out. It is identified as a pervasive problem throughout the world; with various negative social, economic, and environmental impacts (e.g., degraded forest ecosystems, loss of biodiversity, contribution to crime and corruption, and an impediment to economic development), illegal logging was

Fig. 6. Keywords' overlay analysis. **Source:** Own elaboration (VOSViewer 1.6.17, Co-occurrence analysis with Author's keywords as analysis unit).

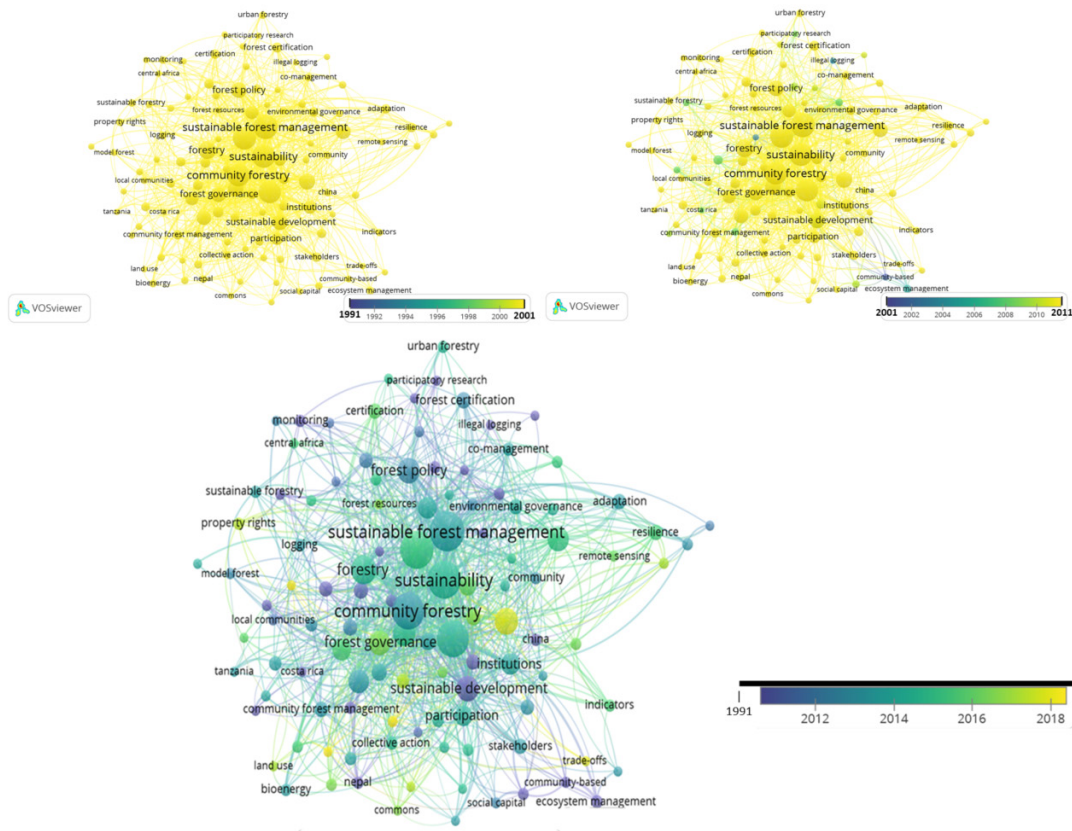
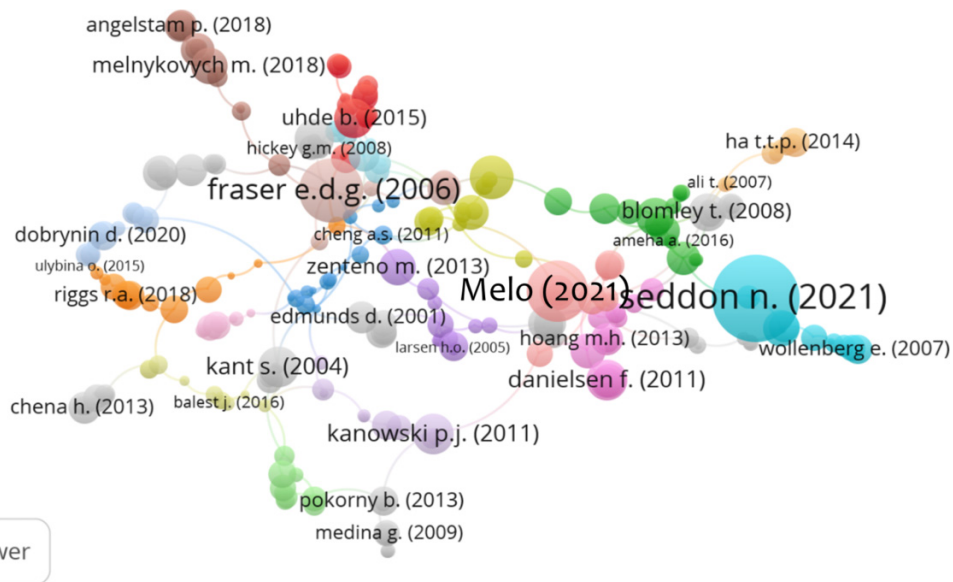


