

# GLOBAL RESEARCH OUTPUT AND GROWTH RATE STUDY IN AGROFORESTRY : A SCIENTOMETRIC ANALYSIS OF DURING 2007-2016

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**Abstract:** The study attempts to analyse the growth and development of Agroforestry research based on the publication output as reflected in Scopus during 2007– 2016. A total of 4030 papers are seen as global research output on Agroforestry research. The study found that the most product year in the terms of publications count is 568 with the highest number of publications in the year of 2016. The least number publications are found to be of 2007 with 283 publications and so on. The data indicates an exponential growth in publications output during the study period. The most productive authors, organisations, most influential journals and most functional sub-field in the area of Agroforestry research have been evaluated. It is clear that relative growth rate of total research output decreased gradually. The growth rate is 0.70 in 2007 which decreased up to 0.16 in 2016. The mean relative growth rate of the during period of 0.266. The whole study period resulted the mean doubling time for total output is 2.716 years. These studies can help researchers to comprehend the magnitude of Agroforestry research in India and establish future research directions.

**Keywords:** Bibliometrics, Scientometrics, Agroforestry, Relative growth rate, Doubling Time

## 1.0 Introduction:

Agroforestry focuses on the wide range of trees grown on farms and other rural areas. Among these are fertilizer trees for land regeneration, soil health and food security; fruit trees for nutrition; fodder trees for livestock; timber and energy trees for shelter and Trees play an important role in ecosystem in all terrestrials and provide a range of products and services to rural and urban people. As natural vegetation is cut for agriculture and other types of development, the benefits that trees provide are best sustained by integrating trees into agricultural system. Farmers have practiced agroforestry since ancient times fuel wood; medicinal trees to cure diseases and trees for minor products viz. gums, resins or latex products. Many of these trees are multipurpose, providing a range of benefits. The National Agriculture Policy (2000) emphasized the role of agroforestry for efficient nutrient cycling, nitrogen fixation, organic matter addition and for improving drainage and underlining the need for diversification by promoting integrated and holistic development of rain fed areas on watershed basis through involvement of community to augment biomass production through agroforestry and farm forestry. Therefore in the quest of optimizing productivity, the multi tier system came into existence. Gap of demand and supply of forest produce in India is widening and forests are unable to fulfill the demand. Agroforestry can play an important role in filling this gap and conservation of natural resources.

## 2.0 Objectives:

1. To study and analyze the overall representation of publications of Agroforestry
2. To sketch the year wise allocation of the publications
3. To depict the subject wise production of publications
4. To identify the document types of the publication
5. To find out the most prolific authors of the publication
6. To find the relative growth rate and doubling time for publications

7. To identify the preferences of source titles for communication of these publications
8. To trace out the geographic distribution of publications

### 3.0 Methodology:

Scientometric analysis of publications by Agroforestry research published during last 10 years (2007-2016) was done which formed the basic data for this study. The data was collected by searching the online database Scopus. The world largest abstract and citation database of peer reviewed literature encompassing almost all subjects of science and technology. Scopus indexes documents of different source types like journals, conference proceedings, book series, trade publications etc., were included the study. The analysis data was done to figure out first top results of prolific authors, subjects and source titles which are considered for publication. The data thus obtained were analyzed and interpreted as distribution of publication individual institutes, subject wise distribution, document type, year wise, language wise, prolific authors, source title, etc.

### 4.0 Significance / Purpose of this Study:

The study was carried out to analyse the growth and development of research contribution of the field Agroforestry and the research publications output as indexed by Scopus database. The aim was to highlight the research output of the Agroforestry, trends in yearly increase and progress of the documents, subject mapping, identifying the medium of publication, finding the most used document type and most prolific authors in the field in terms of publications count. It will be of enormous use for the scientometticans in general.

### 5.0 Results and Analysis:

**5.1 Year Wise Distribution of Publications:** The table -1 illustrates the yearly allocation of publications of the Agroforestry. It provides the year wise output of publications. It found that the most product year in the terms of publications count is 568 with the highest number of publications in the year of 2016. The least number publications are found to be of 2007 with 283 publications.

