



Scientometrics study on Agroforestry Research based Research Publication: A Global perspective

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Abstract

The study explained "Agroforestry" worldwide in a scientometrics study. The data were retrieved from the Web of Science database during the period 2017–2021. A total of 3900 records were found during the research period. In the year 2021 published more number of 914 articles with 9 H-Index published. The least number of records, 436, were published in 2018 with a 36 H-Index. In the field of "Agriculture," the research area holds 1376 records, which is 40.21% of total records. Out of 3900 records, the above authors have contributed the most papers (1297) published on Agroforestry research. Followed by five authors who published 600 records. A single author has contributed 113 (3.30%) records. Multi-Author has contributed 3790 (97.17%) records. The degree of collaboration ranges from 0.95 to 0.97. The average degree of collaboration is 0.97. The growth rate gradually increased year by year from 0.59 to 1.97, and double time gradually decreased every year from 1.17 to 0.47. The average growth rate is 1.04, and the average double-time mean is 0.74.

Keywords: Agroforestry, forest cultivation, tree growing, Scientometric, Degree of Collaboration, Bibexcel.

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I. Introduction

Many landowners and land managers do not realize that forest management can be deliberately linked to agriculture. This deliberate process of combining agriculture and forestry to create integrated and sustainable land-use systems is called agronomy. Although this concept is new to many, agroforestry is relatively old-fashioned in many parts of the world. Another key aspect of agroforestry is that it provides both economic and environmental benefits simultaneously. These benefits include protection against loss of topsoil, regeneration of soil fertility, crop, and livestock protection, diversification of products and protection against the risk associated with volatile commodity markets, wildlife habitat enhancement, enhanced aesthetics, water quality management, waste management, and carbon sequestration.

Today, agronomy is largely associated with tropical climates, although it is also a land-use method that is used successfully in temperate climates. This includes most parts of Alaska and most parts of the United States, except most of southern Texas and Florida. So what exactly is agroforestry, and how might it benefit you as a landowner or land manager? It is an intentional, intensive, integrated system that takes advantage of the interactive benefits derived from combining trees and shrubs with crops and/or livestock, and it has proven successful in many regions across the United States. In other words, it means putting the right plant in the right place for the right purpose. Common types of agro-forestry systems applied by landowners and land managers across the United States are silvopasture, alley cropping, forest farming, riparian forest buffers, and windbreaks. There are also several special applications worth consideration. While most agroforestry practices can be applied almost anywhere in the United States, climate, soil type, and rainfall remain limiting factors.

1.1 Scientometrics

Nalimov and Mulchenko define this term, "as a subfield which applies quantitative methods to the study of science as an information process". In this information model, publications are carriers of information and promoters of communication. Haitun treats 'Scientometrics', as a scientific discipline that performs reproducible measurements of scientific activity and reveals its objective quantitative regularities. According to him, scientometric methods include statistical and thesaurus methods, and indicators as to the number of citations terms, etc.

