# TRACING THE SCIENTIFIC OUT PUTS OF INDIAN AGRICULTURE BASED ON PUBLICATIONS : A SCIENTOMETRIC ANALYSIS

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## Abstract

***Objectives :*** *Analyses the Indian publications output in agriculture research during 2008-2018 on several parameters including contribution and citation impact of most productive countries, India's overall contribution, its growth pattern, citation impact, the share of international collaboration, identification of significant participating countries in India's international collaboration, most productivity and impact of leading Indian institutions and authors.*

***Methods:*** *The Web of Science Citation Database has been used to retrieve the data for 10 years (2008 - 2018) by searching the keywords "Agriculture Research" in combined Title, Abstract and Keywords field.*

***Results:*** *TheWorld output 3,72,458 and the Indian publications output in Agriculture research consisted of 24358 papers during 2008 – 2018 and which increased from 2414 papers in 2015 to 2365 papers in 2018, which decreased from 2043 during 2011& during to 2009. The share of Indian overall Agriculture research was 11.56% during 2008 - 2018, which increased from 9.061% during 2012 to 9.709% during 2018.*

***Conclusions**: Indian research out put on Agriculture research is quite low in the global context as reflected from its publication output per thousand publication (0.001) and its world publication share (3.28%) during 2018 - 2018. Also, the impact and quality of Indian research is low compared to select development and developing countries.*

**Key words** : Agriculture Research, India, Scientometric Study, Web of Science (WoS).



## Introduction

The 20th century may be described as the century of the development of metric sciences like librametrics, bibliometrics, scientometrics, cybermetrics or webometrics, informetrics and lastly altmetrics. The objective of the study is to use quantitative techniques and methods to assess the research domain. Scientometrics has become prominent day by day because of the need to measure and evaluate the huge investments in Science and Technology (S&T) sectors, especially in research and development activities. Journals are the primary communication channel in disseminating research and scholarly information and publishing papers in high impact and good quality national as well as international journals is strongly related with gaining prestige, reputation and academic achievement in higher education environment(Serenko et. al., 2010).

The invention of agriculture is one of the great revolution of human history. The availability of nutritional adequacy of food have been driving forces for human evolution and civilization. People often lived a nomadic life as hunters and gatherers following the migration of animals or moving during seasonal changes in the weather prior to the domestication of plants and animals, some 12,000 years ago. The adoption of agriculture, and the domestication of plants and animals reduced the nomadic lifestyles among groups of people. Communities of humans grew larger. Eventually, as

agriculture flourished and produced larger food surpluses, these communities grew into cities, that furthered the pursuit of government, art and technology for which human civilization is known (Knechtges, 2012).

## Objectives of the Study

The study aimed to :

i. Examine the growth of Agriculture research literature covered in Web of Science Citation Database for the period 2008 to 2018;
ii. Analyze the forms used for communicating agriculture research;
iii. Identify the language wise productivity;
iv. Identify the organizational collaboration in agriculture research;
v. Analyses the international linkages of Indian agriculture research output;
vi. To study most preferred Indian and foreign journals;
vii. Examine the subject-wise distribution of articles; and
viii. Analyze the most prolific authors in Indian agriculture research.



## Review of Literature

**Sagar, Kademani&Bhanumurthy (2014)** have analysed the agriculture research publications in India during 1993-2012 based on the Web of Science database. The objective of the study was to perform a scientometric analysis of all agriculture research publications by Indian scientists. The parameters studied include growth of publications and citations, domain-wise distribution of publications and citations, activity index, international collaboration, highly productive institutions, highly preferred journals, and highly cited publications.

**Siwach &Parmar (2018)** have studied the publication trends of CCS Haryana Agricultural University (CCSHAU) during 2001-2015. The study focussedthe year-wise research output, major subject categories, national and international collaborations, top journals for publication, most prolific authors, keywords, authorship pattern, citations pattern and highly cited

paper of CCSHAU. The 15 year publication data of the university indicate that a total of 2649 paper were published from 2001-2015 receiving 15282 citation. Nearly 47% of the university research was published in ten journal and it has collaborated with many institutions at national and international level in its research publication.



