

Publication Trends in the Informal Sector Innovation Research

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ABSTRACT

Innovation research, representing other than the formal sector, has gained momentum in the last two decades and different terms like grassroots innovations, frugal innovations, *jugaad*, inclusive innovations and informal sector innovations are used. These key terms have specific and contextual meaning and represent different sets of innovations that are different from its traditional or Schumpeterian understanding of innovations. The Scopus and Google Scholar database suggest that since 2005, the number of publications has increased and focus is given on publishing research on informal sector innovations. Further scientometric analysis of Scopus database on parameters of the subject area, document type, country of publication, source journal and institutional affiliation is conducted. The results suggest that in the last one decade the relevance of such innovations have been recognised by academicians and policymakers alike and most of studies or cases are coming from developing economies, especially India. This also suggests that many government and non-government efforts have been made to identify the role of informal sector innovations in developing economies in a major way.

Keywords: Grassroots Innovations, *Jugaad*, Inclusive Innovations, Frugal Innovations, Informal Sector Innovations, Scientometrics.

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Received: 22-07-2018

Revised: 15-07-2019

Accepted: 07-11-2019

DOI: 10.5530/jscries.9.2s.32

INTRODUCTION

In the last two decades, the informal sector innovation research has caught the attention of academicians, policymakers and enthusiasts alike. There are several terms, often used interchangeably, such as grassroots innovations, green innovations, inclusive innovations, frugal, informal sector innovations and *jugaad* to denote innovations other than the formal sector. However, their nature and meaning are contextual and represent a diverse set of innovations. For instance, grassroots innovation term is not very old. However, it has been practised by many cultures for centuries under different names.^[1] Similarly, *jugaad* is used for innovations both in the formal as well as informal sector innovations. The informal sector, considered as one of the largest sectors for employment generation and contributor to the gross domestic product (GDP) in many economies, especially developing countries, had a pessimistic understanding. This sector was looked as unproductive and a hindrance for development in the larger context.^[2] Later on, it was realised that rather than having a negative outlook of the informal sector, one should

develop a better understanding of it from other perspectives.^[1,2] The recent trend in looking at this sector as a knowledge generator and breeding ground for various forms of innovations has attracted scholars to understand the context and relevance of innovations coming out of the informal sector. Such innovations are considered to be by, for and at the grassroots.^[3] There are various interest groups, such as policymakers, scholars and promoters of informal sector innovations, have started looking into the innovations from the informal sector and addressed them using various terms as mentioned above. There are certain country or context-specific terms one can find in the literature, for instance, *Jua Kali* in Kenya, *Système D* in France, *DIY* in the USA, folklore innovations in China and *Gambiarra* in Brazil.^[1] This has not only increased research publications, but also funding has been pumped into it to tap the potential to address various problems such as accessibility, environmental, inclusivity and so forth. For instance, Honey Bee Network (HBN), an informal movement, started in the late 80s in India by Prof. Anil K Gupta and his associates to tap the potential of knowledge in the informal sector.^[4] Later, this movement has been able to successfully institutionalise the grassroots innovations by establishing Society for Research and Initiatives for Sustainable Technologies and Institutions (SRISTI) and National Innovations Foundation (NIF).^[5] They have attracted funds not only from civil society organisations, but the Indian government has also helped them. The activities of these organisations are to scout, document, give awards,

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commercialise and file a patent for grassroots innovations from India. This has also popularised the term through its efforts in and outside India. Such activities have established this field of knowledge and academic literature has been noticeably developing and evolving worldwide on informal sector innovations; however, conceptual ambiguities are still there.^[1]

In this context, this paper has purposively selected five keywords, namely grassroots innovations, *Jugaad*, inclusive innovations, frugal innovations and informal sector innovations, to explore the advancements in the research in this field. Defining these five keywords is out of the ambit of this paper, as they bear different meaning as per the context in which they are used.^[6] Further, this will help students, those who are planning to do research in this area, in identifying their research themes. Therefore, the paper considers these five keywords used by scholars to understand the publication trend in the informal sector innovations across the globe by using scientometric analysis.

The structure of the article is as follows: Literature review is presented in Section 2 and Section 2.1 highlights the role of scientometric analysis and 2.2 presents the discussion on the key terms used for this research. Section 3 presents the methodology and material used for this research. Results are presented in Section 4 on various themes and a discussion on results and conclusion is presented in Section 5.

LITERATURE REVIEW

Scientometric analysis

The scientometric analysis is a science of understanding the uses of various keywords used in science and as a field in academics. This also intends to understand the way and methodologies using a field of knowledge. Scholars like R. K. Merton, Derek J. de Solla Price and Eugene Garfield have developed this field of enquiry.^[7] Bornmann and Leydesdorff^[8] argue that in today's context quality of research, funding and prize opportunities are measured by quantitative techniques like bibliometrics and scientometric analysis. These methods are not only measures of individuals, but also of institutions and countries. Such methods calculate the research productivity of individuals, institutions and countries.^[9] Such productivity research considers all the possible sources of data like journal publications, books, book chapters and conference proceedings. Scholars have defined two perspectives, namely normative and descriptive, to understand the progress of a field of enquiry.^[10] The normative approach in scientometric analysis explores the norms and rules in the development of a field. On the other hand, descriptive approach observes the actual activities in the field of enquiry. This paper uses the descriptive approach of analysis of the informal sector innovation studies.

