Summer 6-18-2020

Assessment of Research output on Bamboo in India: A Bibliometric Study

Dr. Ashutosh Agrahari
ICFAI University Tripura, ashuagrahari@yahoo.com

C. P. Chaudhary
Panjab University Extension Library- Ludhiana (India), Chaudharycp@gmail.com

Prof. S. N. Singh
Mizoram University, Mizoram, drsinghsn@yahoo.com

Malabika Acharjee
Delhi World Public School, Agartala, acharjee.malabika02@gmail.com

Assessment of Research output on Bamboo in India: A Bibliometric Study

Dr. Ashutosh Agrahari[1], C P Chaudhary[2], Prof. S. N. Singh[3], Malabika Acharjee

[1]Asst. Professor, Dept. of Library and Information Science, ICFAI University Tripura (India) Email: ashuagrahari@yahoo.com

[2]Assistant Librarian, Panjab University Extension Library- Ludhiana, Punjab (India) Email: chaudharycp@gmail.com

[3]Head of Department, Library and information Science, Mizoram University (India) Email: drsinghsn@yahoo.com

[4]Librarian, Delhi World Public School, Agartala (India) Email: acharjee.malabika02@gmail.com

Abstract

This study assessed the research output on Bamboo for a period of 29 years (1989-2018). The web of science database has been used to retrieve worldwide publication records on bamboo research. The records were analysed using the descriptive statistics. Based on the retrieved data, various aspect of literature on bamboo research analysed and interpreted. The performance of the most productivity countries, authors, journals, Institution wise, and Growth rate and doubling time have assessed. The articles were classified as Research, review and others and grouped under 22 subjects to identify the subject coverage of bamboo research. The study found a positive growth in research and review article while very sharp decrement was observed. The growth rate and doubling period were estimated 8.5 and 8.34 respectively. Most of the articles written on Agriculture, Material Science, building technology and chemistry. M. Das (Presidency University, Department Life Science, Kolkata) is the most prolific primary author while R. Kumar (National Institute of Technology, Department of Mechanical Engineer, Silchar, India) mostly occurred as secondary author. Local and National collaboration mostly observed in the paper. India is the most productive country of world followed by china and Tamilnadu is most productive state of India. Indian Institute of Technology, India is a premier institute in bamboo research activity.

Keyword: Bamboo Research, Bibliometrics Analysis, Research Articles, Review Articles, Prolific Authors, Publication output

1.0 Introduction

Bamboo is the fastest growing plants of the world. It is one of most important resources characterised by high strength and low weight. The growth rate of bamboo is ranging from 30 to 100 cm per day in growing season (April-June). It can grow to a height of 36 m with a diameter of 1-30 cm. The plant 'Bamboo' is gaining more attention as a plant of global interest due to their values and wide range of usage for humans. In the North East India, the species of bamboo such as Bambusabalcooa, Bambusapallida and Melocannabacifera are mainly used for edible purposes. About 3000 companies in the world are engaged in the production of various bamboo products such as panels, flooring, pulp, daily use articles, charcoal etc. (Basumatary et al., 2017).

In Indian restaurants, there are about 11 popular intercontinental dishes prepared from the shoots of bamboo. India is the third largest country, where 125 bamboo species have been reported. The North Eastern region of India is rich in the diversity of bamboos. The region has 58 species of bamboo under 16 genera (Arora and Maurya, 1988). According to UN's Industrial Development organisation the market of bamboo in India reached to 5.5 billion USD by 2015 while the North East's bamboo production to grow up to 1.25 billion USD in the same period (Sarma, 2014, July 26- August 1).

Bamboos belonging to family Poaceae are considered as one of the most versatile multi utility forest tree grasses (Nongdam and Tikendra, 2014). People from different country address bamboos in different names. The Chinese called bamboos as "friends of the people", Vietnamese called as "my brother" and Indians as "green gold" because of their multiple application.

India is the second largest country in production of bamboos after that China (Toppo, November 2018). It is environment friendly and sustainable resources available in India, particularly in North-East India. Bamboo is

very adaptable because some species of bamboo change its habit according to nature. Bamboo is the kind of material which is sufficiently cheap and plentiful those meet the vast needs of the human population. The medicinal value of bamboo is also important. Many species of bamboo are used as a source of medicinal products.

In the assessment of research publication, the Bibliometric technique is the most important. The bibliometric approach usually based on quantitative characteristics attributes of publication. The present work is based on the analysis of the bibliographical data of publications available on bamboo research in web of Science database. The central concern of this study is to provide scholars, academicians and scientist and other interested parties with an updated view on bamboo research.

1.1 Objectives of the Study

Following objectives have been considered for the study:

1. To identify publication growth and trends of the bamboo literature
2. To identify authorship pattern and collaboration trend in bamboo literature
3. To assess the subject coverage of bamboo literature
4. To asses institution contribution on bamboo literature
5. To identify geographical distribution of bamboo literature.

2.0 Literature Review

The increasing front of any topics can be assessed by reviewing related studies. The following literature have been reviewed to know the approaches that have been made in last few decades.

Agrahari, Chaudhry and Sing (2019) have categorised 1241 articles into research and non-research articles, for analysing subject coverage, publication trend and prolific author of the journal Scientometric from the period 2001 to 2010. The study found a sharp positive growth in research articles over the period while a negative growth has been observed in non-research articles only. Most of the research articles were devoted to Bibliometric Study, Citation Studies, Research Output, Collaboration Analysis, while the major topic for non-research articles were Bibliometric study, patent analysis, statistics and research assessment over the period.

