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Research Article

Mapping the Grassroots Innovation Research: A Bibliometric Analysis and Future Agenda

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ABSTRACT

Grassroots innovation is a vital catalyst for economic growth, social progress, and sustainable development. This paper conducts a comprehensive bibliometric analysis of grassroots innovation, examining citation patterns, co-occurrence trends, and influential sources, leading authors, and contributing countries. Rooted in bottom-up, locally driven initiatives, grassroots innovation offers promising solutions to societal challenges. The publication trend identified a remarkable increase in grassroots innovation over the last eight years. Citation analysis identifies seminal works and influential authors, showcasing the field's intellectual evolution. Co-occurrence analysis reveals thematic clusters, providing nuanced insights into research trends. Prominent sources, authors, and institutions are recognized, fostering collaboration and informed decision-making. The identification of publication sources and contributing authors was based on both the number of documents published in the field and their importance as determined by citation index. Geographical distribution analysis highlights countries contributing significantly to grassroots innovation research, offering valuable perspectives for regional interventions. Finally, the United Kingdom, India, and the United States were discovered to be the most publishing countries on grassroots innovation. This bibliometric review equips researchers, policymakers, and practitioners with essential knowledge to nurture inclusive and sustainable grassroots innovation ecosystems.

Keywords: Grassroots innovation, Bibliometric analysis, Citation trends, Co-occurrence analysis, Influential sources.

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INTRODUCTION

Innovation plays a critical role in driving economic growth, social progress, and sustainable development. While traditional innovation has often been associated with large corporations and formal research institutions, there is a growing recognition of the significant contributions made by grassroots innovation.[1] Grassroots innovation refers to bottom-up, locally driven initiatives that create novel solutions to address social, environmental, and economic challenges.[2] These innovations are typically driven by individuals, communities, and small-scale organizations operating outside of established institutional frameworks.[3]

Understanding the landscape of grassroots innovation is vital for policymakers, researchers, and practitioners seeking to foster inclusive and sustainable development. Conducting a comprehensive bibliometric review offers a valuable approach to examining existing literature, identifying key research trends, and charting future research directions.[4] This paper presents a bibliometric analysis study focused on grassroots innovation, exploring citation patterns, co-occurrence analysis, and influential sources, leading authors, and contributing countries.

Citation analysis is a fundamental aspect of bibliometric research, providing a quantitative assessment of the influence and impact of scholarly works.[5] By analysing citation patterns within the corpus of grassroots innovation literature, this study aims to identify seminal works, influential authors, and major research themes. This analysis offers insights into the intellectual foundations of the field, highlighting the evolution of ideas and concepts over time.

Co-occurrence analysis is another crucial component of this bibliometric review. By identifying frequently co-occurring keywords or concepts within the literature, it enables a comprehensive understanding of the thematic landscape of grassroots innovation research.[6] Uncovering the relationships and associations between these keywords reveals the main research areas and facilitates the identification of knowledge gaps and opportunities for future investigation.

Furthermore, this review aims to identify influential sources in the field of grassroots innovation. By examining the number

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of citations received by various journals, this study highlights key platforms for disseminating research in this domain. This analysis aids researchers in selecting appropriate outlets for their work and provides policymakers and practitioners with insights into the most influential sources for staying informed about grassroots innovation developments.

In addition, the review will shed light on leading authors and institutions contributing to grassroots innovation research. By identifying prolific authors and institutions, this study recognizes those who have made significant contributions to the field's advancement. This information facilitates collaboration opportunities among researchers and institutions, promoting the exchange of ideas, best practices, and fostering a collective effort to address societal challenges through grassroots innovation.

Moreover, the geographical distribution of grassroots innovation research will be examined to gain insights into the countries contributing the most to the field. This analysis provides an understanding of regional disparities and highlights areas that may require additional research, support, or policy interventions to foster grassroots innovation. It also enables policymakers to identify successful models and initiatives from different countries that can be adapted and replicated to promote grassroots innovation in their respective regions.

By presenting a comprehensive analysis of the existing literature on grassroots innovation, this bibliometric review lays a solid foundation for future research in this domain. The findings can guide researchers in identifying key research gaps, emerging trends, and areas for further investigation. Policymakers and practitioners can benefit from the insights to inform policy formulation, funding decisions, and strategies for fostering inclusive and sustainable grassroots innovation ecosystems.

In conclusion, this bibliometric review represents a significant contribution to the study of grassroots innovation. Through citation analysis, co-occurrence analysis, and the identification of influential sources, authors, and countries, this study provides valuable insights into the field's landscape. The findings will contribute to the collective knowledge on grassroots innovation and inform future research, policy, and practice to promote inclusive and sustainable development.

This study aims to answer the following research questions:

- In terms of time, journals, authors, affiliated nations and institutions, type of study, and economy, what are the current publication trends in grassroots innovation?
- What are the key research themes and influencing papers in this area?
- How has grassroots innovation research grown intellectually, and what are its current research trends?
- What are the research gaps and potential areas of further study?