Table - 1 : Year-Wise Distribution of Publications

S.No	Year	Number of Publications	% of 4030
1	2007	283	7.02
2	2008	287	7.12
3	2009	332	8.24
4	2010	353	8.76
5	2011	398	9.88
6	2012	438	10.87
7	2013	454	11.27
8	2014	457	11.34
9	2015	460	11.41
10	2016	568	14.09

**5.2 Document Type Distributions:** The Table -2 demonstrates the distribution of publications in terms of document types. The articles were found the most used document type Article with 3374 documents, Book chapter with 208, Review with 194, Conference paper with 132, Article in press with 40, and so on. The least used document type was letter with only 7 documents.

Table-2:Document Type Distributions

S.No	Types of Documents	No of Documents	% of 4030
1	Article	3374	83.72
2	Book Chapter	208	5.16
3	Review	194	4.81
4	Conference Paper	132	3.28
5	Article in Press	40	0.99
6	Book	25	0.62
7	Note	14	0.35
8	Short Survey	14	0.35

9	Editorial	13	0.32
10	Erratum	9	0.22
11	Letter	7	0.17

**6.0 Statistical Tools Were Used of This Study:****6.1 Relative Growth Rate**

The relative growth rate and doubling time model developed by Mahapatra was applied to examine the growth rate of research publications of Agroforestry. The relative growth rate is increased in the number of publications or pages per unit of time. A specified period of interval can be calculated from the following equations.

$$\overline{R}(1-2) = \frac{W_1 - W_2}{T_2 - T_1}$$

Where,  $\overline{R}(1-2)$  is mean relative growth rate over the specified period interval

$W_1 = \text{Log } W_1$  : (Natural Log of initial number of publications / pages)

$W_2 = \text{Log } W_2$  : (Natural Log of final number of publications / pages)

$T_2 - T_1$  = The unit difference between the initial time and final time

The relative growth rate for both publications and pages can be calculated separately. Therefore,

$\overline{R}(a)$  = Relative growth rate per unit of time (year)

$\overline{R}(p)$  = Relative growth rate per unit of pages, per unit of time (year)

**6.2 Doubling Time:**

From the calculation, it is found that there is a direct equivalence existing between the relative growth rate and doubling time. If the number of publications/pages of a subject doubles during a given period, then the difference between the logarithm of the numbers at the beginning and at the end of the period must be the logarithms of the number 2. If one uses a natural logarithm, this difference has a value of 0.693. The corresponding doubling time for publications and pages can be calculated by using the following formula:

$$\text{Doubling time (Dt)} = \frac{0.693}{\overline{R}}$$

$$\text{Therefore, Doubling time for publications Data Dt(a)} = \frac{0.693}{\overline{R}(a)}$$

$$\text{Doubling time for pages Dt(p)} = \frac{0.693}{\overline{R}(p)}$$

**6.3 Relative Growth Rate and Doubling Time for Publications:**

A study of data in table - 3 indicates the relative growth rate and doubling time for publications of Agroforestry research. It is clear that relative growth rate of total research output decreased gradually. The growth rate is 0.70 in 2007 which decreased up to 0.16 in 2016. The mean relative growth rate for the periods 2007 – 2016 the relative growth rate of 0.266. The whole study period resulted the mean doubling time for total output is 2.716 years.

Table-3: Relative Growth Rate And Doubling Time For Publications

Year	R.O	Cumulative O/P	W1	W2	R(a) W2-W1	Mean R (a) (1-2)	Doubling time Dt(a)	Mean Dt(a) (1-2)
2007	283	283	-	5.64	-	0.266		2.716
2008	287	570	5.64	6.34	0.70		0.99	
2009	332	902	6.34	6.80	0.46		1.51	
2010	353	1255	6.80	7.13	0.33		2.10	
2011	398	1653	7.13	7.41	0.28		2.48	
2012	438	2091	7.41	7.64	0.23		3.01	
2013	454	2545	7.64	7.84	0.20		3.47	
2014	457	3002	7.84	8.00	0.16		4.33	
2015	460	3462	8.00	8.14	0.14		4.95	
2016	568	4030	8.14	8.30	0.16		4.33	

#### 6.4 Language Distributions:

Table – 4 represents the distribution of publications in terms of languages used for writing. Here, it is observed that the English language gains the ground with highest number of 3731 documents followed by Portuguese with 189 documents.