Cajee (2018) studied bamboos spread throughout the Himalayas with a variety of different genera adapted to different ecological zones. At the eastern end of the Himalayas heavy monsoon rain, low level of evaporate-transpiration, minimal water stress is providing suitable conditions to bamboo growth. This paper presents a general survey of the diversity of bamboo species and its utilisation in the north-eastern region of India. About 125 bamboo plant species belonging to 23 genera occur in India. Similarly, about 78 species belonging to 19 genera occur only in north-eastern region itself. The different form of bamboo species results in a utilisation pattern that has geographical and cultural implications.

Gupta, Ahmed, Gupta & Tiwari (2015) analysed 3,089 papers on global camel research during 2003–2012, indicated an average annual growth rate of 11.20 % and registered an average citation per paper of 2.24. The highest publication output came from USA. Eight out of 15 most productive countries have achieved high relative citation index (1 and above): Belgium (3.61), Australia (2.69), UK (2.38), Canada (2.33), France (2.07), USA (1.87), Germany (1.65), UAE (1.11) and Kenya (1.09) during 2003–2012. Agricultural and biological sciences (43.35 % share) contributed the largest share during 2003–2012. The world camel research output originated from 311 organizations, of which the top 20 contributed 31.72 % global publication share during 2003–2012.

Anand (2015) analyses Research literature on Bamboo during 2004-2013, 1614 research articles of CAB Database. The Study revealed that USA is significant county and dominating in the research development activities of bamboo followed by India. The collaborative researches are considered as an

important facet of modern science, it resulted that predominance of multi authored papers over single authored papers is seen. The most prolific prime institutions are from India and most prolific prime institutions are Forest Research Institution, Derahdun and Kerala Forest Research Institution, Kerala, Thrissur are identified and critically examined for its features.

Wang & Ho (2012) evaluated the global scientific output of bamboo research and assessed the characteristics of the research tendencies and performances. Data were based on Science Citation Index Expanded & Web of Science. The five indicators, the number and ranking of total articles, first author articles, corresponding author articles, independent articles, and collaborative articles, were applied to evaluate country and institution performances. Research tendency was investigated by statistically. Results showed the bamboo research mainly focused on the Web of Science category of multidisciplinary materials science. The China ranked first in the five publication indicators except the item of internationally collaborative article. Topics related to carbons, nanotubes, and adsorptions were the foci in bamboo research.

Sun, Cheng, & Jiang (2008) analysed characteristics and sorts of bamboo composite materials, elaborated processing technology and features of different bamboo composite materials, focused on current status of bamboo processing industry in China, brought up some problems, and to look into the research direction and future of bamboo composite materials in China.

Patra, Bhattacharya, & Verma (2006) analysed growth pattern, core journals and authors' distribution in the field of bibliometrics using data from Library and Information Science Abstracts (LISA). Bradford's law of scattering is used to identify core journals and determines 'Scientometrics' as the core journals in this field. Lotka's law was used to identify authors' productivity patterns. It is observed that authors' distributions do not follow original Lotka's law. Study also identified 12 most productive authors with more than 20 publications in this field.

3.0 Dataset and Research Methodology

The data have been retrieved from the Web of science bibliographical database by Clarivate Analytics, US. It indexes over 33,000 journals with citation references across 256 disciplines in 2019. The database has been searched under the keyword "bamboo" in terms of topic (title, abstract, author keywords, and Keywords provided by web of Science) within the publication year limitation from 1989 to 2018. Document information including names of authors, title, abstract, author keywords, Keywords Plus, contact address, year of publication, categories, and names of journals publishing the articles were downloaded into spread sheet software. Following data set has been analysed for the study:

Table 1.4.1 Data for Study

Items	Number
Articles	1059
Authors	2560
Institutions	761
Subject	22
Country	44
Indian states &UT	34
Journals	463

Additional coding was performed manually for the number of origin country and institution of the collaborators, and impact factors of the publishing journals. The impact factors will be taken from the Scientific Journal Rank (SJR). Collaboration type was categorized and determined by the addresses of the authors as: National Collaboration are single country articles with authors addresses from the same country with different institution; internationally collaborative articles with authors addresses from more than one country; Local collaborative articles with authors' addresses from the same institution.

4.0 Data Analysis

There are a total of 1059 publications over the 30 year (1989-2018) that have been analysed to trace the various dimensions of Bamboo research activities.

4.1 Literature Growth and Trends

The literature growth is the mirror that shows static or dynamic dimension of a discipline. In 1986, there was recorded only 7 paper in Web of science database while in 2018 it was recorded 81 papers on bamboo research. The growth rate of literature calculated 8.5% while doubling period calculated 8.23 years. The table 4.1.1 recorded all articles into three categories: Research, Review, and Other articles (newsletter, proceedings, editorial material, correction, meeting abstract, letter, and note). It shows that the largest share (92.82%) of articles are the research articles that includes 983 articles. In the year 1989-1994, the share of research article was 73.47% (36 articles) that increased gradually over the period and reached upto approximate 94% during 1995-2018. While the number of review articles was zero in the year 1989-1994 that increased to 27 (5.17%) articles in the period (2013-2018). The number of other articles has been decreased over the year and reached from 26.53% to 1.34%.

Table 4.1.1 Growth &Trend of literature on Bamboo Research (1989-2018)

Year	Articles					
	Research		Review		Other	
	No.	%	No.	%	No.	%
1989-1994	36	73.47	0	0.00	13	26.53
1995-2000	58	95.08	2	3.28	1	1.64
2001-2006	119	94.44	3	2.38	4	3.17
2007-2012	282	93.69	12	3.99	7	2.33
2013-2018	488	93.49	27	5.17	7	1.34
Over All	983	92.82	44	4.15	32	3.02

Data source*: *Primary data

It can be clearly observed from the figure 4.1.1 that the curve of research articles are above the other articles which shows the highest share of research articles. The curve of Research articles has a step upward between the years 1989-2000 and touch the highest point (95.08%) of the share then the line goes straight and slightly moving downwards. In the figure the trend line associated with research articles are moving upwards which is a sign of positive growth in the articles. Other articles have a step-down trend line which indicates the negative growth over the years.