Informal sector innovations: Keywords

The literature on innovation has evolved over a period of time and captures the complexity, nuances and multidimensionality of the concept of innovation.^[11,12] However, a major part of the literature developed in the context of innovation pertains to the formal sector, which operates under, more or less, clearly defined problem situations, incentives structures and regulatory frameworks.^[13] In contrast, informal sector innovations operate in an informal setup, where neither the problem situations nor incentive structure nor the regulatory framework is well defined. These individual innovators work in the informal setups, where their motivations, local institutions and other actors become important factors in shaping the trajectory of innovation.^[8,13,14] In reality, these innovations can be based on, both traditional knowledge as well as modern technologies and adapt them to local conditions^[13] by people at the bottom of the pyramid.^[3] There are many factors responsible for making such innovations a core component of the Indian innovations systems along with similar concepts such as 'grassroots innovations', *Jugaad*, frugal innovations, informal sector innovations and inclusive innovations. However, as mentioned earlier, these concepts are different from each other and Kumar and Bhaduri^[1] and Bhaduri^[15] argue that they are different from each other if we look at the 'values' generated by them in their socio-economic context. Van Beers *et al.*^[16] also suggest that inclusive and frugal innovations are similar to certain characteristics, but not necessarily all-inclusive innovations are frugal or vice versa. Bhatti^[17] defines frugal innovations as "innovation which attempts to serve large bottom and lower-middle-class population demands are termed as 'frugal innovation' lies at the intersections of technology innovation, institutional innovation and social innovation (p.5)." Thus, frugal innovations are not only technological innovations, but other innovations can be considered frugal. Prahalad and Mashelkar^[18] have also differentiated frugal innovations from *Jugaad* by arguing that *Jugaad* is developing the alternative and improvisations to deal with the scarce resources and solving the complex problems. Moreover, they see *Jugaad* as compromising the quality of products. Devi and Kumar^[6] reiterate that all 'grassroots innovations' can be frugal; however, all frugal innovations cannot be grassroots innovations.

Mashelkar, President, *The Global Research Alliance* defines inclusive innovation as "the knowledge creation, acquisition, absorption and distribution efforts targeted directly at meeting the needs of the low-income or the base-of-the-pyramid (BoP) population. The focus of Inclusive Innovation is on delivering high-performance products and services or high experience at ultra-low cost to the people whose needs are generally not addressed." He further proposed a working definition of inclusive innovation as "any innovation that leads

to affordable access of quality goods and services creating livelihood opportunities for the excluded population, primarily at the base of the pyramid and on a long-term sustainable basis with a significant outreach.»¹ Thus, he is not only focusing on innovation as output but also creating income generation activities for people at the margins. Similarly, Utz and Dahlman (2007) define inclusive innovation as “innovation efforts that can help improve the productivity and livelihoods of people in India’s vast informal economy. [Such efforts can] benefit from harnessing collaborative efforts of formal creation efforts for the poor (cited in p. 20).^[19]” Thus, collaborative efforts with poor and excluded groups are important for making an innovation inclusive. The informal sector innovation keyword is used by a few scholars in India and Nigeria and they consider all innovations coming from the informal sector and not for the informal sector.^[1,20,21] Thus, they consider grassroots innovations, *jugaad* and frugal innovations generated in the informal sector as part of informal sector innovations.

Therefore, despite the differences among these keywords, they represent one or other kind of innovations in the informal sector. Since, conceptual ambiguity still persists with all of the selected keywords, the paper refrains from defining them. Despite that, they are building up strong research themes and scholars are exploring empirical evidence of such innovations in various context. Thus, the scientometric analysis would help in mapping different contexts of informal sector innovations around the globe.

MATERIALS AND METHODS

Data Source

Falagas *et al.*^[22] have made a comparative analysis of various scientific sources of information, namely PubMed, Scopus, Web of Sciences and Google Scholar and suggest that each of them has their strength and weakness. Therefore, for this study, a descriptive scientometric analysis of the Scopus database (available at <https://www.scopus.com>) is used for analysing data on various parameters such as scholars, their affiliations, country profile and so on. The paper also explores Google Scholar (available at <https://scholar.google.co.in/>) database to track the number of publications over the period around these keywords, including citations and patents, as Scopus has limited number of listed journals and there are other forms of publications, which are not listed in it.

Keyword search

In a similar study, Hossain^[23] used the keyword “grassroots innovation” and Hossain^[24] “frugal innovations” and

discussed various dimensions of their use in academic literature. Furthermore, the results in Hossain^[23] is focused on grassroots innovations in the context of environmental sciences. However, in this research, the search was made using five keywords, often used interchangeably, namely frugal innovations, grassroots innovations, inclusive innovations, informal sector innovations and *jugaad* used in the context of informal sector innovations. Although, their use and extent are different from each other, which is discussed in the earlier section.