Fig. 7. The most prominent papers. **Source:** VOSViewer 1.6.17, normalised co-citation analysis with documents as an analysis unit.



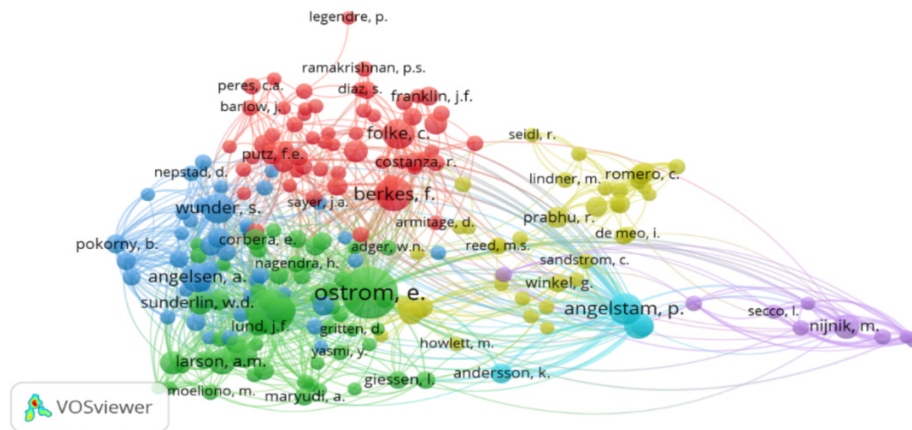
in the agenda of public authorities at this time. In the European Union and the USA, this problem was tackled by establishing several measures within the European Union Forest, Law, Enforcement, Governance and Trade (FLEGT) Action Plan

2003 (EU 2003) and the Tropical Forest Conservation Act in the USA (USA 1998), for example. Thus, stakeholders' engagement in forest management to deal with this type of problem gained importance at this time.

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Fig. 8. Co-citation analysis. **Source:** Own elaboration (VOSViewer 1.6.17, co-citations analysis with Authors as an analysis unit). Legend:

- Cluster 1 (red; 122 authors): systemic approach (anthropocene, social-ecological systems, and sustainable development goals)
- Cluster 2 (green; 118 authors): community-based (resource pool, land use, and rights)
- Cluster 3 (dark blue; 76 authors): environmental services and resources use
- Cluster 4 (golden; 66 authors): assessment, decision-making, and planning
- Cluster 5 (purple; 29 authors): timber (wood), European forestry, ecological perspective, developing and transitioning countries
- Cluster 6 (turquoise; 7 authors): innovation



From 2006 until 2011, there was an evolution for wider-concept keywords like collaboration and participatory management or ecosystem management and sustainable management. At the same time, the mention of criteria and indicators appears, which coincides with FSC's creation of certification standards and codes of good practice, adopted in an ever-increasing number of countries around the world. These results thus indicate that from command-and-control forest policies focused on solving concrete problems, there is an evolution towards bottom-up approaches for more integrated and sustainable forest management.

The results obtained in the current study indicate that the research is adopting a more holistic perspective, seeking to reflect the total value of the forest, including ecosystem services and the impact of interaction with human beings, as confirmed by some recent studies (Loomis et al. 2019; Takahashi et al. 2022; Taye et al. 2021). Consequently, the literature has evolved from the community-based concept to a broader perspective as the importance of stakeholder participation in forest matters became more evident. This result is consistent with the analysis performed to manage the sample size. Concepts like governance, forest policy, community forestry, and ecosystem management have emerged in the abstract analysis using MaxQDA. Therefore, it suggests that the sample reflects the research goals since it has face and construct validity increasing the results' reliability (Remenyi et al. 1998; Flick 2014).