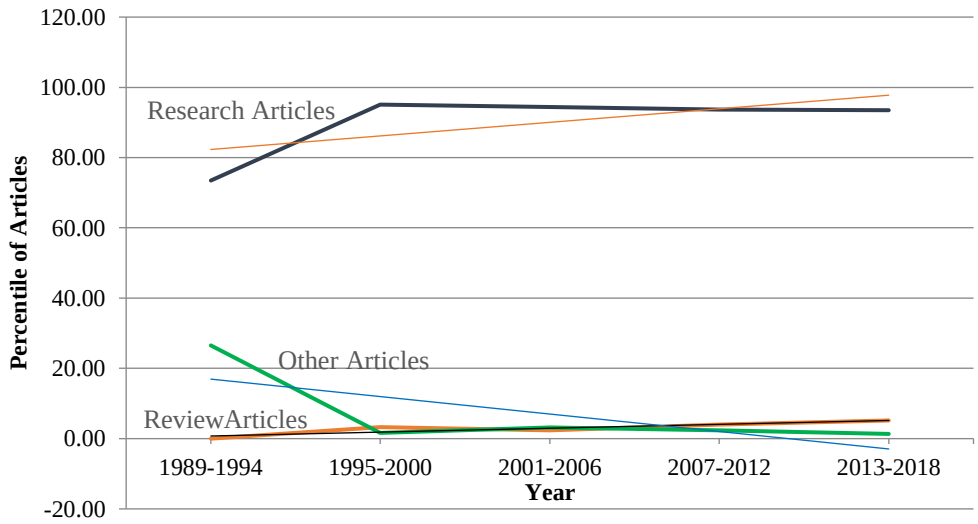


Figure 4.1.1 Growth and Trend of Literature on Bamboo research

Table 4.1.2 Source of Bamboo Literatures

S.N.	*Journals Name*	*Country*	*Quartiles*	*SJR*	*No. of Articles*
1	Current Science	India	Q2	0.27	57
2	Indian Journal of Traditional Knowledge	India	Q2	0.31	37
3	Journal of Reinforced Plastics and Composites	US	Q1	0.62	33
4	Journal of Applied Polymer Science	US	Q1	0.55	24
5	Journal of Food Science and Technology	India	Q1	0.79	18
6	Indian Journal of Fibre & Textile Research	India	Q2	0.33	17
7	Journal of Scientific and Industrial Research	India	Q2	0.31	16
8	Cellulose Chemistry and Technology	Romania	Q3	0.28	11
9	Journal of Forestry Research	China	Q2	0.37	11
10	BioResources	US	Q2	0.43	10
11	Polymer Composites	US	Q2	0.5	10
12	Bioresource Technology	Netherlands	Q1	2.16	8
13	Journal of Industrial Textiles	US	Q2	0.5	8
14	Journal of Natural Fibers	US	Q3	0.31	8
15	Journal of Plant Biochemistry and Biotechnology	India	Q2	0.4	8
16	Other 385 Journal				

The collected literatures for study are the part of more than 400 worldwide publication most of the publication published form India and They fall under Q1 & Q2. The literature was dispersed in journals of various discipline that shows the importance of bamboo that has been studied with various approach.

4.2 Authorship Pattern

The authorship pattern found in analysed publications on bamboo researches are recorded in Table 4.2.1. and have been divided into four-time segment (1989-1994,1995-2000,2001-2006,2007-2012, and 2013-2018). It has been observed that the shares of two authors' paper are largest in comparison to other authorship pattern over the year. But the share of two authors' paper decreased drastically during 2001-2018 and it reached from 47% to 28%.

The share of three author's paper during 1989-2000 was 20% and its share increased to 4-7% during 2001-2018. It also has been observed from the table that the share of five and six and more than six authors' papers was very less but it increased during 2001-2006, 2007-2012 and 2013-2018 up to 20%.

Table 4.2.1. Authorship Pattern in Bamboo Publication (1989-2018)

Authorship	Articles									
	1989 - 1994		1995 - 2000		2001 - 2006		2007 - 2012		2013 - 2018	
	No.	%	No.	%	No.	%	No.	%	No.	%
Single Author	10	20.41	5	8.20	7	5.56	15	4.98	9	1.72
Two Authors	21	42.86	29	47.54	34	26.98	87	28.90	133	25.48
Three Authors	10	20.41	12	19.67	31	24.60	82	27.24	128	24.52
Four Authors	7	14.29	11	18.03	20	15.87	57	18.94	88	16.86
Five Authors	1	2.04	4	6.56	17	13.49	30	9.97	61	11.69
≥ Six Authors	0	0.00	0	0.00	17	13.49	30	9.97	103	19.73
Total	49	100	61	100	126	100	301	100	522	100

***Data source*:** *Primary data*

The data showed that the number of single authored paper has increased drastically. And its lowest contribution fined in 2013-18.

4.2.1 Prolific Authors

There are 2560 unique authors, of them 702 are primary authors and 1858 are secondary authors recorded.