**Hasan & Singh (2007)**have assessed the contributions of agriculture and allied fields in Himachal Pradesh, based on publications, indexed in AGRICOLA, AGRIS, CAB Abstracts and FSTA CD-ROM databases during 1990-1994. In this macroscopic study they tries to answer questions such as which institutions are carrying out the research, in which journals, in what sub-fields the contributors are strong, and so on. The paper maps the field under the following heads; quantum of production, form-wise distribution, authorship pattern, institutions, ranking of periodicals, subject dispersion, citation study, length of publications, languages of publications, languages of summaries, country-wise productivity, state wise productivity and classification by journal impact factor.

**Ahila&Nagarajan**have analysed the 22,065 global publications in pharmaceutical research, deriving publication data from Web of Science database during 1999-2010 (12 years). It analysis the global publication growth, share and rank of top 15 most productive countries, authorship pattern, identic action of high productive institutions and journals.

**Reddy and Mahesh Kumar (2006)** provided a scientometrics analysis of world papers published by 57 countries in 10 major sub – specialities appearing in three leading international journals during the ten-year period. Dotson et al. (2011) analysed changes in the authorship and characteristics of articles in pharmacy journals during the 20-year period. In the field of Bibliometrics of country output in pharmacology only a few studies have been carried out on India.

## Methodology

The study will analyze the research output of agriculture research for the period 2008 – 2018 on several parameters. The Web of Science citation database has been used to retrieve the publications data for 26 years. The web of science is the search platform provided by Thomson Reuters. The study period 1990 – 2018 is selected as the database is available. Search string used for the data retrieval is SU=(Agriculture) AND Timespan= 2008 – 2018. Database=SCSCI, A&HCI, this search criteria yielded 24,354 records.



## Analysis and Results

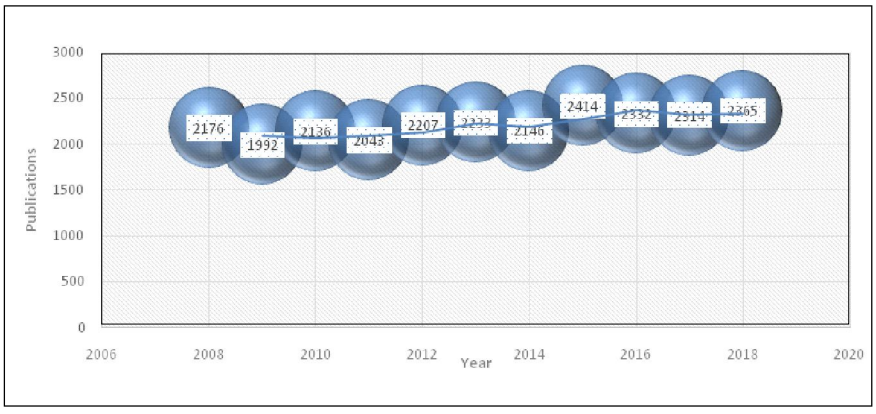
### Contribution of agriculture research publications by year wise

Data on the bibliographical records were collected from the online version of web of science (WoS) pertaining to Agriculture research publications from India for the period of 2008 to 2018. A total of 24,354 publications were collected, table 1 and figure 1 revels features of agriculture research. India has produced 24358 papers and received 187464 citations with 7.70% average citations per paper. As per the web of science data the cumulative publications growth of agriculture research of India had increased from 2176to 2365. India produced the highest number of publications in the year 2018 i.e. 2365 and produced least number of publications in the year 2009 i.e. 1992. In 2008 India contributed 2176 articles, received 28214 citations with 12.97 ACP and the highest h-index recorded in the year 2008 only i.e. 75. In 2009 produced 1992 articles received 20346 citations (with 10.21 ACP), and in 2018 produced the maximum number of articles.