Data analysis

Documents related to main journals in this field, publication year, country profile, institutional affiliations and subject area retrieved from the Scopus database. However, for the publication year both, Scopus and Google Scholar, databases were used for the simple reason that the Scopus database has its limitations and only listed journals are displayed. Also, at the beginning of any research area few publications, which are not part of journal articles, are also available from Google Scholar.

RESULTS

Publications timeline

Publication timeline has been searched on two sources i.e. Scopus and Google Scholar for the simple reason that most of the journals are not listed on the Scopus database. The result shows that altogether 512 publications have been listed on Scopus and around 11549 on Google Scholar since 1980s for all the five keywords (Table 1).

In which ‘grassroots innovations’ and ‘frugal innovations’ are most frequently used terms followed by ‘inclusive innovation’ and ‘*jugaad*’. Only five publications have been reported for informal sector innovations. The reason could be that these key terms have been defined in a broader manner and they also include innovations from the formal sector. However, these key terms have basic differences, as we discussed earlier, among them. For instance, scholars from the UK consider initiatives of the formal sector for grassroots communities as ‘grassroots innovations.’ However, Indian scholars

Table 1: Publications database.

Source Keyword	Scopus	Google Scholars
Grassroots Innovation	164	3241
Jugaad	54	2058
Inclusive Innovation	105	2942
Frugal Innovation	184	3258
Informal Sector Innovation	5	50

Author’s compilation (July 2018)

1 <http://www.theglobalresearchalliance.org/index.php/inclusive-innovation> [cited 2018, Jul 18].

consider innovations in this category only by individuals and communities in the informal sector. Similarly, the term 'jugaad', frugal and inclusive innovations have wider use, even they are used in the context of formal sector innovations.

If we look at the Scopus database, frugal innovation is the most frequently used term and most of the studies have focused on innovations from the formal sector followed by grassroots

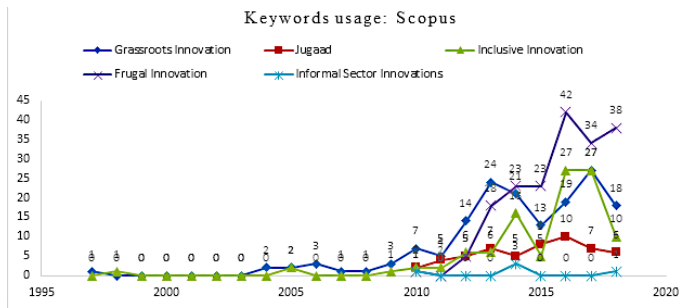


Figure 1: Keywords usage: Scopus (Scopus, July 2018).

innovations (Figure 1).

The Google Scholar database suggests that frugal innovation is the most used term in comparison to other four keywords (Figure 2). However, the first uses of term grassroots innovations can be traced back to 1980s, where it was used in the context of innovations in the field of education. Since then the usage of this word has changed and now used in varied context especially innovations by the grassroots communities in India. The reason could be HBN has popularised the term not only in India but worldwide through its various efforts. For instance, the establishment of SRISTI in the early 1990s and NIF in the year 2001 have provoked scholars to look into the scope of such innovations for wider applicability. The initial research on grassroots innovation by Bhaduri and Kumar^[13] has looked into the socio-economic context of grassroots innovation and tried to understand innovators local context and their motivation to come up with such innovations. Perhaps this was the triggering point and one can find after that sudden rise in publications by other scholars around the theme. The later publications have explored other dimensions of grassroots innovations such as diffusion dynamics,^[14] patenting,^[20,25] grassroots innovation as movement,^[4] lived experiences of grassroots innovators^[26] and so on. Until then, the research on jugaad, frugal and inclusive were still rooted in the formal sector innovations. They have been conceptualised as how one can use innovations from the formal sector for the poor and excluded people. In other words, in the initial phase, they were conceptualised as 'top-down model' in contrast to 'bottom-up model' of grassroots innovations. The keyword 'informal sector' is still in a very nascent stage and a few scholars from India are focusing on this key term. Thus, the

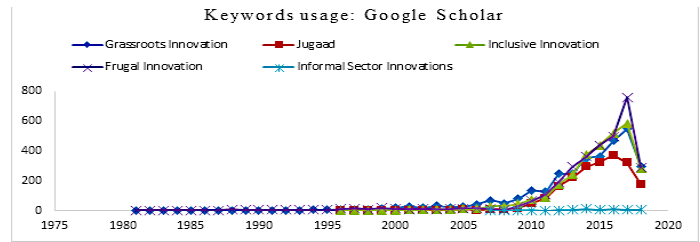


Figure 2: Keywords usage: Google Scholar (Google Scholar, July 2018).

overall picture suggests that since 2010 the focus on informal sector innovations has increased throughout the globe.