4.2.1.1 Primary Prolific Author

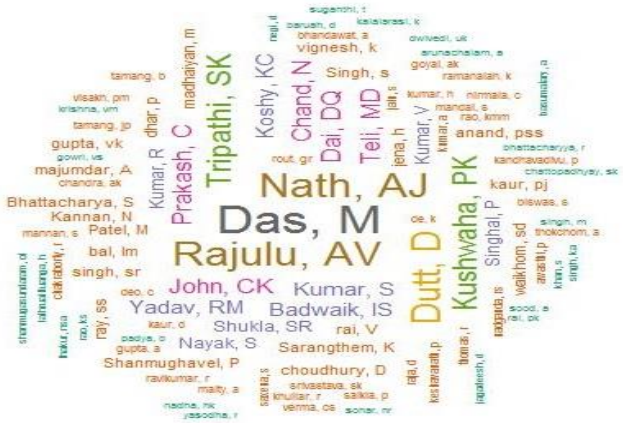
The most frequently appeared primary author among 702 primary authors is Das, M of Presidency University, Department Life Science, Kolkata, India with 16 articles(see figure & Table 4.2.2) and ranked 1st.

Table 4.2.2 Prolific Primary Author (1989-2018)

Rank	Author's Name	No. of Articles
1	Das, M	16
2	Rajulu, AV	13
2	Nath, AJ	13
3	Dutt, D	12
4	Tripathi, SK	10
5	Kushwaha, PK	9
6	Dai, DQ	8
6	Prakash, C	8
6	Teli, MD	8
7	John, CK	7
7	Chand, N	7
8	Kumar, S	6
8	Koshy, KC	6
8	Yadav, RM	6
8	Badwaik, IS	6
9	Shukla, SR	5
	Other 686 Authors	921

Rajulu AV of Sri Krishnadevaraya University, Department Polymer Science & Technology, Anantapur, Andhra Pradesh, India, and Nath AJ of Assam University, Department Ecology & Environment Science, Silchar 788011, Assam, India both are ranked 2nd with 13 articles followed by Dutt D(Indian Institute Technology Roorkee, Dept Paper Technology, Saharanpur , India) ranked 3rd with 12 articles and so on as shown in table 4.2.2.

In the figure 4.2.2, that is associated with table 4.2.2 present first top hundred primary authors. It clearly can be seen that das, M presented in biggest font which indicates highest number of paper.in such



way, Rajulu, AV, Nath, AJ, Dutt, D, Tripathi, SK, Kushwaha, PK are presented in figure respective to their contribution.

Figure 4.2.2 Cloud of Primary authors of Bamboo articles (1989-2018)

Tripathi SK and Kushwoaha, PK secured 4th and 5th rank respectively contributing 9,and 8 papers. Out of 702, 548 unique primary authors written only one article and 84 authors contributed two articles only.

4.2.1.2 Secondary Prolific Author

Table 4.2.3 Prolific Secondary Author (1989-2018)

Rank	Author's Name	No. of Articles
1	Kumar, R	20
1	Sood, A	20
2	Das, AK	17
3	Naik, SN	15
4	Dhat, DJ	14
4	Kumar, A	14
4	Pal, A	14
5	Satya, S	13
6	Tyagi, CH	11
6	Upadhyaya, JS	11
7	Hyde, KD	10
7	Kumar, S	10
7	Rajulu, AV	10
8	Malik, RS	9
8	Nadgauda, RS	9
	other 1843 Authors	2641

The most frequently appeared co-authors among 1858 authors are Kumar R of National Institute Technology, Department Mech Engn, Silchar, India (See Table & Figure and Sood A (CSIR, Div Biotechnology, Institute Himalayan Bioresource Technology, Palampur , Himachal Pradesh, India) . Both authors are ranked 1st with the article 20 followed

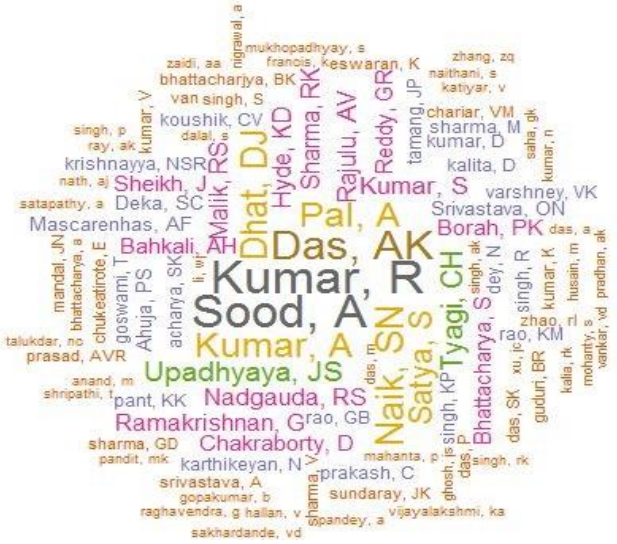


Figure 4.2.3 Cloud of Secondary Prolific Author

by Das AK. of Assam University, Department Ecol & Environm Science, Silchar , Assam, India with the article17 ranked 2nd. Naik SN of Indian Institute Technology, Ctr Rural Dev & Technology, Delhi, India with the articles15 ranked 3rd and so on shown in the table 4.2.3.

4.2.2 Collaboration among Authors

The recorded collaboration has been identified as Local, National and International. The table **4.2.4.** made known that most of the articles recorded under local and national collaboration. In the year 1989-1994 the share of articles in local and national collaboration are equal that is 46.15%. The local collaborations are higher during 1995-2012 than the national and international collaboration. During 2013-2018 the local collaboration drastically decreased and reached to 35.99% (185 articles), in vice versa the national collaboration increased and covered highest share of collaboration 49.42% (254 articles) over the period. The share of articles written in international collaborations is very less (12.73%).