GRASSROOTS INNOVATION: AN OVERVIEW

Evolution of grassroots innovation

Recently grassroots innovation has started gaining attention as a new paradigm in the innovation literature.[1] Grassroots innovation can be considered as a credible mechanism that can aid in the socioeconomic growth of grassroots communities.[7] Although prior studies have been empirical in terms of their methodology, procedures, and innovative practices, grassroots innovation still needs a lot of attention.[8]

A search for alternative methods of innovation resulted from growing concern over the shortcomings of mainstream innovation. The People's Science,[9] Honey Bee Network,[10] and Technologies for Social Inclusion[11] are social movements and the voices that gave shape to grassroots innovation.[12] Grassroots innovation activists and practitioners have driven these network activities and initiatives. These innovations aim to create socio-technical and economic solutions.[13] It is stimulated by a culture that emphasises democracy, diversity, openness, practical experimentation, social learning, and negotiation.[14]

In India, the term 'grassroots innovation' was used approximately 25 years ago by the Honey Bee Network, an initiative by Prof. Anil Gupta. The aim of creating Honey Bee Network was to identify, recognise, and document local innovation from the informal sector. As stated by,[10] grassroots innovation is the innovation of the poor, for the poor, and by the poor. Through *shodh yatra*, an initiative by Societies for Research and Initiatives for Sustainable Technology and Institution (SRISTI), an attempt is made to reach out to the remotest part of India with a strong belief that hardship and challenges of natural surroundings are key motivators of innovation and creativity. It aims at the discovery of traditional knowledge and grassroots innovation.

The informal sector in India provides employment to the majority of the workforce. The informal sector is characterised by low productivity, adding to the cause of socio-economic inequalities. This sector is perceived as source of low technological and labour-intensive jobs, less inclined to innovation. India, not being very receptive to the new ideas, ironically happens to be one of the first few countries to recognise innovation emanating from the informal sector and its capacity to solve problem.[15]

In India, approximately 325,000 grassroots innovations were documented (National Innovation Foundation). The grassroots innovators, either on their own or through support and interventions, have the capability to make a difference for the population in the informal sector. It has been observed that innovation policy and system cannot infuse innovations at the grassroots level until a bridge is created between informal and

formal sector that can allow the opportunities to be realized.[15,16] Honey Bee Network tries to fix the organizational gap by increasing the number of participants and helping the grassroots innovations by transferring knowledge and resources among local, national, and even international individuals and groups.[17]

Conceptualising Grassroots innovation

There is no universal definition of grassroots innovation.[18] However, various scholars have defined grassroots innovation according to the scope of their study,[16] defined grassroots innovation as "a *network of activists and organizations generating novel bottom-up solutions for sustainable development and sustainable consumption, solutions that respond to the local situation and the interests and values of the communities involved.*" While,[19] have defined grassroots innovation as "a *complex set of socio-political and economic aspirations of people, who normally bank on their skills and practical experience, rather than the formal body of technical knowledge, to carry out technological activities.*" As stated by,[10] grassroots innovation is the "i*nnovation developed by uneducated people (lack a professional degree), self-employed outside the realm of formal set-up, without taking any help or assistance from formal institutions, attributed to isolation from institutional structure.*" While[15] defined grassroots innovation as innovation "e*merging from the people with traditional knowledge and lack of formal education in the isolation of formal market systems plagued by scarcity and hardship in the rural or semi-urban areas developing the products low in novelty in the environment of low resources with the limited commercialization.*"

Significance of present study

In this sub-section, the previous reviews conducted on grassroots innovation are discussed and the significance of present study is also described.

In 2016,[20] did a comprehensive literature assessment of Grassroots innovation. Many aspects of grassroots innovation are explored, from its defining features and key players to the obstacles in its path and the opportunities it presents. This research demonstrates the positive effects of grassroots innovation on sustainability. A comprehensive review by[21] found a persistent epistemic bias favouring the analysis of power and empowerment as strategic exercises in studies of grassroots innovations for sustainable transitions. In a scientometrics analysis of innovations in the informal sector,[22] stated that in the past ten years, both academics and policymakers have recognised the importance of these innovations and that the majority of studies and cases come from developing nations, particularly India. The study contends that significant efforts have been made by both the government and non-government organisations to recognise the importance of ideas from the informal sector in developing countries.

By conducting a comprehensive literature study,[18] sought to conceptualise the ontology of grass-roots innovations and the enabling institutional mechanisms. By critically synthesising the existing literature via a multidisciplinary perspective,[23] underlined the political and economic reasons for grassroots innovations' relative exclusion. The study outlined the elements for grassroots innovations to be marginalised, namely by dissecting an elitist portrayal of innovations and shedding light on the pro-market innovation narrative that has limited the contributions of subaltern innovators.