**Table: 1 Contribution of Agriculture Research Publications by year wise**

| Years | Records | Citations | ACP | H–Index | % of 24358 |
|---|---|---|---|---|---|
| 2008 | 2176 | 28214 | 12.97 | 75 | 8.93 |
| 2009 | 1992 | 20346 | 10.21 | 62 | 8.18 |
| 2010 | 2136 | 24869 | 11.64 | 67 | 8.77 |
| 2011 | 2043 | 24248 | 11.87 | 66 | 8.39 |
| 2012 | 2207 | 19845 | 8.99 | 56 | 9.06 |
| 2013 | 2233 | 19070 | 8.54 | 52 | 9.17 |
| 2014 | 2146 | 15716 | 7.32 | 45 | 8.81 |
| 2015 | 2414 | 13830 | 5.73 | 45 | 9.91 |
| 2016 | 2332 | 10502 | 4.50 | 35 | 9.57 |
| 2017 | 2314 | 7292 | 3.15 | 27 | 9.50 |
| 2018 | 2365 | 3532 | 1.49 | 20 | 9.71 |
| | **24358** | **187464** | **7.70** | | **100.00** |

**Fig. 1: Contribution of Agriculture Research Publications by year wise**



## Forms used for Communicating Agriculture Research

Table 2 illustrates the forms used for communicating of agriculture research, these includes articles published in the scholarly journals, conferences and seminars proceedings, reviews, editorial materials, book chapters,meeting abstracts etc.. The study observed that a total of 24358 publications in Agriculture research output from India it has been observed from table ten are many communicating channels are used by authors to publish their research articles are used by Indian Agriculture research literature. The majority of publications are published in Journal Articles i.e. 23326 (95.763%) followed by Reviews 751 (3.08%) publications, 335 (1.375%) publications published in Proceedings Papers, 162 (0.665%) publications are published as Editorials Materials, 53 (0.218%) publications are published as Book Chapter, 51 (0.209%) publications are published as Correction, 50 (0.205%) publications published as Meeting abstract, 11 (0.045%) publications published as Book reviews, 7 (0.029%) publications are published as Letter and less than 3 of articles are published in Retracted publications. Also observed from the data that more than 99% of articles published in English language.



**Table: 2. Forms used for Communicating Agriculture Research**

| Form Types | Records | % of 24358 |
|---|---|---|
| Article | 2935 | 94.16 |
| Review | 751 | 3.08 |
| Proceedings Paper | 335 | 1.38 |
| Editorial Material | 162 | 0.67 |
| Book Chapter | 53 | 0.22 |
| Correction | 51 | 0.21 |
| Meeting Abstract | 50 | 0.21 |
| Book Review | 11 | 0.05 |
| Letter | 7 | 0.03 |
| Retracted Publication | 3 | 0.01 |

## Organisational-wise Collaboration

Table 3 reveals the ranking of 25 top research organizations of India based on their highest research articles. According to the Web of Science database Indian Council Of Agricultural Research (ICAR)contributed the highest publications to the field i.e. 9938 publications with 40.08%, followed by Indian Agricultural Research Institute with 1904publications (7.817%), Council of Scientific Industrial Research (CSIR) Indiawith 1372 publications (5.633%), Indian Veterinary Research Institutewith 1186publications (4.869%), National Dairy Research Institutewith 982publications(3.03%),Punjab Agricultural Universitywith 958 articles (3.933%) and Indian Institute of Technology System with 912 (3.744%) publications, International Crops Research Institute For The Semi-Arid Tropics (ICRISAT) with 627 (2.574%) publications, GovindBallabh Pant University of Agriculture Technology with 551 (2.254%) publications, Guru Angad Dev Veterinary Animal Sciences University Gadvasu with 549 (2.254%) publications andTamil Nadu Agricultural Universitycontributed 473 (1.942%) publications.