Table 4.2.4. Collaboration Pattern in Bamboo Publications (1989-2018)

Year	Collaboration					
	Local		National		International	
	No.	**%**	**No.**	**%**	**No.**	**%**
1989-1994	6	46.15	6	46.15	1	7.69
1995-2000	20	66.67	9	30.00	1	3.33
2001-2006	76	79.17	28	29.17	8	8.33
2007-2012	139	48.10	113	39.10	37	12.80
2013-2018	185	35.99	254	49.42	75	14.59
Over all	426	44.47	410	42.79	122	12.73

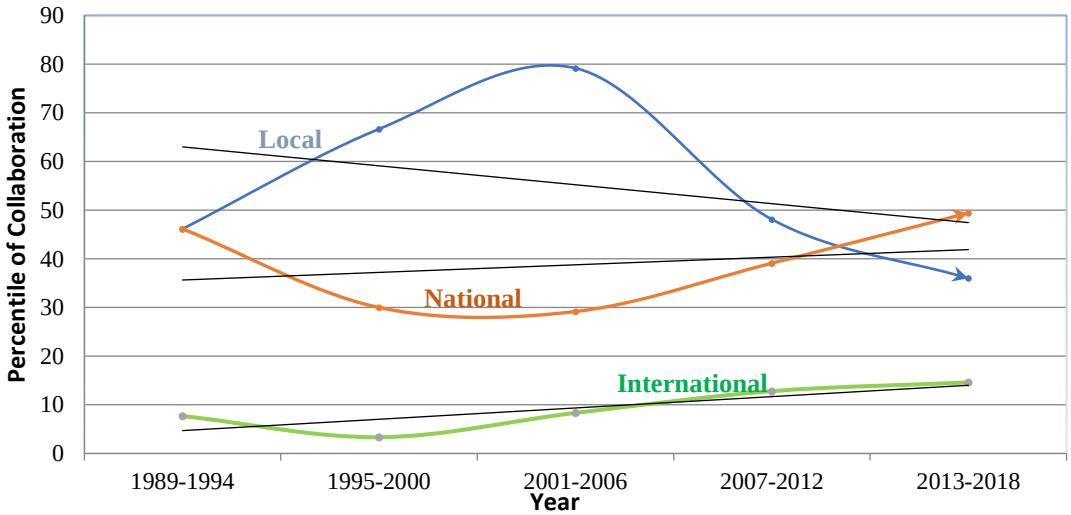


Figure 4.2.4 Collaboration Pattern in Bamboo Publications

In the figure 4.2.4, it clearly shown that the curve line of local collaboration moved upward during 2001- 2006 after that it moved downward sharply while the curve of national collaborations dropped during 1995-2000 after that it moved upward. The trend line (straight black line) associated with the Local collaborations moving downward sharply which indicates decreasing contribution of local collaboration over the year. In the case of National and International collaboration the associated trend line are moved slightly upward which specifies growing number of both collaboration over the year (1989-2018).

4.3 Subject-Wise Distribution of Bamboo Literature

All analysed articles on Bamboo research were grouped into 22 broader subject categories and there presence has been recorded during 1989-2006, 2007-2018 and 1989-2018 in the Table 3.3.1. The table disclosed that maximum number of papers that is 64 (27.23%) were published on the subject Agriculture, followed by Material science with 41 (17.45%) papers and Building Technology with 17 (7.23%) papers during the year 1989-2006.

The year 2007-2018 documented maximum numbers of papers that is 187(22.69%) were on the Agriculture of bamboo, followed by Material science with 183(22.21%) papers and Building Technology with 79(9.59%) papers articles. While the lowest number was covered by each area of library science, law & computer science.

Table 4.3.1 Subject wise distribution

Subject	Year & Number of Publications					
	1989-2006		2007-2018		1989-2018	
	No.	%	No.	%	No.	%
Agriculture	64	27.23	187	22.69	251	23.70
Materials Science	41	17.45	183	22.21	224	21.15
Building technology	17	7.23	79	9.59	96	9.07
Miscellaneous	33	14.04	47	5.70	80	7.55
Chemistry	12	5.11	60	7.28	72	6.80
Environmental science	17	7.23	53	6.43	70	6.61
Biology	16	6.81	49	5.95	65	6.14
Biotechnology	10	4.26	32	3.88	42	3.97
Health & medicine	5	2.13	36	4.37	41	3.87
Biochemistry	9	3.83	20	2.43	29	2.74
Fisheries	4	1.70	21	2.55	25	2.36
Energy & fuels	2	0.85	12	1.46	14	1.32
Physics	2	0.85	12	1.46	14	1.32
Nanoscience & nanotechnology	0	0.00	9	1.09	9	0.85
Behavioral sciences	1	0.43	6	0.73	7	0.66
Geography	0	0.00	5	0.61	5	0.47
Art	0	0.00	4	0.49	4	0.38
Metallurgy & metallurgical building technology	0	0.00	4	0.49	4	0.38
Engineering	1	0.43	3	0.36	4	0.38
Computer science	0	0.00	1	0.12	1	0.09
Law	0	0.00	1	0.12	1	0.09
Library science	1	0.43	0	0.00	1	0.09
Total	235	100	824	100	1059	100.00