This study holds significant relevance in the domain of grassroots innovation for several reasons. Firstly, this study allowed to identifying and analysing the existing body of literature on grassroots innovation, providing insights into the evolution, trends, and thematic areas of research within the field. By examining publication patterns and citation networks, researchers can gain a comprehensive understanding of the key contributors, influential studies, and research gaps in grassroots innovation. Secondly, bibliometric analysis helps map collaborations among researchers and institutions, shedding light on networks and partnerships that drive knowledge creation in this domain. This information can facilitate interdisciplinary collaborations, knowledge exchange, and the formation of research networks aimed at fostering grassroots innovation. Thirdly, by assessing the impact of individual studies and authors, bibliometric analysis can help identify influential works and researchers who have made substantial contributions to the field. Such insights are invaluable for identifying research leaders, potential mentors, and building upon existing knowledge. Lastly, a bibliometric review offers a historical perspective on grassroots innovation, tracing the development of ideas, theories, and approaches over time. This historical context aids researchers in understanding the evolution of grassroots innovation and identifying areas that require further exploration. In summary, conducting a bibliometric review in the grassroots innovation domain can enable to gain a comprehensive overview, identify research gaps, foster collaborations, assess impact, and understand the historical trajectory of this important field.

METHODOLOGY

Bibliometric analysis

In an attempt to deliberately and thoroughly explore a particular area, scholars have used a variety of qualitative and quantitative literature review approaches over time. In this study bibliometric analysis has been used to create a consistent, logical, and transparent research flow and to provide a holistic picture of the literature on grassroots innovation. It seeks to document scholarly exchange in the form of publications. The most often used method for analysing research topics is bibliometrics.[24] It is used to track the knowledge anatomy of a research field.[25]

In order to describe, assess, and keep track of published research, bibliometric analysis uses a quantitative methodology.[26] It has the ability to establish a methodical, open, and reproducible

review process, hence raising the standard of review (Bellis, 2009). Two important bibliometric methodologies are science mapping and performance analysis. Performance analysis is to assess the research and publication output of organisations and individuals. Science mapping strives to shed light on the structure and dynamics of scientific domains.[27,28]

Bibliometric analysis uses statistical approaches to organise bibliographical data in a given field of study.[29,30] It assesses a subject's scientific quality and impact.[31,32] Basic bibliometric studies analyse research field citations. Depending on the chosen unit of analysis, several features of a research field might be examined. Authors, journals, cited references, institutions, and countries make up the majority of the units of analysis. The foundation of citation analysis is the presumption that authors only cite noteworthy works. Citations are therefore, meant to be a gauge of influence.[32] Quantity, which measures productivity by the number of publications, and quality, which measures a publication's influence by the number of citations it receives,[33] are more fine-grained bibliometric metrics.

The purpose of this analysis is to portray and evaluate the existing literature. According to,[34] the bibliometric analysis makes use of statistical tools for the purpose of conducting an objective and quantitative assessment of bibliographic data in order to organise information in a particular academic setting.

Search string

The systematic search for review literature begins with identifying and deciding on keywords and search terms from the literature.[35] Since Scopus is the largest database for academic articles and has far wider and more varied coverage than other databases,[36] it is used. The search was conducted through a single keyword in Boolean search "grassroots innovation" that fetched 335 documents. The inclusion criteria included 'articles and review' published in 'journal' in 'English' language, restricted to the subject areas 'social sciences; environmental science; business, management and accounting; energy' and peer-review research papers published in scientific journals of management discipline. Given that the scientific journals provide for the reliable corpus of extensively peer-reviewed scientific evidences, this study excluded the conference papers and book chapters that were not published in scientific journals.[37] Further, after adequate study, duplicates and erroneous entries were removed from the analysis. Additionally, irrelevant research studies were removed by screening the title, abstract and keywords. The final corpus contained 150 articles.

RESULTS

In this section, the results of the bibliometric review, providing a comprehensive analysis of the publication landscape and research trends in the field of grassroots innovation is presented.

Performance mapping and scientific mapping together with quantitative analysis are employed in this study to gauge output in terms of publication trends. The number of citations, co-citations, and co-occurrences that the research publications have got, are investigated using qualitative analysis. It allowed for the evaluation of the quality of the literature and the impact of the advancement of knowledge in a given area. R-based biblioshiny (bibliometrix tool) and VOSviewer software are used for bibliometric analysis. Over the course of time, the concept of grassroots innovation has attracted the attention of academics and scholars who are interested in acquiring a more comprehensive understanding of the substantial contributions made by researchers. Table 1 presents, on the basis of the bibliometric analysis, the general findings in relation to the number of publications, authors in the various journals, countries, keywords, and references cited.