Journal type

The results of journals type suggest that most of the publication are in different types of journals mostly interdisciplinary in nature (Table 2). The topmost journals publishing on grassroots innovations are related to environmental issues, for instance, *Global Environmental Change*, *Journal of Cleaner Production* and *Energy Policy*, which is also evident from Mokhter.^[23] Although, they are highlighting the social aspects and not the scientific aspects of the environment.

The word jugaad got popularity in the field of management as it is frequently used in the context of formal sector business organisations. Therefore, most of the business and management-related journals are publishing on this keyword. However, there are a few journals from the field of medical sciences have published on jugaad too. Inclusive innovation has taken space in innovation-related journals and further explain how the traditional sources of innovations were not inclusive and this new concept has been incorporated in the literature to make this field of analysis inclusive. Frugal innovation-related research is published in all kinds of journals, dominated by developmental aspects of it such as *European Journal of Development Research*. This may be the reason that most numbers of publications are there related to this keyword in comparison to other four keywords. Informal sector innovations keyword is less used and very few journals have been reported in the results. Although, an interesting point one can observe that not only innovation related journals like *African Journal of Science Technology Innovation and Development* (AJSTID) but science technology and society (STS) related journals such as *Technology in Society* and *Current Science* are paying attention to the publications on informal sector innovations research. This may be due to the interdisciplinary nature of research are happening around these keywords. Another interesting aspect is that AJSTID is publishing with keywords like 'grassroots innovations', 'inclusive innovations' and 'informal sector innovations' more in comparison to other journals. This is perhaps due to the factor that AJSTID is focusing more on African and Asian cases of innovations and most of the authors published in this journal belong to these

Table 2: Top Journals publishing on informal sector innovations.

Grassroots Innovations		Jugaad		Inclusive Innovations		Frugal Innovations		Informal Sector Innovations	
Journal	Papers	Journal	Papers	Journal	Papers	Journal	Papers	Journal	Papers
Global Environmental Change	9	Asia Pacific Journal of Management	2	Innovation and Development	12	European Journal of Development Research	9	African Journal of Science Technology Innovation and Development	2
Environmental Innovation and Societal Transitions	7	Contemporary South Asia	2	African Journal of Science Technology Innovation and Development	5	Journal of Cleaner Production	6	Current Science	1
Journal of Cleaner Production	7	Economic and Political Weekly	2	Picmet 2016 Portland International Conference on Management of Engineering and Technology Technology Management for Social Innovation	4	Procedia CIRP	5	Geography Compass	1
Working Paper Centre For Social and Economic Research on The Global Environment	6	Indian Journal of Anaesthesia	2	Universities Inclusive Development and Social Innovation an International Perspective	4	Sustainability Switzerland	5	Journal of World Intellectual Property	1
African Journal of Science Technology Innovation and Development	4	Journal of Indian Business Research	2	Advances in Intelligent Systems and Computing	4	Globalization and Health	4		
Local Environment	4	Promoting Socio-Economic Development Through Business Integration	2	European Journal of Development Research	3	Journal of Indian Business Research	4		
Current Science	3	20 th Americas Conference on Information Systems Amcis 2014	1	Technology in Society	3	Technology in Society	4		

Source: Scopus (July 2018)

geographical locations. Therefore, one may argue that these keywords have a contextual understanding.

Subject Area

Publication on the informal sector innovations are not limited to social sciences and other fields of knowledge like arts, humanities and natural sciences are also using these terms (Figure 3). Again, this shows that interdisciplinary perspectives are dominant around these keywords and such knowledge is influencing other fields of knowledge and vice versa. Also, the conceptual ambiguity around these keywords has helped scholars to use them in diverse contexts and subject areas. This also gives them the flexibility to define these concepts according to the context in which scholars are looking for such ideas. However, most of the publications are coming from social sciences streams. In that too grassroots and frugal innovations are dominating the discourse.

Interestingly, natural sciences subjects, for instance, pharmacology, veterinary, chemical sciences, physics and mathematics, are also using these keywords frequently. This may be due to the applicability of such innovations in the

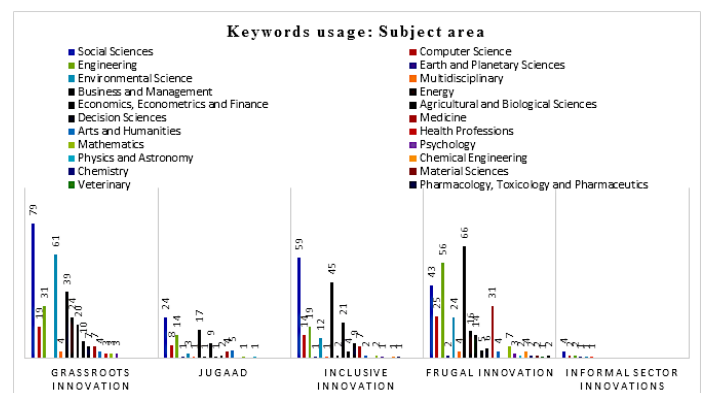


Figure 3: Keywords usage: Subject area (Scopus, July 2018).

diverse subject and possibly they explain activities happening in other fields of knowledge. For instance, many grassroots innovations in India are reported in the field of traditional medicine, plant varieties, engineering and so on.