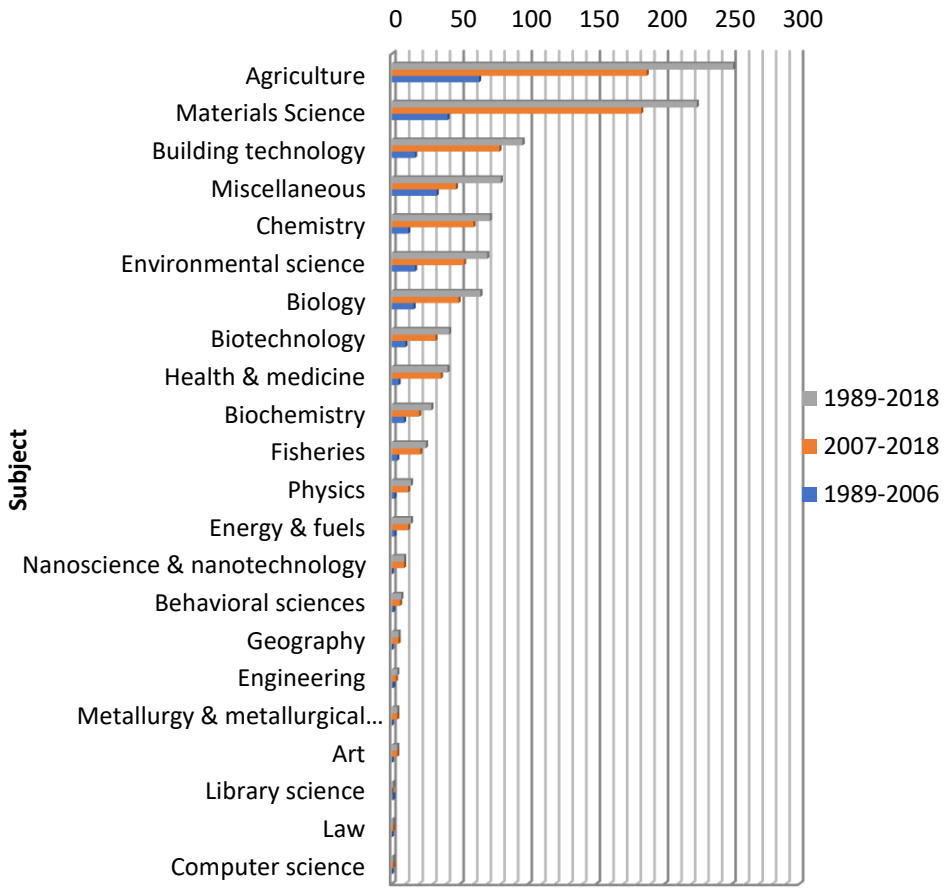


Figure 4.3.1 Subject wise distribution of Bamboo literature

In this figure 4.3.1 it can be seen that Bamboo publications on the subject area of agriculture, material science is highest in both decade, and publications on the subject area of computer science, law and library science are very low.

4.4 Institutional Contribution of Bamboo Literature

The institution wise distribution of paper throws light on the involvement of institution in Bamboo research activities. The related data presented in table 4.4.1 revealed that there were a total 761 Institution/organisation contributed 1059 paper over the last 30 years (1989-2018). The table highlighted of top 15 institutions in field of Bamboo research. The top fifteen most productive institutions belong to India except Chinese Academic Science, belongs to China.

Table 4.4.1. Institutional Distribution of Bamboo literature(1989-2018)

Rank	Institution	Number of Articles
1	Indian Inst Technol, India	134
2	Sri Krishnadevaraya Univ, A P	27
3	Assam Univ, Assam	26
4	Banaras Hindu Univ,U.P.	25
5	Univ Halcutta, W.B.	22
6	Inst Himalayan Bioresource tech, H. P.	20
7	Sona Coll Technol,TamilNadu	18
8	Natl Inst Technol,UttarPradesh	17
9	Bose Inst,Calcutta	14
9	Manipur Univ,Manipur	14
10	Chinese acad sci,China	13

10	Kumaraguru Coll Technol,TamilNadu	13
11	Forest res Inst,Derhadun	12
11	Tezpur univ,Assam	12
11	Univ Delhi,Delhi	12
	Other 746 Institutions	1233

The Indian Institution Technology, India with articles 134 secured 1st rank. Sri Krishnadevaraya University, A P ranked 2nd with 27 articles, Assam university, Assam contributed 26 articles and it got 3rd rank. Banaras Hindu university, U.P with 25 articles ranked 4th.

University Calcutta, W.B. 5th rank with 22 articles, Institute Himalayan Bioresource tech, H. P 6th rank with 20 articles, Sona College Technology, Tamil Nadu 7th rank with 18 articles, Natl Institute Technology, Uttar Pradesh 8th rank with 17 articles. Bose Institute, Calcutta and Manipur University, Manipur both institutions are ranked 9th with articles 14. With 13 articles a national institution, Kumaraguru College Technology, Tamil Nadu with an international institution named Chinese academic science, China also ranked 10th.

The figure 4.4.1 representing the top hundred institutions that made major contribution in Bamboo research during 1989-2018. It also can be seen in figure 4.4.1 Indian Institution Technology highlighted as it contributed highest number of articles. Name of the Institutions represented with abbreviation form so that it can be plotted in the cloud nicely.

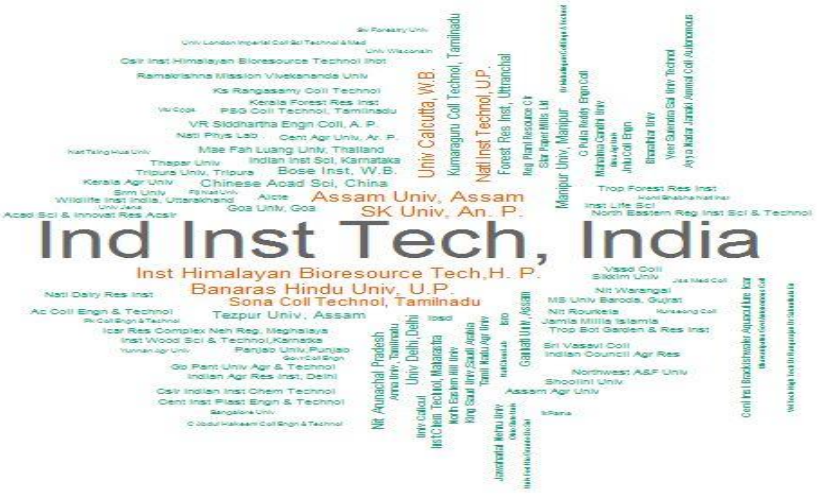


Figure 4.4.1 Cloud of institutional distribution on Bamboo publication

4.5 Geographical Distribution of Literature

Geographical distribution of publication on Bamboo research has been interpreted and plotted country wise and further Indian states were exposed for its productivity for the same. Country wise distribution in all over world (see figure 4.5.1) has been analysed by the number of articles on Bamboo contributed by different countries over the period (1989-2018). Whereas state wise distribution has been analysed by the number of articles contributed by the different state of India over the period of study.