Finally, emerging clusters from the literature help establish different trends that can inspire and guide further studies. Cluster 1 includes studies that consider stakeholder participation under a more systemic approach, in line with changes in the topic from 2017 onwards. This shift also occurred when the European Commission adopted the New EU

Forest Strategy for 2030, a cornerstone initiative within the EU Biodiversity Strategy for 2030, both part of the European Green Deal broader strategy for Europe's carbon neutrality in 2050. The effective involvement of the various types of stakeholders in all phases of implementing this strategy is one of its fundamental pillars (EU 2021).

Although not new, Cluster 2 treats the problem of proper management of public property forests used as a common pool resource. This situation is still an issue, as it implies local communities trading off direct economic benefits they receive from forest areas and other forest-based ecosystem services (Tadesse et al. 2022). Therefore, stakeholders' participation and engagement in forest management of these areas is crucial, as Cluster 2 confirms.

Cluster 3 approaches some historical problems in forest management (e.g., illegal logging previously mentioned) and tackles some market solutions, such as environmental services and REDD+). Stakeholders' engagement and participation are prioritised under these new solutions, like the ones the UNFCCC initiative REDD+ foresees. Thus studies sharing different experiences and lessons learned are valuable for knowledge expansion in this area. Furthermore, evaluation and monitoring are fundamental for implementing the previously mentioned forestry strategy policies in the EU, REED+ activities, or certifications such as that of the FSC, thus, justifying the appearance of these studies in Cluster 4.

Cluster 5 emphasises evaluations and trade-offs through a market-oriented perspective in line with current literature (Loomis et al. 2019; Taye et al. 2021; Takahashi et al. 2022). It suggests an increasing interconnection between accountability and economic value represented in the current European corporate sustainability report directive (CSR; EU 2023).

Finally, Cluster 6 includes studies that consider the need for innovation to deal with the challenges related to an SFM, moving from the current solutions and political instruments towards more adequate (and innovative) forestry and forest management policies. Papers included in this cluster discussed developing criteria and indicators for implementing SFM, building decision-support systems, and "landscape laboratories" to maintain and develop long-term information. The need for functional green infrastructures, as well as the use of wood and biomass, spatial planning, and the transition from government to governance are some areas in need of innovation to maintain functional ecosystems for sustainable societies (Angelstam et al. 2018; Seddon et al. 2021). Although this is an emergent research area, it may become crucial in the future considering the difficulties of achieving a sustainable development model with the current practices and approaches, giving this cluster excellent growth potential.

6. Conclusion

This study mapped the status of literature concerning stakeholders' participation in SFM, highlighting its position in the broad topics of forestry and sustainability. The main conclusion is that stakeholders' participation is underrepresented in the SFM topic. By summarising and describing bibliometric indicators, the current study helps further scientific developments, namely, considering the six trends or tendency areas identified: (1) stakeholder participation through a systemic approach; (2) discussion about community-based forestry; (3) historical problems concerning resource use, rights, and ecosystem services; (4) evaluations and regional studies; (5) assessment, decision-making, and planning (including certifications, policies, and results); and (6) innovation, to deal with adaptation, climate change, equity, and resilience. Based on the co-citation analysis illustrated in the network maps, these clusters emerged beyond the most cited publications and represented the status of the literature on stakeholders' participation in SFM. Each cluster contributes to the establishment of the topic in the literature. In this sense, the three first clusters (1, 2, and 3) suggest that stakeholders' engagement in forest management is acknowledged as critical to addressing global problems such as climate change, using a systemic approach and considering the total value of the forest, including the ecosystem services, or handling the mismanagement of common pool resources. Thus, attaining the UN Sustainable Development Goals, particularly SDG no. 15 about Life on Land, or effective implementation of the European Green Deal and its Forest Strategy, implies appropriate stakeholder participation and engagement. Its importance for assessment and subsequent decision-making is further highlighted by Clusters 4 and 5. Cluster 6, although small, treats an essential but overlooked theme: the role of innovation in stakeholders' participation in SFM. Few authors have considered it, making this a promising area for future research. Moreover, this may contribute to a change of focus from the negative aspects and problems concerning stakeholders' engagement in forest management to its positive aspects. New and innovative forest

management policies are crucial for SFM, and their effectiveness and success depend on stakeholders' engagement and participation.