Publication chronology by time period

Figure 1 demonstrates the significant development in the field of grassroots innovation over time. As can be observed in the figure, there are only a handful number of publications till the year 2010. The growth in the publications can be witnessed from the year 2012 onwards; however, there are some highs and lows in the number of publications in the last decade. The growth in the publications in the year 2016 can be attributed to the introduction of Sustainable Development Goals (SDGs) in the year 2015. The onset of pandemic might have caused a decline in the number of publications. Even if there is not an exponential growth but there has been some steady growth in the publications over the years but it shows that there is a huge possibility for the researchers to explore and contribute to the field of grassroots innovation.

Table 1: General results.

Threshold	Number
Time Span	1997:2023
Papers	150
Authors	333
Journals	91
Keywords	505
Cited References	8505

Citation-based outcomes

Table 2 provides insight about the ten highly cited documents concerning grassroots innovation literature. The citation results indicate that[16] is the pioneer of grassroots innovation research. The definition of grassroots innovation as given by[16] has been most frequently cited in grassroots innovation literature. The number of publications each author has produced and the number of citations each author has are measures of the influence of the most influential authors in a particular area of study.[36] The most notable authors contributing to research on grassroots innovation and listed in the table have more than 200 citations.

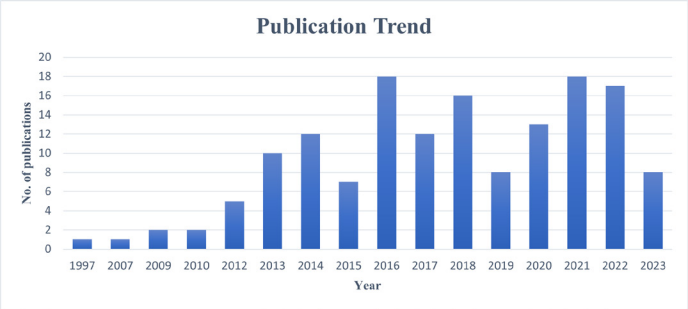

Figure 1: Annual publication trend in grassroots innovation research from 1986 till 2022.

Most influential sources in grassroots innovations

This study identified 150 papers published across 91 different journals as shown in Table 3. The most influential journals in the domain of grassroots innovation can be determined by looking at both the number of papers published in each journal and the number of citations received. The most influential journal, with 11 insightful articles on grassroots innovation, is the *Journal of Cleaner Production*. It is followed by *Environmental Innovation and Societal Transitions* with 9 (6%) publications, *Global Environment Change* and *Technological Forecasting and Social Change* with 7 (4.67%) publications each. Furthermore, journals such as *African Journal of Science, Technology, Innovation and Development, Energy Policy, Energy Research and Social Science* have 4 articles (2.67%) each. *Energy Research and Social Science, Environment and Planning A*, and *Technology Analysis and Strategic Management* have 3 articles each.

Regarding citations, *Global Environmental Change* has received the maximum number (1173) citations, followed by the *Journal of Cleaner Production, Energy Policy*, and *Environmental Innovation and Societal Transitions* with 710, 665, and 559 citations.

Prolific authors and countries

According to our data set, articles on grassroots innovation are published by 333 authors connected to 178 organisations in 30 different countries. According to the number of publications,

Table 2: Highly cited documents in grassroots innovation literature.

Sl. No.	Articles	Year	Author(s)	Citations
1.	Grassroots innovations for sustainable development: Towards a new research and policy agenda.	2007	Seyfang and Smith	1063
2.	Growing grassroots innovations: Exploring the role of community-based initiatives in governing sustainable energy transitions.	2012	Seyfang and Haxeltine	592
3.	A thousand flowers blooming? An examination of community energy in UK.	2013	Seyfang *et al.*	376
4.	Grassroots innovation in community energy: The role of intermediaries in niche development.	2013	Hargreaves *et al.*	372
5.	Transforming innovation for sustainability.	2012	Leach *et al.*	285
6.	Grassroots innovation movements: Challenges and contributions.	2014	Smith *et al.*	280
7.	A grassroots sustainable energy niche? Reflections on community energy in the UK.	2014	Seyfang *et al.*	275
8.	Community action for sustainable housing: Building a low-carbon future.	2010	Seyfang	237
9.	Socio-technical transitions to sustainability: a review of criticisms and elaborations of the Multi-Level Perspective.	2019	Geels	236
10.	Making the most of community energies: Three perspectives on grassroots innovation.	2016	Smith *et al.*	203

the top contributors are listed in Table 4. Adrian Smith affiliated with the University of Sussex leads the list with 11 publications, Gill Seyfang affiliated with the University of Sussex is the second highest contributor with 10 publications, followed by Giuseppe Feola affiliated with Utrecht University having 7 publications and Hemant Kumar affiliated with Central University of Gujarat with 6 publications. While Gill Seyfang and Adrian Smith have received highest number of citations-3568 and 2956 respectively[16] have also received the highest number of citations in the grassroots innovation domain. The two authors have published extensively on grassroots innovation and are regarded as domain experts.