4.5.1 Country wise Distribution

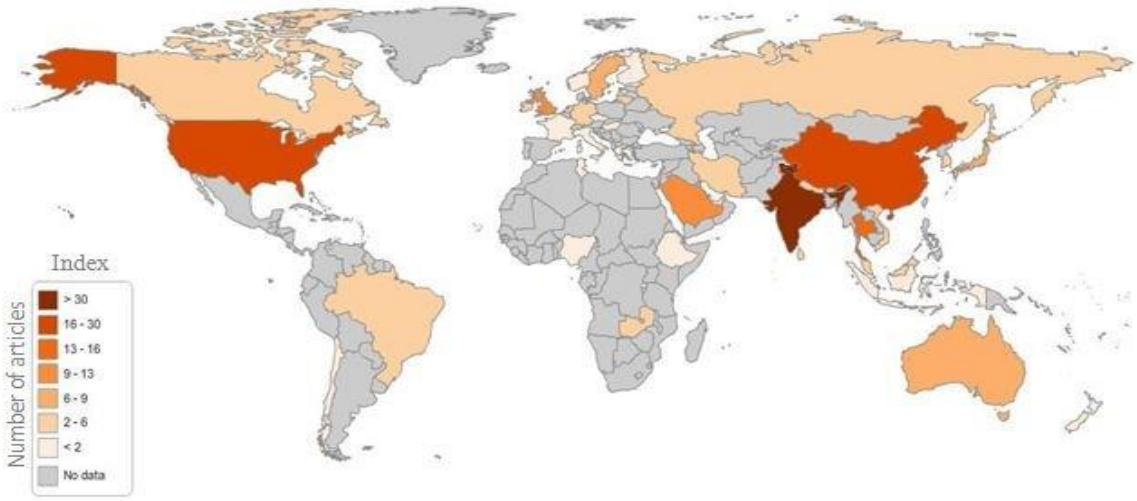
The contributions of different countries were analysed by the contribution of number of paper/s on Bamboo research. The authors from 44 countries out of 195 countries of world made contribution. From the figure 4.5.1 and table 4.5.1, it can be clearly observed that the highest contributions on Bamboo research have been made by India over the 30 years (1989-2018) in the world. There are total 1185 contribution on Bamboo research, of them highest 988 number of contribution were made from India followed by 30 contributions from China and USA each, 14 from Thailand, 12 from UK, and 11 from Saudi Arabia. The major contributions of India prove that the most of the research activities of the world

taking place in India and it also proved that it is one of the important countries in Bamboo cultivation of the world.

Table 4.5.1 Country wise distribution of Bamboo publications

Rank	Country	No. of articles
1	India	988
2	China	30
2	USA	30
3	Thailand	14
4	UK	12
5	Saudi Arabia	11
6	Africa	9
7	Japan	8
8	Australia	7
9	Sweden	6
10	Canada	5
10	Germany	5
11	Brazil	4
11	South Korea	4
11	Malaysia	4
11	Netherlands	4
12	Nepal	3
12	Taiwan	3
12	Vietnam	3
	Other 25 Countries	35

In this world map, it has been clearly shows that India contributes highest number of article on Bamboo literature over the 30 yers (1989-2018).



***Source of map**: www.maps of india.com*

Figure 4.5.1 Publication on Bamboo in the world

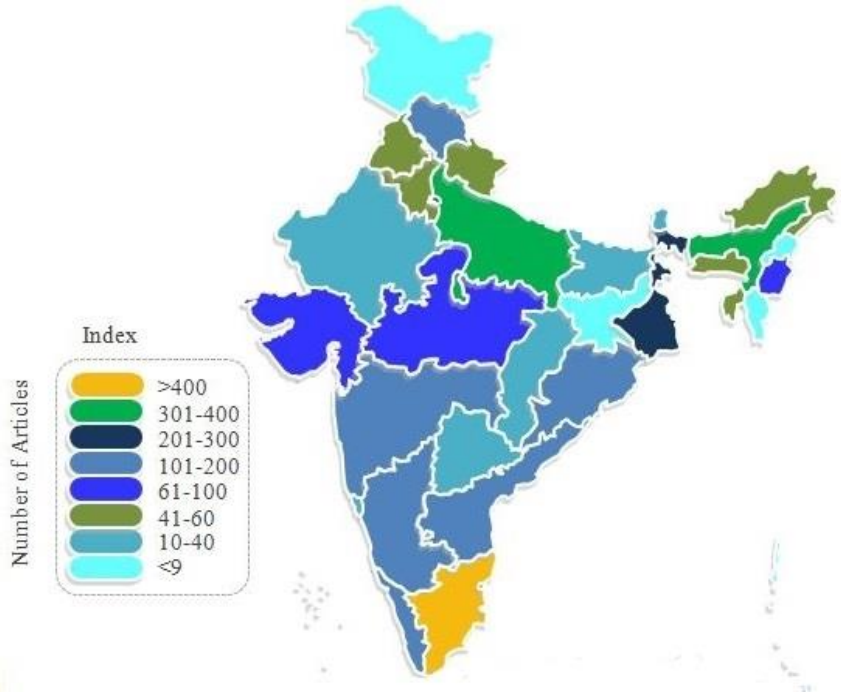
4.5.2 States-wise Distribution

The contributions of different states were analysed by the contribution of number of paper/s on Bamboo research. It can be seen in the table 4.5.2 that out of 36 states of India 34 states contributed the great contribution of Bamboo research. The state who didn't made contribution on Bamboo are Dadra and

Nagar Haveli, and Lakshadweep. From the figure 4.5.2 and table 4.5.2, clearly observed that the highest contributions on Bamboo research have been made by Tamil Nadu (420 articles) over the 30 years (1989-2018) in India followed by 303 contributions of Assam and Uttar Pradesh each ranked 2nd, with 274 article New Delhi ranked 3rd, 259 articles from West Bengal, and 156 from Himachal Pradesh.