II. Review of the Literature

Sedam, M. V., & Vasudev, M. (2021) The study examines the academics and researchers at the Indian Council for Agricultural Research's (ICAR) rate of publishing. The institutional scientific output has been the subject of numerous contemporary scientometric investigations. A quantitative analysis of productivity and the features of numerous ICAR publications are presented in the study. 43876 citations were made to a total of 9236 published contributions over the research period, averaging 4.75 citations per paper. **Ram Newaj & Om Prakash Chaturvedi (2021)** Agroforestry research is site-specific/region specific and hence the technologies developed in agro-forestry vary in different agro-climatic zones. Based on promising tree species for a particular agro-climatic zone, the agroforestry system is characterized for different agro-climatic zones. Agro-forestry provides a unique opportunity to combine the twin objectives of climate change adaptation and mitigation. It can enhance the resilience of the system to cope with the adverse impacts of climate change. **Ollivier, G. (2019)** made sense of the exploration history of Agroforestry, but hardly any papers have investigated the general example of its insight improvement (Nair, 1996; Montambault and Alavalapati, 2005; Barisoux, 2017). In this correspondence, he examines the improvement of this logical space since its appearance in the Trap of Science data set (1979). His most memorable form is a far-reaching lexical inquiry on types of agroforestry. This creates a corpus of 11902 records from 1979 to 2018. They especially center around the advancement of learning about monetary and institutional determinants of dissemination and reception and all the more as of late on change studies toward agroforestry. **Rubinandhini, A., & Gomathi, P. (2018)** This study evaluates the Applied and Environmental Microbiology Journal (AEMJ). It is a biweekly peer-reviewed scientific journal published by the American Society for Microbiology. It was established in 1953 as Applied Microbiology and obtained its current name in 1975. The present bibliometrics study was 15291 scholarly research articles published in 'The Applied and Environmental Microbiology Journal, during the period 2001-2015. The collected data were analyzed with the help of 'The Bibexcel tool'. The references were collected from Mendeley. **Ravanan, C., Balasubramanian, P., & Raghavan, S. (2010)** The botanical name for the coconut is *cocosnucifera*. The tree is considered the most useful tree in the tropics. Coconut is highly nutritious and rich in fiber, vitamins, and minerals. This fruit is classified as a functional food. This study is focused on the growth pattern and overall trend and output of coconut literature during the period from 1995 to 2009, as per the data collected from SCOPUS databases based on several parameters like annual average growth rate, global publication ranks, top published institutes, authors, etc.

III. Objective of the study

- To access the year-wise publication growth pattern of literature from Agroforestry
- To study the Single-author vs multi authors
- To describe the country-wise production
- To show the keywords of literature output and Degree of Collaboration
- To examine the types of documents and to identify the languages.

IV. Methodology

Web of Science core collection citation databases such as SCI – Expanded, SSCI, and A&HCI were used to collect the data as the primary source. We selected the search item Agroforestry in the topic field with the limitation of Five years from 2018 to 2022. We found a total number of 3900 world records that were retrieved as a sample for data analysis. The retrieved data has different categories including articles, reviews, editorial material, meeting abstracts, proceeding papers, and biographical items. The data has been transferred to an Excel spreadsheet for further analysis. For sample data and visual representation of author productivity, VOS viewer software and Bibexcel software have been employed.

V. Data Analysis and Discussion

Table 1 Year-wise Distribution of Agroforestry

S.No	Publication Years	Records	Percentage
1	2021	914	23.44%
2	2022	895	22.95%
3	2020	833	21.36%
4	2019	696	17.85%
5	2018	562	14.41%
Total		3900	100%

Table 1 analyzes the year-wise distribution of agroforestry research worldwide from 2018 to 2022. A total of 3900 records were published during the research period. In this research, publications continuously increased from the year 2018 (562 Publications) to 2021 (914 Publications).