Table 4 also shows the top three countries with a significant number of authors of grassroots innovation articles: the United Kingdom (104 articles), India (52 articles), and the United States of America (33 articles). The study on grassroots innovation is centred in the western portion of the world, as seen by the fact that the United Kingdom came in first on the list, further highlighting the disparity between research conducted in the UK and other regions of the world.

Co-occurrence analysis

Using keyword co-occurrence networks, it is possible to see how concepts are likely to be related to one another.[36] A total of 505 authors' keywords from 150 publications gathered from 91 sources and published between 1997 and 2023 were retrieved for network creation and analysis. In order to create and analyse networks, the papers were retrieved from the Scopus database. The findings (Figure 2) show that keywords like "grassroots innovation," "social innovation," "sustainability," "community energy," "strategic niche management," "sustainability transitions,"

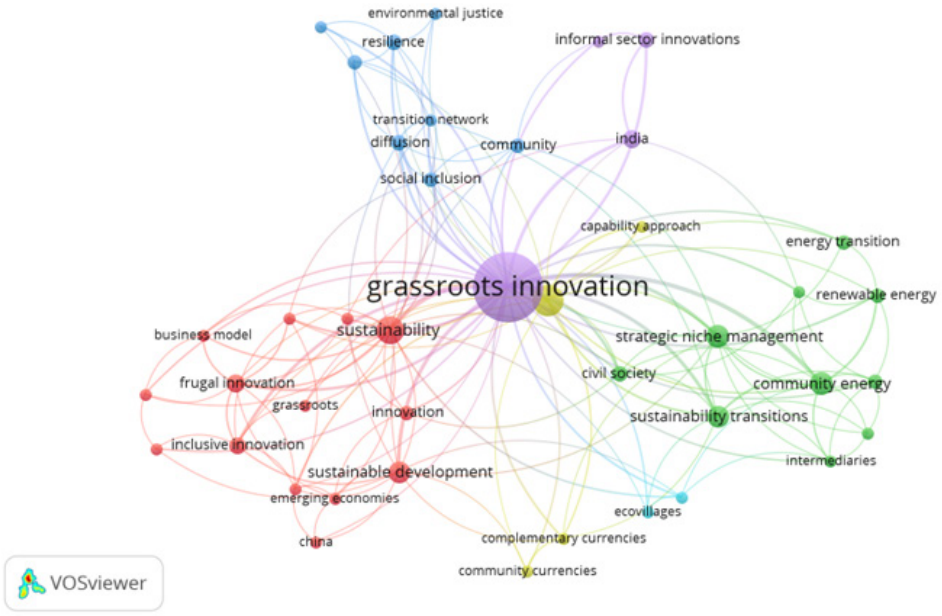

Figure 2: Frequently occurring keywords (Source: VOS viewer).

Table 3: Ten most significant journals.

Sl. No.	Sources	Documents	Citations	%Age contribution
1.	Journal of Cleaner Production	11	710	7.33
2.	Environmental Innovation and Societal Transitions	9	559	6
3.	Global Environmental Change	7	1173	4.67
4.	Technological Forecasting and Social Change	7	166	4.67
5.	Ecological Economics	6	435	4
6.	African Journal of Science, Technology, Innovation and Development	4	90	2.67
7.	Energy Policy	4	665	2.67
8.	Energy Research and Social Science	4	86	2.67
9.	Environment and Planning A	3	296	2
10.	Technology Analysis and Strategic Management	3	182	2

Table 4: Top authors and countries publishing on grassroots innovation.

Top authors			Top countries		
Author	**TP**	**TC**	**Country**	**TP**	**TC**
Adrian Smith	11	2956	United Kingdom	104	5147
Gill Seyfang	10	3568	India	52	276
Giuseppe Feola	7	319	USA	33	358
Hemant Kumar	6	61	Netherlands	23	89
Gautam Sharma	5	41	Spain	18	89
Sergio Belda-Miquel	4	75	China	17	75
Anil Kumar Gupta	4	159	Sweden	17	91
Mokhter Hossain	4	212	Austria	16	282
Noel Longhurst	4	518	Portugal	15	37
Mari Martiskainen	4	623	Finland	14	44

Abbreviations: TP – Total Publications, TC – Total Citations.

Table 5: Description of the clusters.