Table 4.5.2 State wise Distribution of Publication in India

Rank	State	Number of Articles
1	Tamil Nadu	420
2	Assam	303
2	Uttar Pradesh	303
3	New Delhi	274
4	West Bengal	259
5	Himachal Pradesh	156
6	Odisha	147
7	Karnataka	145
8	Kerala	130
9	Maharashtra	106
10	Madhya Pradesh	95
11	Gujarat	86
12	Manipur	79
13	Arunachal Pradesh	59
14	Meghalaya	56
14	Punjab	56
	Other 18 states	



***Source of map**: www.maps of india.com*

Figure 4.5.2 Publication on Bamboo in India

The figure 4.5.2 states are presented in different colour according to their contribution of articles on Bamboo research. As shown in the figure Tami Nadu made the highest contribution with 420 articles on Bamboo Publications.

5.1 Findings and Conclusion

The present study analysed research progress in bamboo research of the 30 years () using bibliometric approach. The study showed a positive growth but it was very slow. The proportion of research articles increased in comparison to review and other articles. Most of the literature published in High impact factor journal and are the part of different discipline's journals and they are part of Q3. In this phenomenon, most of the paper contributed in local and national collaboration and most of the collaboration formed of more than two authors. M Das (Malay Das) of Presidency University, Department Life Science, Kolkata, and R Kumar of National Institute of Technology, Department of Mechanical Engineer, Silchar, India and A. Sood of CSIR, Division Biotechnology, Institute of Himalayan Bioresource Technology, Himachal Pradesh are identified as primary and the secondary prolific author respectively.

Out of 22 subject Category (see table) only three subject categories i.e. Agriculture, Material Science and Building Technology covered the most of the papers published over the year. In the world, the highest active country in bamboo research is India followed by China and USA. In Indian, North east resion's contribution is very nominal. Tamilnadu is very productive state of India followed by Assam, Uttar Pradesh and West Bengal. In world wide Ranking in Bamboo publication, the top fifteen most productive institutions belong to India while the Chinese academic science, of China ranked 10th postion. Most of the article contributed by IIT (Indian Institute of Technology, India) and it is followed by Sri Krishnadevaraya University, Andhra Pradesh (A.P.), Assam university, Assam Banaras Hindu university, Uttar Pradesh (U.P.).

On the basis of the above discussion it can be concluded that India is a premier country of the world in Bamboo research publications. North-east region of India is known as favoured environment of Bamboo and usage of bamboo for house and vegetable are very high but the contribution of Bamboo are less in comparison to South India. The related Institutions and organisation of Bamboo should organise workshops, seminars, and conference time to time so that authors get space to write more literature and the area become richer. Most of the papers are collaborated locally and nationally and most of the collaboration formed in India. Hence, International collaboration should be inspired, it will boost up the share of knowledge among various countries and will increase the research activities in Bamboo research.

References

1. Basumatary, A., Middha, S. K., Usha, T., Basumatary, A. K., Brahma, B. K., & Goyal, A. K. (2017). Bamboo shoots as a nutritive boon for Northeast India: an overview. 3 Biotech, 7(3), 169.
2. Arora, R. K. and S. Mauria 1988. Genetic resource of bamboos - an India perspective, The Indian Forester 114(9): 539–548.
3. Nongdam, P., & Tikendra, L. (2014). The nutritional facts of bamboo shoots and their usage as important traditional foods of northeast India. International scholarly research notices, 2014. Retrieve from https://doi.org/10.1155/2014/679073
4. Toppo, Abha (2018, November3). A complete guide to Bamboo Cultivation.Retrive from https://krishijagran.com/agripedia/a-complete-guide-to-bamboo-cultivation/
5. Agrahari, A. (2019). An Assessment of Subject coverage of Scientometrics from 2001 to 2010. Retrive form https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=5613&context=libphilprac
6. Cajee, L. (2018). Diversity of Bamboo Species and its Utilization in the North-Eastern. International Journal for Research in Applied Science & Engineering Technology, 6(3),3286-99.

7. Gupta, B. M., Ahmed, K. M., Gupta, R., & Tiwari, R. (2015). World camel research: a scientometric assessment, 2003–2012. Scientometrics, 102(1), 957-975.
8. k c,Anand Mapping of Bamboo Research Literature 2004-2014:A Bibliometric Analysis, In: Proceeding of the 4th National Conference of Institute of Scientometrics on Scientometrics and Internet of Things (IoT). Retrived from https://www.researchgate.net/publication/282666588_Mapping_of_Bamboo_Research_Literature_2004-2014A_Bibliometric_Analysis.
9. Wang, M. H., & Ho, Y. S. (2012). A bibliometric analysis of global research on bamboo from 1992 to 2011. Archives of Environmental Science, 6, 68-79.
10. Sun, Z., Cheng, Q., & Jiang, Z. (2008). Processing and properties of engineering bamboo products [J]. Acta Materiae Compositae Sinica, 1.
11. Patra, S. K., Bhattacharya, P., & Verma, N. (2006). Bibliometric study of literature on bibliometrics. DESIDOC Journal of Library & Information Technology, 26(1).