| Table: 3. Organisational Collaboration | | | |
|---|---|---|---|
| **Sl. No.** | **Organizations-Enhanced** | **Records** | **% of** |
| 1 | Indian Council of Agricultural Research ICAR | 9938 | 40.8 |
| 2 | ICAR Indian Agricultural Research Institute | 1904 | 7.817 |
| 3 | Council Of Scientific Industrial Research CSIR India | 1372 | 5.633 |
| 4 | ICAR Indian Veterinary Research Institute | 1186 | 4.869 |
| 5 | ICAR National Dairy Research Institute | 982 | 4.032 |
| 6 | Punjab Agricultural University | 958 | 3.933 |
| 7 | Indian Institute of Technology System IIT System | 912 | 3.744 |
| 8 | International Crops Research Institute For The | | |
| 9 | Semi-Arid Tropics ICRISAT | 627 | 2.574 |
| 10 | GovindBallabh Pant University of Agriculture Technology | 551 | 2.262 |
| 11 | Guru Angad Dev Veterinary Animal Sciences University Gadvasu | 549 | 2.254 |
| 12 | Tamil Nadu Agricultural University | 473 | 1.942 |
| 13 | Banaras Hindu University | 451 | 1.852 |
| 14 | Ccs Haryana Agricultural University | 446 | 1.831 |
| 15 | ICAR Research Complex For Neh Region | 437 | 1.794 |
| 16 | Tamil Nadu Veterinary Animal Sciences University | 353 | 1.449 |
| 17 | ICAR National Bureau of Plant Genetics Resources | 332 | 1.363 |
| 18 | Anand Agricultural University | 322 | 1.322 |
| 19 | Indian Institute of Technology IIT Kharagpur | 302 | 1.24 |
| 20 | ICAR Indian Institute of Horticultural Research | 291 | 1.195 |
| 21 | Bidhan Chandra Agricultural University | 289 | 1.186 |
| 22 | ICAR National Bureau of Animal Genetic Resources | 269 | 1.104 |
| 23 | ICAR Indian Grassland Fodder Research Institute | 265 | 1.088 |
| 24 | Assam Agricultural University | 261 | 1.072 |
| 24 | University of Agricultural Science | 251 | 1.03 |
| 25 | ICAR Central Sheep Wool Research Institute | 226 | 0.928 |

## International Linkages of Indian Agriculture Research

Due to the interdisciplinary growth of subject, the universe of knowledge is very dynamic and is ever-growing. More and more specialization in the subjects achieved by the authors, which is a result of increased participation of group of researchers of different expertise. It has been found from earlier studies that collaboration in research varies from discipline to discipline and for the same discipline from time to time and from one country to another (Sangam, 2011). The internationaldistribution of articlesare presented in Table 4, which gives the country wise-distribution of contributions. Out of total 24358 research articles, USA contributed the highest number of research article contributing 817 publications with (3.354%) share, followed by Australia contributed 404 publication with (1.659%) of total share, Peoples R China published 243 publications with (0.998%) , Germany contributed 206 (0.846%) publications, Canada contributed 17 (2.5%) publications, Germany 15 (2.2%) publications and other countries contributed 1155 publications. Many countries are contributed with below 0.5% share with India in Agriculture research during 2008to 2018.

**Table: 4. International Linkages of Indian Agriculture Research**

| Sl. No. | Countries | Records | % of 24358 |
|---|---|---|---|
| 1 | USA | 817 | 3.354 |
| 2 | Australia | 404 | 1.659 |
| 3 | China | 243 | 0.998 |
| 4 | Germany | 206 | 0.846 |
| 5 | South Korea | 196 | 0.805 |
| 6 | England | 163 | 0.669 |
| 7 | Canada | 161 | 0.661 |
| 8 | Philippines | 145 | 0.595 |
| 9 | Mexico | 129 | 0.53 |
| 10 | Japan | 128 | 0.525 |
| 11 | France | 115 | 0.472 |
| 12 | Netherlands | 92 | 0.378 |
| 13 | Italy | 89 | 0.365 |
| 14 | Iran | 84 | 0.345 |
| 15 | Ethiopia | 76 | 0.312 |
| 16 | Kenya | 73 | 0.3 |
| 17 | Saudi Arabia | 73 | 0.3 |
| 18 | Pakistan | 67 | 0.275 |
| 19 | Nepal | 64 | 0.263 |
| 20 | Scotland | 62 | 0.255 |
| 21 | Brazil | 57 | 0.234 |
| 22 | Spain | 56 | 0.23 |
| 23 | Taiwan | 54 | 0.222 |
| 24 | South Africa | 52 | 0.213 |
| 25 | Switzerland | 51 | 0.209 |