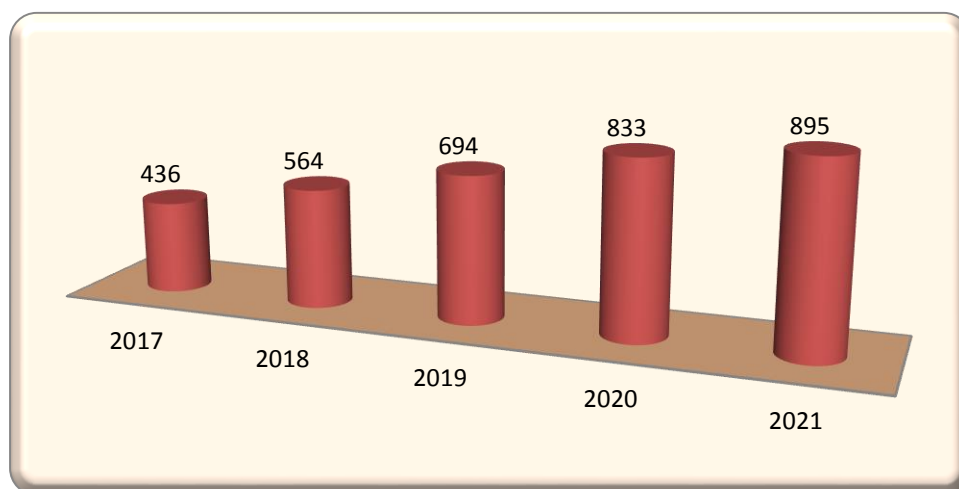


Figure 1 Year-wise Distribution

Table 2 Research Areas Top 10 Out of 74

S.No	Research Areas	Records	Percentage
1	Agriculture	1,487	38.13%
2	Environmental Sciences Ecology	1,403	35.97%
3	Forestry	988	25.33%
4	Science Technology Other Topics	501	12.85%
5	Plant Sciences	326	8.36%
6	Biodiversity Conservation	170	4.36%
7	Geology	106	2.72%
8	Water Resources	105	2.69%
9	Food Science Technology	95	2.44%
10	Engineering	93	2.39%

Table 2 shows the research areas of Agroforestry and the records counts of each research area. This ‘Agriculture’ research area holds 1487 records which are 38.13% of total records. Followed by ‘Environmental Science Ecology’ holds 1403 (35.97%) records Followed by ‘Forestry’ which holds 988 (25.33%) records.

Table 3 Year-wise Authorship Pattern on Agroforestry

Year	1	2	3	4	5	5+	Total
2018	24	46	86	101	117	188	562
2019	27	69	114	119	117	250	696
2020	20	68	142	133	131	339	833
2021	25	65	120	163	167	374	914
2022	14	60	127	147	134	413	895
Total	110	308	589	663	666	1564	3900

(Note: 1* Single Author 2* Two Author 3* Three Author 4* Four Author 5* Five Author Above Five Author)

Table 3 shows the year-wise authorship pattern on agroforestry research publications ranging from single authors to above five Authors. Out of 3900 records, Six authors have contributed the most number of papers (1564) published on Agroforestry research. Followed by five authors who published 666 records

followed by four authors who published 663 papers and the least number of records were published by one author with 110 records.

Table 4 Single vs. Multi Authors

Authors	Publications	Percentage
Single Authors	110	2.82%
Multi Authors	3790	97.17%
Total	3900	100%

The table explains the contribution of the single author and multi-author. Single Author has contributed the minimum number of records with 110 (2.82%) records. Multi-Author has contributed the maximum number of records with 3790 (97.17%) records.