Cluster 1 (Red)	Cluster 2 (Green)	Cluster 3 (Blue)	Cluster 4 (Yellow)	Cluster 5 (Purple)	Cluster 6 (Celeste)
Appropriate Technology	Civil society	Community	Capability approach	Grassroots innovation	Ecovillages
Bottom of the pyramid	Community energy	Diffusion	Community currencies	India	Socio-technical transitions
Business model	Energy transition	Environmental justice	Complementary currencies	Informal sector innovations	
China	Grassroots innovations	Place	Social innovation	Jugaad	
Developing countries	Intermediaries	Resilience			
Emerging economies	Multi-level perspective	Social inclusion			
Entrepreneurship	Renewable energy	Transition network			
Frugal innovation	Strategic niche management	Transition movement			
Grassroots	Sustainable energy				
Inclusive innovation	Sustainability transitions				
Innovation					
Sustainability					
Sustainable Development					

and "sustainable development" are commonly used and recurring terms in the literature.

Co-occurrence analysis revealed six distinct clusters with shared characteristics (Table 5). In the co-occurrence network analysis of authors' keywords, the first cluster emphasized grassroots innovation and its potential impact on sustainable development. The keywords "appropriate technology," "bottom of the pyramid," and "frugal innovation" highlights the importance of cost-effective solutions for developing countries, particularly in emerging economies like China. Furthermore, the keywords "entrepreneurship," "business model," and "inclusive development" suggest a focus on promoting inclusive and

Table 6: Methodological choices and research context for grassroots innovation research.

Panel and period	1997-2011	2012-2016	2017-2022
Panel A: Research approach			
Qualitative	3	28	42
Quantitative	1	1	8
Mixed	0	3	4
Panel B: Research design			
Descriptive	0	14	22
Empirical	3	17	32
Review	0	2	4
Commentary	0	2	6
Conceptual	3	15	17
Panel C: Data collection technique			
Case study	3	17	30
Interview	0	22	35
Archival reports	0	2	5
Literature Review	0	5	8
Observation	0	2	11
Survey	0	5	8
Ethnography	0	0	1
Action research	0	0	1
Statistical tools	1	0	4
Panel D: Data analysis technique			
Coding	0	1	8
Thematic analysis	0	8	10
Descriptive	2	0	0
Correlation or Regression	0	2	3
Others	1	2	6
Panel E: Research focus			
Theory verification	0	1	0
Theory application	1	7	26
Panel F: Geographical Focus			
Single and developing country	2	9	20
Multi and developing country	0	0	4
Single and developed country	4	31	38
Multi and developed country	0	4	15

sustainable innovation that benefits marginalized communities while addressing broader sustainability goals.

The second cluster centred around grassroots innovations and sustainability transitions in the energy sector. The keywords "civil society," "community energy," and "grassroots innovations" highlight the active involvement of local communities in driving the energy transition towards sustainable sources such as renewable energy. The inclusion of keywords like "intermediaries" and "strategic niche management" suggests the importance of supporting actors and frameworks that facilitate the adoption and scaling up of sustainable energy solutions. This cluster reflects the multi-level perspective and emphasizes the need for collaborative efforts to achieve a sustainable energy future.

Table 7: Potential directions for further research.

Components of future research agenda	Research Gap	Proposed research questions
Study context	Research on grassroots innovation focuses primarily on developed countries.	RQ 1: In the context of developing nations, how can grassroots innovation be adopted? RQ 2: Can the national, cultural, and political repercussions be taken into account while investigating grassroots innovation in developing or rising countries?
Methodological challenges	A significant portion of research uses qualitative methods, allowing enough potential for future use of quantitative and mixed-method analyses.	RQ 3: How can we use a mixed-method approach to empirically confirm the phenomenon of grassroots innovation? RQ 4: How can quantitative analysis be used to reveal insights about broader groups of grassroots innovation?
Theoretical research progress	Research on grassroots innovation frequently adopts a multi-level or strategic niche management perspective. It is necessary to investigate how the concept of grassroots innovation has advanced theoretically via the lens of various theories.	RQ 5: What is the role of actor-network theory, social capital, and resource-based view theory in the study of grassroots innovation? RQ 6: How can other theories like social capital or bricolage be coupled with strategic niche management or a multi-level approach in the context of grassroots innovation?
Consideration of other relevant factors	Future studies can examine how market orientation, commercial orientation, and entrepreneurial orientation affect grassroots creativity.	RQ 7: What role do the intermediaries play in commercialization of grassroots innovation? RQ 8: How does entrepreneurial orientation is affected by social, cultural and environmental factors in the context of grassroots innovation? RQ 9: What role do market play in the business performance and long-term success of grassroots organizations? RQ10: What pertinent theoretical presumptions underlie the idea of grassroots innovation, and how might their research of other processes, such as antecedents, mediators, or moderators, clarify them?

The third cluster illuminated community-driven transitions towards environmental justice and social inclusion. The keywords "community," "place," and "resilience" indicate the importance of local contexts and community engagement in shaping sustainable transitions. The inclusion of keywords such as "diffusion" and "transition network" suggests the significance of knowledge sharing and collaborative networks in spreading innovative solutions and practices. This cluster also emphasizes the pursuit of environmental justice and social inclusion within the broader context of sustainability, highlighting the need for equitable and inclusive approaches to transition movements.