The current paper organises information and presents insights from a transdisciplinary standpoint, highlighting synergies to boost sustainability and face current challenges by offering a roadmap to find relevant information. As stressed in the paper, focus on stakeholders' participation is difficult to find in forestry and sustainability literature. Both study areas have transdisciplinary features and multidimensional characteristics, increasing the complexity of providing a research structure. The analysis of journals, countries, universities, and funding sponsors outlines opportunities for future studies. The ten most active countries in the research were the United States, the United Kingdom, Canada, the Netherlands, Switzerland, Brazil, Australia, Germany, Sweden, and Indonesia. This list merges with information from the studies' boundaries and universities' affiliations. The European Union leads the sponsorship, followed close by Canadian institutions.

Additionally, it identifies an overlooked but relevant area that may be considered as an avenue for future studies: the role of innovation in stakeholders' participation in SFM. As with all bibliometric studies, the current paper has limitations associated with the analytical decisions taken. For instance, the study focused exclusively on peer-reviewed papers, excluding books, theses, and conference papers, which could arguably provide additional insights. We acknowledge that different search steps could have yielded different outcomes and that our standpoint constrained results, research goals, and methods.

Future studies can use or even replicate the research structure detailed in other contexts or use the information provided to guide further developments in the study of stakeholder participation in SFM. Specifically, future studies could deepen discussion about the emerging themes clustered in this paper, evolving from a bibliometric study to a systematic literature review. Studies focusing on standard language building, such as typologies, taxonomies, and thematic and sense-making analyses, are also welcome to overcome the issue of different approaches and nomenclature for similar contents that hinder theoretical progress on the topic.

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Author information

Author ORCIDs

Irene Dobarrio Machado Ciccarino <https://orcid.org/0000-0002-6517-4154>

0000-0002-6517-4154

Maria Eduarda da Silva Teixeira Fernandes <https://orcid.org/0000-0001-6584-0412>

0000-0001-6584-0412

Author contributions

Formal analysis: IDMC

Investigation: IDMC

Methodology: IDMC

Supervision: MEdSTF

Writing – original draft: IDMC

Writing – review & editing: IDMC, MEdSTF

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Appendix A

Table A1. Most representative keywords combination.

N.	Keywords	Frequency		Combination parameters in line with the research goal	
		Scopus database Query	MaxQDA codification	Sustainable management	Community/ stakeholder
1	Forest Management	1455	4156	1928	459
2	Forestry	1434	9987	723	1118
3	Sustainable Forestry	694	656	656	41
4	Sustainable Forest Management	459	1152	1152	33
5	Forestry Policy	264	99	3	30
6	Environmental Management	216	777	66	84
7	Environmental Policy	193	392	28	11
9	Forestry Production	184	9	1	0
10	Environmental Economics	179	141	11	2
11	Community Forestry	156	989	50	989
12	Forest Policy	152	2047	114	146
8	Resource Management	150	921	132	231
14	Land Management	141	364	202	21
13	Economic Development	138	345	13	2
15	Participatory Approach	122	42	3	5
16	Forest Resources	99	875	107	36
17	Community Resource Management	95	12	1	12
18	Policy Implementation	92	58	5	3
19	Governance	91	785	83	785
20	Forest Conservation	91	473	48	25
21	Ecosystem Management	76	195	25	7

Source: Pivot table with data from Scopus search engine and MaxQ

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Table A2. Bibliometric papers from Scopus and Web of Science.

Year	Authors	Title	Subject	Citations	Database	Journal	H-Index	Quartile
2010	Klenk, N L; Dabros, A; Hickey, G M	Quantifying the research impact of the Sustainable Forest Management Network in the social sciences: a bibliometric study	Sustainable Forest Management Network contribution to science in several research fields.	17	Web of Science	Canadian Journal of Forest Research	121	Q1
2013	Hickey, G M	International developments in the administration of publicly funded forest research: a review	Forest-related research funded by the public sector	7	Scopus	Forest Policy and Economics	68	Q1
2019	Romanelli, J. P.; Boschi, R. S.	The legacy of Elinor Ostrom on common forests research assessed through bibliometric analysis.	Author's contribution in community-based management research	7	Scopus, Web of Science	CERNE	19	Q2
2020	Holmgren, S; D'Amato, D; Giurca, A	Bioeconomy imaginaries: a review of forest related social science literature	Literature review on bioeconomy imaginaries	7	Scopus	Ambio	127	Q1
2021	Martinho, V J D; Ferreira, A J D	Forest resources management and sustainability: the specific case of European Union countries	Climate change	0	Scopus	Sustainability	85	Q1
2021	Xu, H; Peng, M; Pittock, J; Xu, J	Managing rather than avoiding "difficulties" in building landscape resilience	Literature review on socio-ecological system (SES) resilience	2	Scopus	Sustainability	85	Q1

Source: Retrieved from Web of Science and Scopus in October 2021.