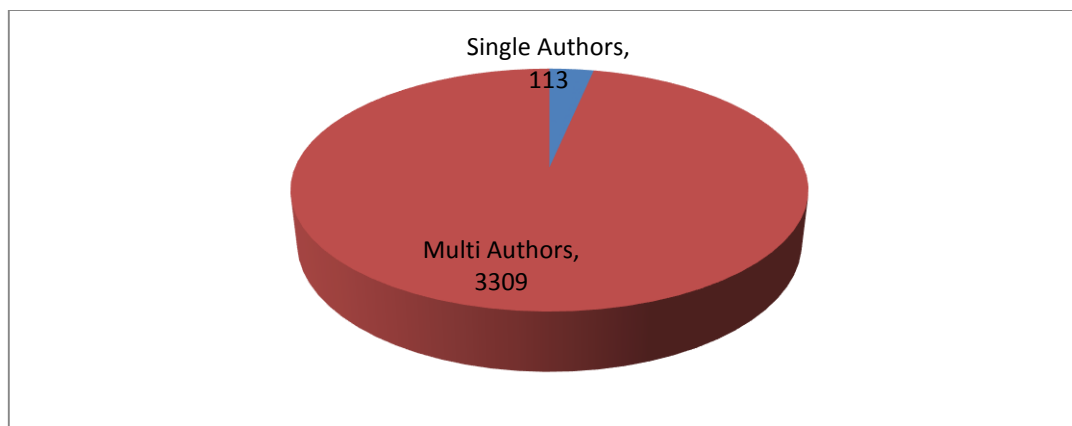


Figure 2 Single vs. Multi Authors

Table 5 Web of Science Categories Top 10 Out of 109

S.No	Web of Science Categories	Records	Percentage
1	Forestry	988	25.33%
2	Environmental Sciences	931	23.87%
3	Agronomy	929	23.82%
4	Ecology	497	12.74%
5	Environmental Studies	471	12.08%
6	Green Sustainable Science Technology	338	8.67%
7	Plant Sciences	326	8.36%
8	Agriculture Multidisciplinary	298	7.64%
9	Soil Science	263	6.74%
10	Biodiversity Conservation	170	4.36%

Table 5 shows us the Web of Science Categories of Agroforestry and the records counts of each research area. This ‘Forestry’ research area holds 988 (25.33%) records. Followed by ‘Environmental Sciences’ holds 931 (23.87%) records Followed by ‘Agronomy’ which holds 929 (23.82%) records.

Table 6 Degree of Collaboration (DC)

Year	Single Author (NS)	Multi Authors (NM)	Total (NS+NM)	DC=NM/NS+NM
2018	24	538	562	0.957295
2019	27	669	696	0.961207
2020	20	813	833	0.97599
2021	25	889	914	0.972648
2022	14	881	895	0.984358
Total	110	3790	3900	0.971795

Table 6 to determine the degree of collaboration ranges from 0.95 to 0.97. The average degree of collaboration was 0.97. It indicates that there exists the highest collaboration among the authors in the research.

Formula,

$$DC = Nm/Ns + Nm$$

$$DC = 3790 / 110 + 3790$$

$$= 3790 / 3900 = 0.97.$$

Table 7 Relative Growth Rate (RGR) & Doubling Time (DT)

Year	Records	Cumulative	W1	W2	W2-W1	Mean R(a)	DT 0.693/R(a)	Mean DT(a)
2018	562		6.33			1.04	1.174576	0.74
2019	696	1258	6.54	7.13	0.59			
2020	833	2091	6.72	7.64	0.92			
2021	914	3005	6.81	8	1.19			
2022	895	3900	6.79	8.26	1.47			
Total	3900							

Table 7 determined the relative growth as ranges from 0.59 to 1.47 and doubling time as ranges from 0.47 to 1.17 during the study period 2018-2022. The average growth rate is 1.04 and the average Doubling Time mean is 0.74. The growth rate is gradually increased year by year and Doubling Time is gradually decreased by every year.