Also, the efforts by SRISTI and NIF to link grassroots innovators with many technical institutions like Indian Institute of Technology (IITs) and Indian Institute of Management (IIMs) in India has given scope to the scholars to work on these innovations from interdisciplinary perspectives. Furthermore, scholars in the west have expanded the notion of grassroots innovations to the innovations coming from the formal sector and labs^[4] for solving problems of poor and excluded people. This has broadened the scope of publishing on these keywords in diverse sets of subjects.

Document Type

The document type is another important search criterion and Sigogneau (p.589)^[27] argues that each document type has a function in the production and dissemination of knowledge. For instance, article publication presents original research and review gives a synthesis of published research in a field of knowledge. He further argues that for calculating productivity, for a nation, in research Institute for Scientific Information (ISI) has categorised twelve different types of documents. Since this research is looking into a comparatively new field of knowledge, it has considered all possible document types results in the Scopus database. Further, these document types may have different meanings and forms based on the field of knowledge, concepts and language they are using, journal structure and due to ISIS categories (p.591).^[27] Thus, in this study, we found that most of the research is published in the form of articles using all types of selected keywords followed by book chapters (Figure 4). There are 111 articles published using grassroots innovations, 100 frugal innovations, 58 inclusive and 28 *jugaad*. In terms of books publications four inclusive innovations, 3 each with grassroots and frugal innovations and none for *jugaad* and informal sector innovations have been found. However, there is one book by

Rojdou *et al.* on *jugaad* published in the year 2012, although, this book is not listed in the Scopus database.

There is a significant number of book chapters with keywords grassroots innovations (11), *jugaad* (8), inclusive innovations (14) and frugal innovations (10) are published. Conference papers also published with these keywords. These publications suggest that scholars are taking interest in these areas of research and a number of opportunities have been created to understand these concepts by organising national and international conferences around these themes. Furthermore, such an analysis will open up new avenues to classify the document types as this field of knowledge evolves.

Country Profile

The data on country profile suggests that research using keyword ‘grassroots innovations’ are coming from the USA (56), the UK (31) and India (23). Most of the studies in these countries are focusing on cases of grassroots innovations are from small or developing economies, where the informal sector plays a major role in the economy. This also shows that the informal sector is recognised for its different kind of knowledge generation activities. In other words, the informal sector is looked from an ‘optimistic’ viewpoint what Chen (2007) suggests.

There are other smaller economies working on similar research topics, however, their publications are smaller in number. The keyword ‘*jugaad*’ is used mostly in India (19) and the UK (12) followed by the USA (7), France (4) and Germany (4). The reason could be that the origin of the word ‘*jugaad*’ can be traced to Indian mythologies.^[1] Inclusive innovation research keyword is used mostly in the UK (19), The USA (10), the Netherlands and South Africa (9) followed by India, Norway and Canada (7) and Argentina (6). The keyword ‘frugal innovation’ is most frequently used by India (31), the USA (30) and the UK (24). The other countries like Germany (19), France (18), Finland (11), Belgium and the Netherlands (10) have also contributed in a significant way (Figure 5 and 6).

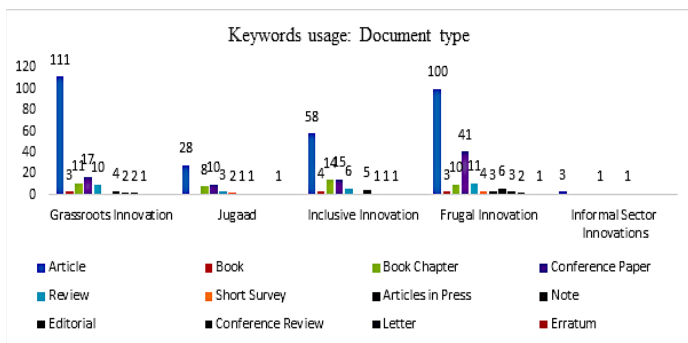


Figure 4: Keywords usage: Document type (Scopus, July 2018).

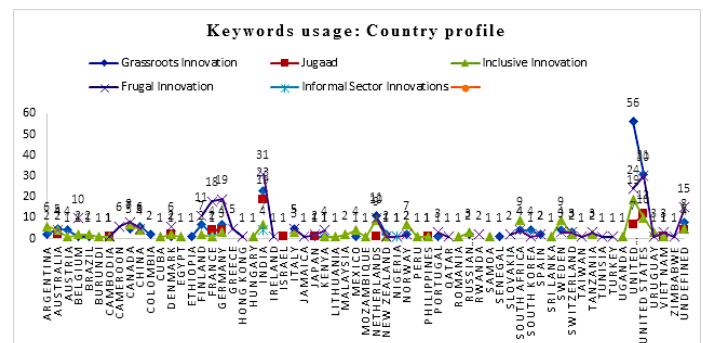


Figure 5: Keywords usage: Country Profile (Scopus, July 2018)

Table 3: Top ten institutions publishing with these keywords.