Table – 4: Language Distributions

S.No	Language distribution	No of Documents	% of 4030
1	English	3731	92.58
2	Portuguese	189	4.69
3	Spanish	93	2.31
4	Chinese	75	1.86
5	French	34	0.84
6	German	12	0.30
7	Japanese	3	0.07
8	Croatian	2	0.05
9	Italian	2	0.05
10	Korean	1	0.02
11	Serbian	1	0.02
12	Turkish	1	0.02
13	catalan	1	0.02

#### 6.5 Subject Wise Distribution of Publications:

Table – 5 depicts the analysis of the data, subject wise distribution of publications retrieved for the years considered for the study. There were 2921 publications in Agricultural and Biological science subject occupying the highest position. This is followed by Arts and Humanities with 1620, Biochemistry, Genetics and Molecular Biology with 478 and Business, Management and Accounting with 216 publications and so on. The weakest subject area found to be veterinary and social sciences with only 2 publications.

Table – 5 Subject Wise Distributions of Publications

S.No	Subject wise distribution	No of publications	% of 4030
1	Agricultural and Biological Sciences	2981	73.97
2	Arts and Humanities	1620	40.20
3	Biochemistry, Genetics and Molecular Biology	478	11.86
4	Business, Management and Accounting	216	5.36
5	Chemical Engineering	186	4.62

6	Chemistry	142	3.52
7	Computer Science	138	3.42
8	Decision Sciences	135	3.35
9	Earth and Planetary Sciences	90	2.23
10	Economics, Econometrics and Finance	69	1.71
11	Energy	66	1.64
12	Engineering	55	1.36
13	Environmental Science	43	1.07
14	Health Professions	37	0.92
15	Immunology and Microbiology	34	0.84
16	Materials Science	28	0.69
17	Mathematics	25	0.62
18	Medicine	23	0.57
19	Multidisciplinary	21	0.52
20	Neuroscience	18	0.45
21	Nursing	15	0.37
22	Pharmacology, Toxicology and Pharmaceutics	13	0.32
23	Physics and Astronomy	8	0.20
24	Psychology	5	0.12
25	Social Sciences	2	0.05
26	Veterinary	2	0.05
27	Undefined	1	0.02

### 6.6 Top 25 Source Titles in Terms of Number of Productivity:

Table -6 shows source titles with their total number of publications. The list shows the source titles up to 25 ranks which established in this analysis. It is found that the Agroforestry systems gets the maximum number documents to be published with 549 titles in its share followed by Agriculture Ecosystems And Environment with 140 titles and Forest Ecology And Management with 52 and so on.

**Table-6: top 25 Source Titles In Terms of Number of Productivity**

S.No	Subject wise distribution	No of Productivity	% of 4030
1	Agroforestry Systems	549	13.62
2	Agriculture Ecosystems And Environment	140	3.47
3	Forest Ecology And Management	52	1.29
4	Small Scale Forestry	48	1.19
5	Forests Trees And Livelihoods	45	1.12
6	Journal Of Forestry Research	40	0.99
7	Biodiversity And Conservation	37	0.92
8	Revista Arvore	36	0.89
9	Acta Horticulturae	35	0.87
10	Range Management And Agroforestry	32	0.79
11	Shengtai Xuebao Acta Ecologica Sinica	32	0.79
12	Journal Of Sustainable Forestry	31	0.77
13	Environmental Management	29	0.72
14	Handbook On Agroforestry Management	28	0.69
15	Plos One	28	0.69
16	Plant And Soil	27	0.67
17	Communications In Soil Science And Plant	26	0.65