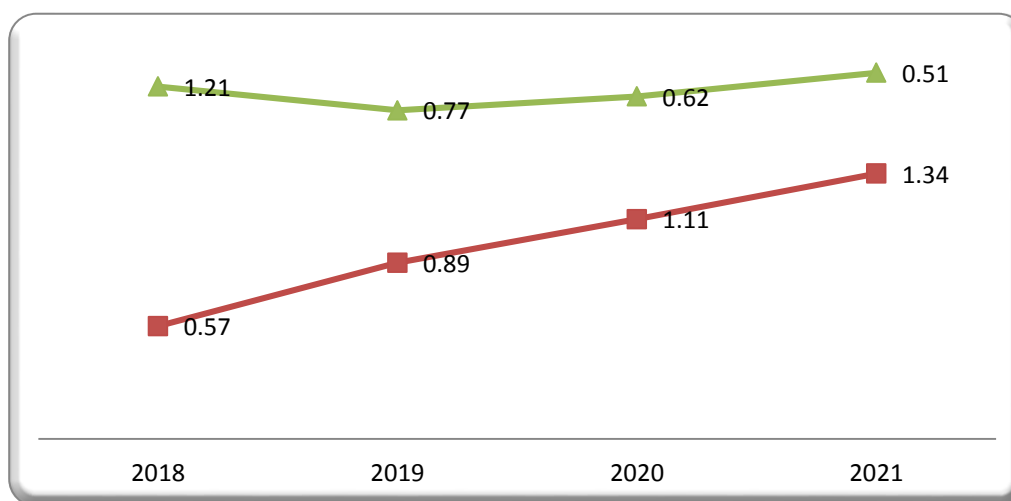


Figure 3 Relative Growth Rate & Doubling Time

Table 8 Document-wise Distribution of Agroforestry

S.No	Document types	Records	Percentage
1	Article	3,553	91.10%
2	Review Article	289	7.41%
3	Proceeding Paper	41	1.05%
4	Early Access	27	0.69%
5	Editorial Material	27	0.69%
6	Correction	19	0.49%
7	Letter	6	0.15%
8	Book Chapters	5	0.13%
9	Meeting Abstract	4	0.10%
10	Data Paper	3	0.08%
11	Book Review	1	0.03%
12	News Item	1	0.03%

Table 8 shows the document-wise distribution. This study has 12 types of documents during the study period. It is identified that a total of 3900 publications with 42 H-Index were published by article, followed by review articles with 3533 Publications with 31 H-Index. The least number of publications published by letters, Data Papers, and News Items.

Table 9 Highly Productivity Keyword on Agroforestry (Top 15 only)

S.No	Keywords	Records
1	Agroforestry	527
2	Management	515
3	Biodiversity	418
4	Forest	370
5	Conservation	331
6	Systems	327
7	Diversity	324
8	Agroforestry Systems	303
9	Growth	291
10	Ecosystem Services	275
11	Climate Change	275
12	Land-Use	219
13	Nitrogen	215
14	Dynamics	212
15	Trees	208

Table 9 shows Zipf’s law of the keyword occurrence in Agroforestry research. The table presented the top 15 keywords. The word ‘Agroforestry’ is the most occurred keyword which appeared in 527 articles and placed in the first rank, and ‘Management’ occurred in 515 articles. The remaining keywords occurred in below 400 articles. Relation between the rank of a word and the frequency of its appearance in a long text. If ‘r’ is the rank of a word and ‘f’ is its frequency, then mathematically Zipf’s law can be stated as follows:

$$rf = c, \text{ where 'c' is a constant.}$$

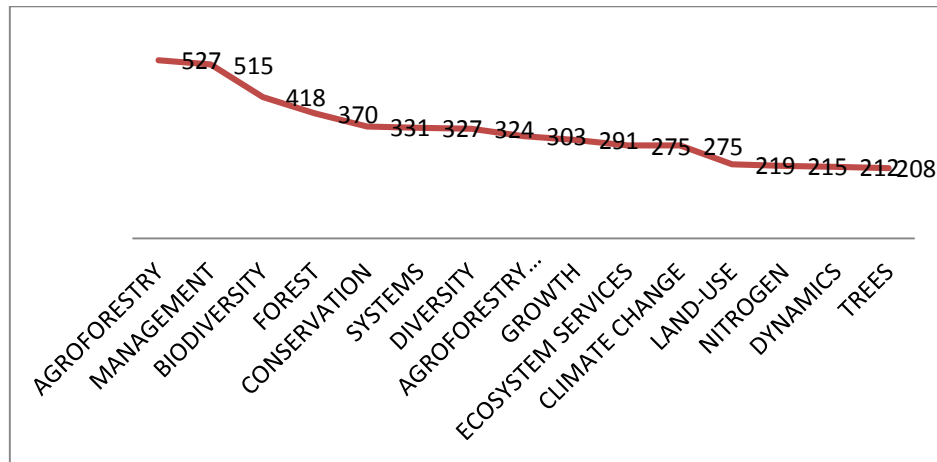


Figure 4 Zipf law word occurrence

published 560 articles which are ranked in first place, followed by Brazil's 489. The remaining articles are published in less than 446 records. India has published 384 records which are ranked in Fifth place.