Grassroots Innovation		Jugaad		Inclusive Innovation		Frugal Innovation		Informal Sector Innovation	
Institutions	No.	Institutions	No.	Institutions	No.	Institutions	No.	Institutions	No.
University of East Anglia, UK	20	Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany	2	Universiteit Stellenbosch, South Africa	8	University of Cambridge, UK	6	Central University of Gujarat, India	3
University of Sussex, UK	19	King Edward Memorial Hospital India	2	Wageningen University and Research Centre, Netherlands	5	Panepistimion Patron, Greece	6	Jawaharlal Nehru University, India	2
University of Reading, UK	7	The University of California, Irvine, US		Lunds Universitet, Sweden	5	Imelda Hospital, Belgium	6	University of Nigeria, Nigeria	1
Jawaharlal Nehru University, India	5	Seth Gordhandas Sunderdas Medical College, India	2	Universidad Nacional de Quilmes, Argentina	4	Aalto University, Finland	6		
Indian Institute of Technology, Guwahati, India	4	Microsoft Research, US	2	University of Sussex, UK	4	Ecole Centrale de Nantes, France	5		
Tellus Institute, US	4	Queen Mary, University of London, UK	2	DST-NRF Centre of Excellence in Scientometrics and Science, South Africa	3	Universitat Gottingen, Germany	5		
Tianjin University of Finance and Economic, China	4	University of Miami, US	2	University of Manchester, UK	3	Delft University of Technolog, Netherlands	4		
Indian Institute of Management Ahmedabad, India	4	University of Cambrid, UK	2	Open University, UK	3	IBM Research, US	4		
Central University of Gujarat, India	3	Tuljaram Chaturchand College, India	1	University of Toronto, Canada	3	Imperial College London, UK	4		
Delft University of Technology, Netherlands	3	National Defense Academy, India	1	Universidad de la Republica, Uruguay	3	Queen's University, Kingston, Canada	4		

Source: Scopus (July 2018)

The keyword ‘informal sector innovation’ is in its nascent stage and only two countries namely India (4) and Nigeria (1) have used it. However, if we look at the overall country profile, one

can sense that even smaller countries, especially from Asian, African and South American continents, are contributing to research with these keywords, although in a limited way. Also, the publications dominated by western countries on these keywords suggest that funding opportunities to conduct research are more available in comparison to developing economies. Thus, given the complexities around these keywords, there is need to encourage institutions in smaller and developing countries to focus on research on such keywords as these economies are mostly dominated by the informal sector and they have to identify and explore the potential of such diverse and often neglected knowledge.

Institutional affiliation

The scientometric analysis is also a measure of the productivity of institutions engaged in a field of research. Table 3 reflects upon the top ten institutions engaged in research on different keywords in the informal sector innovation research. One

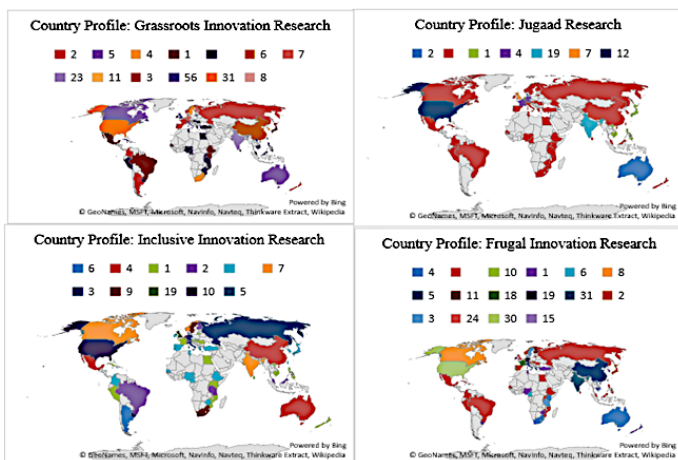


Figure 6: Country profile.

thing is clear that each research group in these institutions focus their research on one keyword at a time.

The word grassroots innovations have highest publications from the UK universities and Indian institutions are second to that. With 'jugaad' keyword Germany, the UK, the USA institutions are publishing more. Inclusive innovation keyword is more used in South African, Swedish, Argentinian, Canadian and Uruguay institutions. Publications are more produced by the European institutions followed by USA and Canada with the keyword 'frugal innovation'. A few private organisations, like Microsoft and IBM Research, are also publishing with these keywords. The keyword informal sector innovations are used by only an Indian university and a Nigerian university. Further, Serenko *et al.*^[9] point out that research published in new discipline is dominated by single-authored paper. However, these study results suggest that most of the publications are not by single authors. They are generally a collaborative project at various levels. For instance, in UK scholars from more than one institution have collaborated to research on the keywords. In India, scholars have published together due to a PhD project, where authors were Ph.D supervisor and student. Also, there is a paper where co-authorship has been given to fourteen individuals as they have contributed in various form in conceptualising the idea of grassroots innovations in India (see for instance Gupta *et al.*)^[28] This could be due to the reason that the informal sector is vast and scattered, especially in India and perhaps for an individual, it is difficult to conduct the primary database research alone. Therefore, despite a very challenging research area, the informal sector is getting attention equally from developed and developing economies both. Perhaps these results are indicating that the informal sector is going to stay and one must look at it from an 'optimistic view' what Chen^[2] argues for. Furthermore, Kumar and Bhaduri^[1] argue that informal sector is full of knowledge and time has come to explore the knowledge of common people.