Table A3. The most important papers.

N	Author	Year	Title	Author keywords	Length
1	Ali, T., Ahmad, M., Shahbaz, B., Suleri, A.	2007	Impact of participatory forest management on vulnerability and livelihood assets of forest-dependent communities in northern Pakistan	Livelihoods, participation, sustainable forest management, vulnerability	Regional
2	Ameha, A., Meilby, H., Feyisa, G.L.	2016	Impacts of participatory forest management on species composition and forest structure in Ethiopia	confounding variables, decentralised forest management, forest user group, generalised additive models, human disturbance, impact evaluation, propensity score matching	Regional
3	Angelstam, P., Naumov, V., Elbakidze, M., Manton, M., Priednieks, J., Rendenieks, Z.	2018	Wood production and biodiversity conservation are rival forestry objectives in Europe's Baltic Sea Region	biodiversity; collaborative learning; ecosystem services; governance; green infrastructure; land-sharing; land-sparing; spatial planning; sustained yield forestry	Regional
4	Balest, J., Hrib, M., Dob, Z., Paletto, A.	2016	Analysis of the effective stakeholders' involvement in the development of national forest programmes in Europe	forest policy; inclusiveness; level of participation; stakeholders; sustainable forest management	Regional
5	Blomley, T., Pfliegner, K., Isango, J., Zahabu, E., Ahrends, A., Burgess, N.	2008	Seeing the wood for the trees: an assessment of the impact of participatory forest management on forest condition in Tanzania	Eastern Arc; forest condition; participatory forest management; sustainable use; Tanzania	Regional
6	Chena, H., Zhu, T., Krotta, M., Calvo, J.F., Ganesh, S.P., Makot, I.	2013	Measurement and evaluation of livelihood assets in sustainable forest commons governance	Biodiversity conservation; capital; community participation; forest resources; governance; livelihood assets; powerful stakeholders	Broad approach
7	Cheng, A.S., Danks, C., Allred, S.R.	2011	The role of social and policy learning in changing forest governance: an examination of community-based forestry initiatives in the U.S.	Community-based forestry; governance; policy change; policy learning; social learning	Regional
8	Danielsen, F., Skutsch, M., Burgess, N.D., Jensen, P.M., Andrianandrasana, H., Karky, B., Lewis, R., Lovett, J.C., Massao, J., Ngaga, Y., Phartiyal, P., Poulsen, M.K., Singh, S.P., Solis, S., Sørensen, M., Tewari, A., Young, R., Zahabu, E.	2011	At the heart of REDD+: a role for local people in monitoring forests?	Climate change; co-benefits; community-based management; forest degradation; governance; locally based monitoring	Broad approach
9	Dobrynin, D., Smirennikova, E., Mustalahti, I.	2020	Non-state forest governance and "Responsibilization": the prospects for FPIC under FSC certification in Northwest Russia	Forest governance; forest stewardship council (FSC); free prior informed consent (FPIC); local communities; Northwest Russia; "Responsibilisation"	Regional
10	Edmunds, D., Wollenberg, E.	2001	A strategic approach to multistakeholder negotiations		Broad approach
11	Fraser, E.D.G., Dougill, A.J., Mabee, W.E., Reed, M., McAlpine, P.	2006	Bottom up and top down: analysis of participatory processes for sustainability indicator identification as a pathway to community empowerment and sustainable environmental management	Botswana; British Columbia, Canada; case study methodology; Guernsey, United Kingdom; participatory processes; sustainability indicators	Regional

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Table A3. (continued).