The fourth cluster focused on social innovation and alternative economic models that promote capabilities and community empowerment. The keywords "capability approach" highlights the importance of considering people's capabilities and freedoms as the central focus of development. Additionally, the inclusion of keywords such as "community currencies" and "complementary currencies" suggests the exploration of alternative forms of exchange that foster social and economic resilience at the local level. This cluster signifies the potential of social innovation to address societal challenges by empowering communities and creating more inclusive and sustainable economic systems.

The fifth cluster centred around grassroots innovation and informal sector innovations in India, with a particular emphasis on the concept of "Jugaad." The keywords "grassroots innovation" and "informal sector innovations" highlight the significance of bottom-up approaches and locally driven solutions in addressing societal challenges. India, as a context, showcases the rich tapestry of informal sector innovations that emerge from within communities. The inclusion of the term "Jugaad" signifies the indigenous practice of frugal innovation and resourcefulness in finding creative solutions amidst constraints. This cluster underscores the importance of recognizing and leveraging

grassroots innovation and the informal sector in fostering sustainable and inclusive development in India and beyond.

The sixth cluster focused on the intersection of ecovillages and socio-technical transitions. The keywords "ecovillages" signify intentional communities that strive for ecological sustainability, social cohesion, and a high quality of life. These communities serve as living laboratories for experimenting with alternative lifestyles and sustainable technologies. The inclusion of "socio-technical transitions" suggests a broader framework for understanding the transformative processes required for transitioning to sustainable systems at both societal and technological levels. This cluster highlights the potential of ecovillages as real-world examples and catalysts for socio-technical transitions, offering insights into the integration of ecological principles and sustainable technologies within communities.

Methodological choices and research context for grassroots innovation research

The methodological choices, which consist of research approach, research design, data collection and analysis techniques and research context that consists of research focus and geographical focus related to grassroots innovation research, are presented in Table 6, spanning 25 years in the literature (i.e., from 1997 till 2023). The reason behind exclusion of the year 2023 is that some of the articles are still in-press.

Panel A indicates the most preferred *research approach* for grassroots innovation research. Across all time slices, the qualitative research approach has topped the chart. Over time period, the share of qualitative research approaches has kept increasing, which means it is stills a widely prevalent research approach in studying grassroots innovation. While quantitative approach could be seen rising in the last time slice as the recent studies have incorporated quantitative methodology in their research. Moreover, mixed approaches i.e., a mix of qualitative and quantitative studies have witnessed a little surge.

Panel B depicts the preference for *research design* in grassroots innovation research. It can be observed that in the last time slice, a fair number of studies are descriptive, empirical and conceptual. Moreover, reviews have also increased. The rise in empirical articles is an indicator that more studies whose conclusions are exclusively derived from concrete and verifiable evidence are increasing in the field of grassroots innovation.

Panel C exhibits a preference for *data collection techniques* for grassroots innovation research. As evident from panel A, qualitative methodology has been widely adopted to delve deeper into the grassroots innovation phenomenon. Within qualitative, case study approach has been commonly used. While the preferred data collection technique across the time slices has been interview. Both semi-structured and open-ended interview techniques are preferred by the researchers. An interesting trend in the qualitative research approach is the growing share of observation, action research, and literature reviews. Similarly, surveys and the use of some statistical tools have slowly taken up the pace, which leaves scope for future researchers to collect the data through surveys and apply some statistical tool or through following a mixed approach to gain insights and then testing it through some statistical tests.

Panel D illustrates the *data analysis techniques* preferred by grassroots innovation scholars. Qualitative researchers have preferred coding and thematic analysis during the past decade. While the share of coding the data has increased during the last time slice, the share of thematic analysis has slightly reduced. The share of descriptive data analysis has declined sharply and only took place during the initial years. Some of the most commonly used statistical tools include Structural Equation Modelling (SEM), regression and correlation. Other methods of analysing the data include conducting sensitivity analysis in the Analytical Hierarchy Process (AHP).

Panel E discloses the *research focus* of grassroots innovation research. The vast majority of the corpus has focused on the application of existing concepts or theories, such as strategic niche management and multi-level perspective, in real-life settings. While only a single study has verified a theory, which is an indication of the immense space for developing and testing to theorise the grassroots innovation phenomenon and moving beyond the boundaries of conventional theories such as strategic niche management and multi-level perspective.

Panel F presents the *geographical focus* of grassroots innovation research. Most of the studies across all the years have focused on a single country, not particularly on any specific country but are highest in number as compared to studies on multi countries. Much of the studies took place in developed countries as opposed to developing countries. The developing countries still remain to be explored in terms of grassroots innovation phenomenon. There is a huge scope for cross-country comparison studies.