DISCUSSION AND CONCLUSION

Scientometric analysis results have been obtained from various fields such as publications year, journals, subject area, document type, country and institutional profile working on informal sector innovations. However, the only year-wise publication was possible on both the data sources i.e., Scopus and Google Scholar. Results in the Scopus show that before the year 2000, only 'inclusive innovation' and 'grassroots innovations' terms were used by the researchers and that too in a limited way. Most of the uses started 2005 onwards and other words like 'jugaad' and 'frugal' were used frequently. The word 'informal sector innovations' is still not used by many and some scholars in India and Nigeria are using it. Google Scholar results showed the uses of word grassroots

innovation since the 1980s and were used in the context of innovations in the field of education. Further, it was in use during the 1900s and one reference was found for the term *jugaad* in 1995. However, like Scopus, other words use came into regular practice after 2005. This shows that the focus of scholars towards researching informal sector innovations shifted after the year 2000 and in India, this may be due to the HBN efforts and establishment of SRISTI and NIF and their activities. At the global level, the paradigm shift happened due to the importance of informal sector knowledge in the context of solving environmental problems and where formal sector have failed to address the issues of poor and excluded people. Also, it was realised that the informal sector is going to stay despite the speculation that it will vanish from all major economies. One can also observe a shift in the theories of innovations from system to individual innovators like open innovations and individual innovations.

The journals which are publishing on informal sector innovations are interdisciplinary in nature and focusing on economic and environmental impacts of such innovations. The dominant area of research on these words is social sciences. However, in natural sciences such as mathematics, engineering, biochemical, material sciences and earth and planetary sciences scholars have used these words. If we look at the document type, most of the publications are in conferences proceedings and review. Later, there was a slight increase in journal publications and but still, books are very few in these areas of research. The result of a country profile in the Scopus, suggests that most of the publications are coming from western countries such as the United Kingdom and the United States. From Asian countries, India is the topmost publisher on these terms. Also, in the UK and the USA, the word grassroots innovation is more used. However, in India, the word frugal is used frequently. If we look at the institutional affiliations, most of the technical institutions such as IITs and IIMs are using the word *jugaad* and frugal. On the other hand, social science-based institutions such as JNU is using grassroots innovations and informal sector innovations words more. Interestingly, in Canada, scholars are using only inclusive innovations and no other keywords usage found in the results.

Thus, the results obtained from the Scopus suggests that there is an increase in the research on informal sector innovations in the last one decade. Scholars are trying to understand these innovations from various perspectives using different methods. However, due to the limitation of Scopus, one cannot have a comprehensive view of research in the non-western countries on the informal sector innovations. Scholars in the African and Asian countries are working on these areas in the informal sector as it is a dominant feature in these economies and one must devise a robust mechanism, by providing funding and

developing institutional capabilities, to capture the research trends in informal sector innovations in these continents too. Also, this study will open new areas of research, such as exploring collaboration among scholars and institutions on these research themes and how different countries are looking at innovations from the informal sector.

ACKNOWLEDGEMENT

I am thankful for the audiences, especially Shekhar Jain and Saradindu Bhaduri, at The Fourth IndiaLICS International Conference 2017, New Delhi and reviewers of the journal for their valuable comments on the earlier version of the paper. I am also thankful to the Central University of Gujarat for providing me access to the Scopus database.

CONFLICT OF INTEREST

The author declare no conflict of interest.