**Major 25 Productive Journals of Indian Agriculture Research**

Table 5reveals the top productive sources preferred by the authors of India in the field of agriculture research. *Indian Journal of Animal Sciences*ranked first in terms of publications i.e. 3001 publications with 12.32% of total publications and followed by Indian *Journal of Agricultural Sciences contributed 2739 publications with 11.245%, Bio resource Technology* which are contributed 1587 publications with 6.515%%, *Indian Journal of Horticulture*produced 1212 with 4.976% publications, I*ndian Journal of Animal Research* contributed 1100 with 4.516% publications, *Legume Research* produced 970 with 3.982% publications, *Journal of Agro meteorology* produced 724 with 2.972% publications, *Industrial Crops and Products*produced 619 with 2.541% publications, *Research on Crops*produced 599 with 2.459% publications, *Buffalo Bulletin*produced 589 with 2.418% publication, *Communications in Soil Science and Plant Analysis* produced 420 with 1.724% publications, *International Journal of Agricultural and Statistical Sciences*produced 369 with 1.515% publications, *Scientia Horticulture* produced 342 with 1.404% publications and *Animal Nutrition and Feed Technology* Produced 335 with 1.375% publications published respectively.

**Table 5. Major 25 Productive Journals of Indian Agriculture Research**

| Source Titles | Records | % of 24358 |
|---|---|---|
| Indian Journal of Animal Sciences | 3001 | 12.32 |
| Indian Journal of Agricultural Sciences | 2739 | 11.245 |
| Bio resource Technology | 1587 | 6.515 |
| Indian Journal of Horticulture | 1212 | 4.976 |
| Indian Journal of Animal Research | 1100 | 4.516 |
| Legume Research | 970 | 3.982 |
| Journal of Agro meteorology | 724 | 2.972 |
| Industrial Crops And Products | 619 | 2.541 |
| Research on Crops | 599 | 2.459 |
| Buffalo Bulletin | 589 | 2.418 |
| Communications in Soil Science and Plant Analysis | 420 | 1.724 |
| International Journal of Agricultural and Statistical Sciences | 369 | 1.515 |
| Scientia Horticulture | 342 | 1.404 |
| Animal Nutrition and Feed Technology | 335 | 1.375 |
| Range Management and Agroforestry | 335 | 1.375 |
| Agricultural Mechanization in Asia Africa and Latin America | 301 | 1.236 |
| Sugar Tech | 270 | 1.108 |
| Journal of Agricultural and Food Chemistry | 269 | 1.104 |
| Tropical Animal Health and Production | 264 | 1.084 |
| Euphytica | 245 | 1.006 |
| Journal of the Science of Food and Agriculture | 237 | 0.973 |
| Field Crops Research | 226 | 0.928 |
| Genetic Resources and Crop Evolution | 197 | 0.809 |
| Crop Protection | 196 | 0.805 |
| Biomass Bioenergy | 195 | 0.801 |



**Distribution of Articles among Sub-disciplines**

The Indian Agriculture research published during 2008to 2018 was classified under 25 major sub-disciplines (as defined by Web of Science citation database). Table 6. Reveals that the top 25 research areas of India in the field of Agriculture research.Plant Sciencesaccounted for the largest publications i.e.2146 (8.81%) followed by Biotechnology Applied

Microbiologysubject produced 2046 (8.383%) publications, Energy Fuels produced 1788(7.341%) publications,Chemistry produced974 (3.999%) publications, Food Science Technology produced 767 (3.149%) publications, Veterinary Sciences published 572 (2.348%) publications, Water Resources published 532 (2.184%) publications, and Environmental Sciences Ecology produced 354 (1.453%) publications etc.