Identification of research gap

With reference to the future direction of the research, the bibliometric analysis offers insightful information. Developed countries are the primary context in which the idea of grassroots innovation has been studied. The grassroots innovation research in developing countries such as India and China has started gaining the pace but still there is a need for more research in the developing countries. Studies on grassroots innovation can undertake cross-country comparison between the developed and developing countries to shed light on how grassroots innovation context differs across the world. Additionally, relatively few researches have tested the interrelationship of its antecedents and effects using mathematical analysis (Table 7). As majority of the studies have adopted qualitative methodology, there remains huge scope for testing the grassroots innovation phenomenon

empirically through quantitative analysis or mixed-method analysis. Some of the predominant theories include strategic niche management and multi-level perspective in the sustainability transition literature related to grassroots innovation, paving the way for building new theories or testing some existing theories in the context of grassroots innovation. The existing theories can even be combined with some other theories to explore the phenomenon of grassroots innovation from various lenses.

The research on grassroots innovation is still in its nascent stage, there are many opportunities for future researchers to explore the phenomenon of grassroots innovation by identifying its antecedents, some mediating and moderating factors that can have an impact on its outcome. Moreover, market orientation, commercial orientation and entrepreneurial orientation have not been explored much in grassroots innovation context but all these aspects are very crucial in the success of grassroots innovation. With the present investigation, there is potential for more meaningful research to be done in the context of grassroots innovation.

CONCLUSION

This study analysed and disclosed the evolution of grassroots innovation research between the years 1997 and 2023 by making use of a bibliometric analysis. It has assessed the research and publication produced by authors, journals and countries. Using co-occurrence networks of keywords, the study sought to better understand the structure and dynamics of the grassroots innovation area. This study draws conclusions based on a review of the relevant previous research and provides a summary of the most recent findings.

The findings of this bibliometric review provide valuable insights into the field of grassroots innovation. The chronological arrangement of publications demonstrated the various phases of the evolving grassroots innovation pattern. The results of the citation analysis point to a significant relationship between the authors of the most cited articles and the most illustrious works. The most productive authors were Gill Seyfang and Adrian Smith, whose work "Grassroots innovations for sustainable development: Towards a new research and policy agenda" had the highest number of citations. The authors Gill Seyfang and Alex Haxeltine wrote the second-most cited work, "Growing Grassroots Innovations: Exploring the Role of Community-Based Initiatives in Governing Sustainable Energy Transitions." Furthermore, the most frequently cited articles usually specify the themes that rule the research.

The number of academic papers published on the topic and the average amount of citations for each author were examined in this study to determine who the most prominent authors are. Adrian Smith, Gill Seyfang, Giuseppe Feola, Hemant Kumar, and Gautam Sharma have the most articles on grassroots innovation to their credit. The authors who have received the most citations for their work are Gill Seyfang, Adrian Smith, Mari Martiskainen, Noel Longhurst, and Giuseppe Feola. The number of publications reflects the productivity output of the authors, but the number of citations reflects the popularity of the author's work.

Journal of Cleaner Production, Environmental Innovation and Societal Transitions, Global Environmental Change, and Technological Forecasting and Social Change are the journals with the highest citations per article. This may imply that not only do these journals publish more articles, but they also publish authors of the highest calibre. The most influential institutions are University of Sussex, Indian Institute of Management, and Central University of Gujarat.

The impact of the most significant countries was also examined in the study. The United Kingdom, the United States, the United Kingdom, and Austria are the countries with the highest citations. The United Kingdom, India, and the United States are countries with the most publications. In terms of both the number of documents and the overall number of citations, the United Kingdom tops the list.

The analysis also underscores the interdisciplinary nature of grassroots innovation, emphasizing the importance of collaboration across fields like sociology, economics, and environmental studies. Overall, these findings offer a comprehensive understanding of the current state of grassroots innovation, paving the way for future research and contributing to the scholarly discourse on this important topic.

A co-occurrence analysis of keywords was employed to delve into the topic of grassroots innovation. Through this analysis, six distinct clusters were identified, each representing a specific theme or aspect within the field. The findings from this co-occurrence analysis offer valuable insights into the multifaceted nature of grassroots innovation. By uncovering these thematic clusters, the research provides a comprehensive understanding of the various dimensions, challenges, and opportunities within the field. Moreover, these findings inform future research and policy agendas, enabling policymakers, practitioners, and researchers to focus their efforts on areas that hold the most potential for fostering grassroots innovation and driving sustainable development.

This study holds practical implications in terms of guiding future research on grassroots innovation and expanding our understanding of this field. Furthermore, it has the potential to contribute to social progress by fostering inclusive and sustainable practices within communities, promoting bottom-up approaches to innovation.

However, this study is not free from limitations. Only one database is used for data collection in this study. Another drawback is that bibliometrics cannot capture context and intention for scholarly

citation.[38] Thus, a bibliometric study cannot fully explain the citation behaviour's complexity.

CONFLICT OF INTEREST

The author declares no conflict of interest.

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