REFERENCES

- Kumar H, Bhaduri S. Jugaad to grassroot innovations: Understanding the landscape of the informal sector innovations in India. *African Journal of Science, Technology, Innovation and Development*. 2014;6(1):13-22.
- Chen MA. Rethinking the Informal Economy: Linkages with the Formal Economy and the Formal Regulatory Environment. *DESA Working Paper*. 2007;46. ST/ESA/2007/DWP/46 Available from: http://www.un.org/esa/desa/papers/2007/wp46_2007.pdf. Accessed on 17 November 2018.
- Gupta AK. *Grassroots Innovation: Minds on the margin are not marginal minds*. India: Penguin Random House. 2016.
- Smith A, Fressoli M, Abrol D, Around E, Ely A. *Grassroots Innovation Movements*. New York: Routledge. 2017.
- Ustyuzhantseva OV. Institutionalization of grassroots innovation in India. *Current Science*. 2015;108:1476-82.
- Devi WP, Kumar H. Frugal Innovations and Actor–Network Theory: A Case of Bamboo Shoots Processing in Manipur, India. *The European Journal of Development Research*. 2018;30(1):66-83.
- Garfield E. The intended consequences of Robert K. Merton. *Scientometrics*. 2004;60(1):51-61.
- Bornmann L, Leydesdorff L. Scientometrics in a changing research landscape: Bibliometrics has become an integral part of research quality evaluation and has been changing the practice of research. *EMBO Reports*. 2014;15(12):1228-32.
- Serenko A, Bontis N, Grant J. A scientometric analysis of the Proceedings of the McMaster World Congress on the Management of Intellectual Capital and Innovation for the 1996-2008 period. *Journal of Intellectual Capital*. 2009;10:8-21.
- Neufeld D, Fang Y, Huff S. The IS identity crisis. *Communications of the Association for Information Systems*. 2007;19(1):447-64.
- Marinova D, Phillimore J. Models of innovation. *The International Handbook on Innovation*. Oxford: Elsevier Science. 2003;45-53.
- Rothwell R. Successful industrial innovation: Critical factors for the 1990s. *R and D Management*. 1992;22(3):221-40.
- Bhaduri S, Kumar H. Extrinsic and intrinsic motivations to innovate: Tracing the motivation of 'grassroot' innovators in India. *Mind and Society*. 2011;10(1):27-55.
- Abrol D, Gupta A. Understanding the diffusion modes of grassroots innovations in India: A study of Honey Bee Network supported innovators. *African Journal of Science, Technology, Innovation and Development*. 2014;6(6):541-52.
- Bhaduri S. Frugal innovation by 'the small and the marginal: An alternative discourse on innovation and development. Inaugural lecture Prince Claus Chair in Development and Equity, Erasmus University Rotterdam, The Hague, The Netherlands. 2016;44. Available from: https://www.researchgate.net/publication/303677051_Frugal_Innovation_by_the_small_and_the_marginal_an_alternative_discourse_on_innovation_and_development. Accessed on 20 August 2018.
- Beers CV, Knorringer P, Leliveld A. Frugal Innovation in Africa, Towards a Research Agenda. Paper presented at 14th EADI General Conference 'Responsible Development in a Polycentric World: Inequality, Citizenship and the Middle Classes'. Bonn, Germany. 2014. Available from: <http://www.cfia.nl/uploads/cf-fia/attachments/Frugal%20Innovation%20in%20Africa.pdf>. Accessed on 16 March 2018.
- Bhatti YA. What is Frugal, what is Innovation? Towards a Theory of Frugal Innovation. 2012;1-45. Available from SSRN: <https://ssrn.com/abstract=2005910> or <http://dx.doi.org/10.2139/ssrn.2005910>. Accessed on 16 March 2018.
- Prahalad CK, Mashelkar RA. Innovation's Holy Grail. *Harvard Business Review*. 2010;88. Available from: <https://hbr.org/2010/07/innovations-holy-grail>. Accessed on 17 November 2018.
- Murray A. Developing an Inclusive Innovation Agenda for Canada. *CSLS Research Report 2016-18*. Prepared for Innovation, Science and Economic Development Canada. 2016. Available from: <http://www.csls.ca/reports/csls2016-18.pdf>. Accessed on 20 August 2018.
- Sharma G, Kumar H. Intellectual property rights and informal sector innovations: exploring grassroots innovations in India. *The Journal of World Intellectual Property*. 2018a;21(3-4):123-39.
- Sheikh FA. Science, technology and innovation policy 2013 of India and informal sector innovations. *Current Science*. 2014;106(1):21-5.
- Falagas ME, Pitsouni EI, Malietzis GA, Pappas G. Comparison of PubMed, Scopus, Web of Science and Google Scholar: Strengths and weaknesses. *The FASEB Journal*. 2008;22(2):338-42.
- Hossain M. Grassroots innovation: A systematic review of two decades of research. *Journal of Cleaner Production*. 2016;137:973-81.
- Hossain M. Mapping the frugal innovation phenomenon. *Technology in Society*. 2017;51:199-208. DOI: 10.1016/j.techsoc.2017.09.006.
- Sharma G, Kumar H. Exploring the Possibilities of Utility Models Patent Regime for Grassroots Innovations in India. *Journal of Intellectual Property Rights*. 2018b;23(2-3):119-30.
- Joshi RG, Chelliah J, Ramanathan V. Exploring grassroots innovation phenomenon through the lived experience of an Indian grassroots innovator. *South Asian Journal of Global Business Research*. 2015;4:27-44.
- Sigogneau A. An Analysis of Document Types Published in Journals Related to Physics: Proceeding Papers Recorded in the Science Citation Index Database. *Scientometrics*. 2000;47:589-604.
- Gupta A, Sinha R, Koradia D, Patel R, Parmar M, Rohit P, *et al.* Mobilizing grassroots' technological innovations and traditional knowledge, values and institutions: Articulating social and ethical capital. *Futures*. 2018;23(2-3):119-130.