**Table: 6.Distribution of Articles among Sub-disciplines**



| Sl. No. | Research Areas | records 24358 | % of |
|---|---|---|---|
| 1 | Plant Sciences | 2146 | 8.81 |
| 2 | Biotechnology Applied Microbiology | 2042 | 8.383 |
| 3 | Energy Fuels | 1788 | 7.341 |
| 4 | Chemistry | 974 | 3.999 |
| 5 | Food Science Technology | 767 | 3.149 |
| 6 | Meteorology Atmospheric Sciences | 761 | 3.124 |
| 7 | Veterinary Sciences | 572 | 2.348 |
| 8 | Water Resources | 532 | 2.184 |
| 9 | Environmental Sciences Ecology | 354 | 1.453 |
| 10 | Genetics Heredity | 325 | 1.334 |
| 11 | Reproductive Biology | 302 | 1.24 |
| 12 | Entomology | 252 | 1.035 |
| 13 | Forestry | 181 | 0.743 |
| 14 | Engineering | 176 | 0.723 |
| 15 | Computer Science | 103 | 0.423 |
| 16 | Business Economics | 97 | 0.398 |
| 17 | Life Sciences Biomedicine Other Topics | 87 | 0.357 |
| 18 | Geology | 78 | 0.32 |
| 19 | Science Technology Other Topics | 57 | 0.234 |
| 20 | Nutrition Dietetics | 32 | 0.131 |
| 21 | History Philosophy Of Science | 19 | 0.078 |
| 22 | Fisheries | 14 | 0.057 |
| 23 | Sociology | 10 | 0.041 |
| 24 | Endocrinology Metabolism | 9 | 0.037 |
| 25 | Mycology | 9 | 0.037 |

**Most Productive Authors in Indian AgricultureResearch**

The Table 7. Shows the highly productive authors from Indian Agriculture research output during the study period. Their highest papers, irrespective of their subjects in the Period of 2008 – 2018 as reflected in Web of Science Citation Database. The highly productive authors, are listed in below table, Kumar A, and Kumar, S. they contributed 877 (3.6%) publications respectively, followed by Kumar, R. contributed 545 ((2.237%) publications, Singh R contributed 473 (1.942%) publications, Singh S contributed 465 (1.909%) publications, Singh A. K.Contributed 432 (1.74%) publications end etc.



**Table 7. Most Prolific Authors in Indian Agriculture Research**

| Authors | records | % of 24358 |
|---|---|---|
| Kumar, A. | 877 | 3.6 |
| Kumar, S. | 877 | 3.6 |
| Kumar, R. | 545 | 2.237 |
| Singh, R. | 473 | 1.942 |
| Singh, S. | 465 | 1.909 |
| Singh, A. K. | 432 | 1.774 |
| Singh, A. | 361 | 1.482 |
| Kumar, P. | 348 | 1.429 |
| Singh, M. | 337 | 1.384 |
| Singh, S. K. | 326 | 1.338 |
| Singh, D. | 312 | 1.281 |
| Singh, B. | 304 | 1.248 |
| Kumar, V. | 297 | 1.219 |
| Sharma, A. | 292 | 1.199 |
| Kumar, D. | 245 | 1.006 |
| Kumar, M. | 243 | 0.998 |
| Singh, P. | 235 | 0.965 |
| Sharma, S. | 234 | 0.961 |
| Kumar, N. | 193 | 0.792 |
| Singh, J. | 184 | 0.755 |
| Singh, G. | 183 | 0.751 |
| Sharma, R. | 182 | 0.747 |
| Singh, S. P. | 167 | 0.686 |
| Singh, R. K. | 159 | 0.653 |
| Singh, K. | 148 | 0.608 |

A number of research questions pertaining to country, institutional and individual productivity, co operation patterns, publication frequency, and favourite inquiry methods were proposed and answered. Based on the findings, many implications emerged that improve one's understanding of the identity of Agriculture research as a distinct scientific field.It is observed that majority of Indian Agriculture research publications are published in English language.



## Conclusion

There is a need for the hour to increase the research and development investments at institutional level. Academic institutions should take steps to crate interest in research in agriculture among graduate and postgraduate students and also among young authors and scientist. Such efforts should include specialised training programmes with support from funding agencies. Indian research out put on Agriculture researchis quite low in the global context as reflected from its publication output per thousand publication (0.001) and its world publication share (3.28%) during 2008 - 2018. Also, the impact and quality of Indian research is low compared to select development and developing countries.Indian Journal of Animal Sciences ranked first in terms of publications i.e. 3001 publications with 12.32% of total publications and followed by Indian Journal of Agricultural Sciences contributed 2739 publications with 11.245%. The study period. Out of total 24358 research articles, USA contributed highest number of research article contributing 817 publications with (3.354%) share, followed by Australia contributed 404 publication with (1.659%).

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