18	Current Opinion In Environmental	26	0.65
19	Biomass And Bioenergy	24	0.60
20	Land Use Policy	22	0.55
21	Agronomy For Sustainable Development	21	0.52
22	Biological Conservation	20	0.50
23	Journal Of Environmental Management	20	0.50
24	Pesquisa Agropecuaria Brasileira	20	0.50
25	Applied Agrometeorology	19	0.47

### 6.7 Top 25 Prolific Authors in Terms of Productivity Count

Table – 7 represents the list of top 25 prolific authors in terms of productivity count and their affiliations thereof. The list is ranked in the order of decreasing productivity. It is found that author Tschardtke, T. first rank followed by Udawatta, R.P. second rank in the list. The van Noordwijk, M. third position among the productivity.

**Table-7: Top 25 Prolific Authors in Terms Of Productivity Count**

S.No	Prolific authors	No of Productivity	% of 4030
1	Tschardtke, T.	45	1.12
2	Udawatta, R.P.	33	0.82
3	van Noordwijk, M.	31	0.77
4	Jamnadas, R.	26	0.65
5	Jose, S.	25	0.62
6	Clough, Y.	23	0.57
7	Lal, R.	22	0.55
8	Akinnifesi, F.K.	21	0.52
9	Isaac, M.E.	21	0.52
10	Harmand, J.M.	20	0.50
11	Salvati, L.	20	0.50
12	Vaast, P.	20	0.50
13	Ajayi, O.C.	19	0.47
14	Dhyani, S.K.	19	0.47
15	Nair, P.K.R.	19	0.47
16	Bayala, J.	18	0.45
17	Sileshi, G.W.	18	0.45
18	Taboada-Castro, M.T.	18	0.45
19	Anderson, S.H.	17	0.42
20	Rodríguez-Blanco, M.L.	17	0.42
21	Roshetko, J.M.	17	0.42
22	Schroth, G.	17	0.42
23	Tchoundjeu, Z.	17	0.42
24	Kalinganire, A.	16	0.40
25	Mosquera-Losada, M.R.	16	0.40

### 6.8 Top 10 Geographic Distribution of Productivity

Table – 8 shows geographic distribution of the top 10 countries. The list shows United States leads the table with 760 publications, followed by Brazil with 488, India with 433 publications and occupied third position. The minimum number of publication was collaborated with Indonesia with only 203 publications.



**Table – 8 Top 10 Geographic Distribution of Productivity**

S.No	Geographic distributions	No of Productivity	% of 4030
1	United States	760	18.86
2	Brazil	488	12.11
3	India	433	10.74
4	Germany	318	7.89
5	United Kingdom	263	6.53
6	China	255	6.33
7	France	250	6.20
8	Kenya	222	5.51
9	Spain	206	5.11
10	Indonesia	203	5.04

**7.0 Conclusion:**

Observing the complete scenario of Agroforestry publications in years covered under this study, it found that the most product year in the terms of publications count is 568 with the highest number of publications in the year of 2016. The least number publications are found to be of 2007 with 283 publications and so on. It is clear that relative growth rate of total research output decreased gradually. The growth rate is 0.70 in 2007 which decreased up to 0.16 in 2016. The mean relative growth rate for the periods 2007 – 2016 the relative growth rate of 0.266. The whole study period resulted the mean doubling time for total output is 2.716 years. It was observed that Indian scientist prefer to publish their documents in the articles from and in English language or foreign language. In addition, there seems a constant increasing trend in research output which increases significantly year after year. There were 2921 publications in Agricultural and Biological science subject occupying the highest position. This is followed by Arts and Humanities with 1620, Biochemistry, Genetics and Molecular Biology with 478 and Business, Management and Accounting with 216 publications and so on. The list is ranked in the order of decreasing productivity. It is found that author Tscharrntke, T. first rank followed by Udawatta, R.P. second rank in the list. The van Noordwijk, M. third position among the productivity. The study found that the United States leads the table with 760 publications, followed by Brazil with 488, India with 433 publications and occupied third position. The minimum number of publication was collaborated with Indonesia with only 203 publications. These studies can help researchers to comprehend the magnitude of Agroforestry research in India and establish future research directions.

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