N	Author	Year	Title	Author keywords	Length
12	Ha, T.T.P., van Dijk, H., Visser, L.	2014	Impacts of changes in mangrove forest management practices on forest accessibility and livelihood: a case study in mangrove-shrimp farming system in Ca Mau Province, Mekong Delta, Vietnam	Forest company; forest management; Mangrove-shrimp; Mekong Delta; natural resource management; shrimp farming	Regional
13	Hickey, G.M., Innes, J.L.	2008	Indicators for demonstrating sustainable forest management in British Columbia, Canada: an international review	Forest policy; monitoring framework; sustainability	Regional
14	Hoang, M.H., Do, T.H., Pham, M.T., van Noordwijk, M., Minang, P.A.	2013	Benefit distribution across scales to reduce emissions from deforestation and forest degradation (REDD+) in Vietnam	Accountability; benefit sharing system; effectiveness; equity; participatory; payment for environmental services; REDD+; transparency; watershed management	Regional
15	Kanowski, P.J., McDermott, C.L., Cashore, B.W.	2011	Implementing REDD+: lessons from the analysis of forest governance	Climate change; Copenhagen Accord; deforestation; forest degradation; forest governance; REDD+	Broad approach
16	Kant, S., Lee, S.	2004	A social choice approach to sustainable forest management: an analysis of multiple forest values in Northwestern Ontario	Borda's rule; forest values; ordinal preferences; social choice; social welfare; stated preferences; sustainable forest management	Regional
17	Larsen, H.O., Smith, P.D., Olsen, C.S.	2005	Nepal's conservation policy options for commercial medicinal plant harvesting: stakeholder views	Community forestry; forest policy; Himalaya; Nepal; non-timber forest products; participation	Regional
18	Medina, G., Pokorny, B., Weigelt, J.	2009	The power of discourse: hard lessons for traditional forest communities in the Amazon	Community forestry; development projects; environmental discourse; Logging; NGOs	Regional
19	Melnykovich, M., Nijnik, M., Soloviy, I., Nijnik, A., Sarkki, S., Bihun, Y.	2018	Social-ecological innovation in remote mountain areas: adaptive responses of forest-dependent communities to the challenges of a changing world	Forest ecosystem services; marginalised rural areas; multifunctional forestry; Ukrainian carpathians; well-being	Regional
20	Melo, F.P.L., Parry, L., Brancalion, P.H.S., Pinto, S.R.R., Freitas, J., Manhães, A.P., Meli, P., Ganade, G., Chazdon, R.L.	2021	Adding forests to the water-energy-food nexus		
21	Pokorny, B., Scholz, I., de Jong, W.	2013	REDD + for the poor or the poor for REDD+? About the limitations of environmental policies in the Amazon and the potential of achieving environmental goals through pro-poor policies	Amazon; development policies; forest management; poverty alleviation; rural development; sustainability	Regional
22	Riggs, R.A., Langston, J.D., Margules, C., Boedhihartono, A.K., Lim, H.S., Sari, D.A., Sururi, Y., Sayer, J.	2018	Governance challenges in an eastern Indonesian forest landscape	Indonesia; integrated natural resource management; polycentric landscape governance; theory of change	Regional
23	Seddon, N., Smith, A., Smith, P., Key, I., Chausson, A., Girardin, C., House, J., Srivastava, S., Turner, B.	2021	Getting the message right on nature-based solutions to climate change	Biodiversity; climate change adaptation; climate change mitigation; policy; sustainable development	Broad approach

Table A3. (concluded).

N	Author	Year	Title	Author keywords	Length
24	Uhde, B., Hahn, A., Griess, V.C., Knoke, T.	2015	Hybrid MCDA methods to integrate multiple ecosystem services in forest management planning: a critical review	Ecosystem services; forest management planning; multiple criteria; quantitative optimisation; stakeholder participation; trade-offs; uncertainty	Broad approach
25	Ulybina, O.	2015	Model forests in the Russian Federation: local perspectives, challenges and outcomes	Environmental management; model forest; participatory environmental governance; Russian Federation	Regional
26	Wollenberg, E., Merino, L., Agrawal, A., Ostrom, E.	2007	Fourteen years of monitoring community-managed forests: learning from IFRI's experience	Community forests; governance; monitoring; networks; research	Regional
27	Zenteno, M., Zuidema, P.A., de Jong, W., Boot, R.G.A.	2013	Livelihood strategies and forest dependence: new insights from Bolivian forest communities	Brazil nut; community forestry; forest governance reforms; non-timber forest products; Northern Bolivian Amazon	Regional

Source: VOSViewer 1.6.17. Citation analysis with documents as an analysis unit.

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