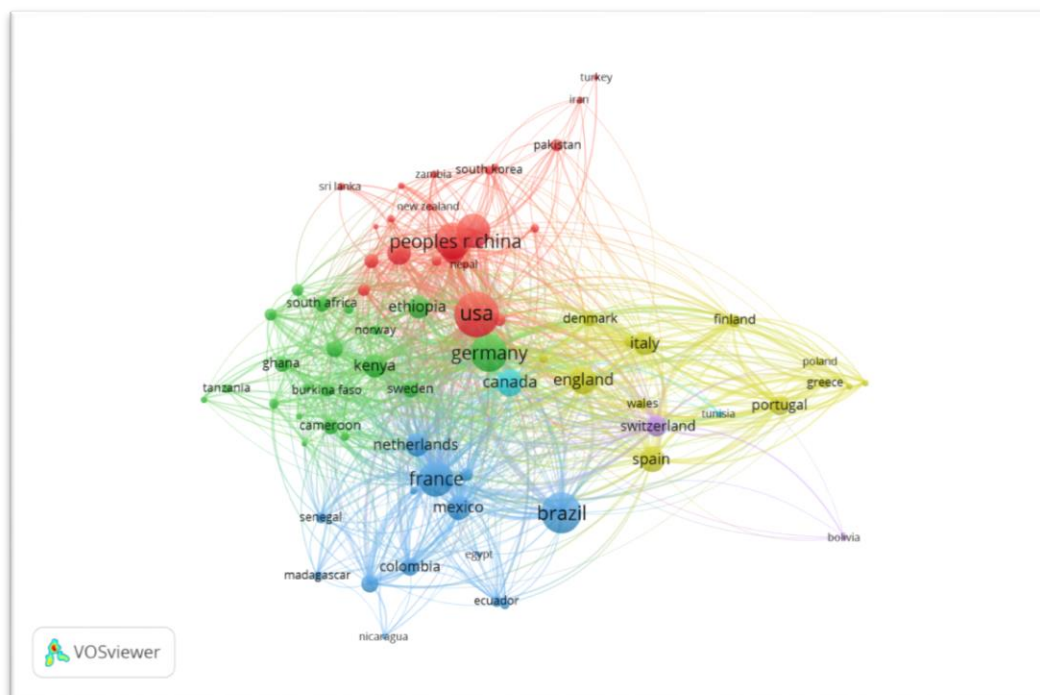


Figure 6 Visualization map of the Country's

VI. Findings and Conclusion

The year-wise distribution of Agroforestry research worldwide from 2018 to 2022. A total of 3900 records were published during the research period. In this research, publications continuously increased from the year 2018 (562 Publications) to 2021 (914 Publications). The research areas of Agroforestry and the records counts of each research area. This 'Agriculture' research area holds 1487 records which are 38.13% of total records. Single Author has contributed the minimum number of records with 110 (2.82%) records. Multi-Author has contributed the maximum number of records with 3790 (97.17%) records. the Web of Science Categories of Agroforestry and the records counts of each research area. This 'Forestry' research area holds 988 (25.33%) records. The degree of collaboration ranges from 0.95 to 0.97. The average degree of collaboration was 0.97. It indicates that there exists the highest collaboration among the authors in the research. The average growth rate is 1.04 and the average Doubling Time mean is 0.74. The growth rate is gradually increased year by year and Doubling Time is gradually decreased by every year.

This study has 12 types of documents during the study period. It is identified that a total of 3900 publications with 42 H-Index were published by article, followed by review articles with 3533 Publications with 31 H-Index. Zipf's law of the keyword occurrence in Agroforestry research. The table presented the top 15 keywords. The word 'AGROFORESTRY' is the most occurred keyword which appeared in 527 articles and placed in the first rank. English is a dominant language that is used for communication around the world. This study also evident that there are 3806 (97.59%) articles published in the English Language, and the remaining languages are published below 40 articles. Among these participating countries top ten countries are presented according to their publications. The USA published 560 articles which are ranked in first place, followed by Brazil's 489. The remaining articles are published in less than 446 records. India has published 384 records which are ranked in Fifth place.

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