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# Analyzing the publishing trends of the Indian Council for Agricultural Research (ICAR): A Scientometric Study

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## **Abstract**

*The study analyses the publication productivity of the faculty and researchers of the Indian Council for Agricultural Research (ICAR). Many scientometric studies have been done about institutional scientific outcome in recent years. The study presents a quantitative study of productivity, characteristics of various aspects of publications of ICAR. A total of 9236 contributions published and received 43876 citations with 4.75 average citations per paper in the study period.*

**Keywords:** Scientometric analysis, Agriculture, ICAR, Web of Science, Prolific Authors and International Collaboration.

## **Introduction**

Agriculture is the major economic source of the most developing countries, in India nearly 650 million people are dependent on agriculture or related activities. Agriculture and allied sectors contribute nearly 25 per cent of the Gross Domestic Production (GDP). Scientometrics has become an important field of study to monitor the progresses in scientific performance of a research group, a department, a university etc. The importance of agricultural research in India was recognized as early as in 1929 with the establishment of the Indian Council of Agricultural Research (ICAR) on the recommendations of the Royal Commission on Agriculture. ICAR plans, conducts and promotes research, education, training and transfer of technology for the advancement of agriculture, animal husbandry and fisheries and also envisages their applications at the field level through extension agencies under the Central and State Governments. It encompasses 52 Central Institutes, 32 National Research Centers, 12 Project Directorates, and 91 All India Coordinated Research projects and employs about 30000 personnel, of which nearly 7000 are engaged in active research and its management. In addition to this, 38 State Agricultural Universities employ about 26000 scientists for teaching, research, and extension education.<sup>1</sup> Thus, India has a huge

infrastructure of research in agricultural sciences. The present study makes an attempt to quantify the publications output of ICAR using Science Citation Index Expanded (Web of Science) for the period 2009–2018.

### **Objectives of the study**

The main objective of the present study is to analyse the research performance of the ICAR for the period from 2009 to 2018 using various qualitative and quantitative indicators.

The specific objectives are to:

- analyse the growth of publications and the citation impact;
- find out the most preferred journals for publication by the scientists;
- ascertain the country-wise distribution of journals & publications;
- identify the most prolific authors;
- Language distribution of the literature;
- To find out the institutional and International Collaboration; and
- To know the highly papers.

### **Data Sources**

The Scopus and Web of Science are the two most widely popular multidisciplinary, bibliographic databases used for conducting the scientometric analysis. The present study uses the Web of Science, database for the retrieval of data. The data was downloaded for a period of 10 years (2009 to 2018). The string used for the retrieval of data was *AD=( Indian Council for Agricultural Research) AND CU= (INDIA) AND PY=(2009-2018)* and the search was restricted to the Science Citation Index. Various qualitative and quantitative indicators were used for the analysis of the research output which include Total number of Publications (TP), Total number of Citations (TC), Citations Per Paper (CPP), h-index.

### **Year-wise research output of ICAR**

The table 1 shows the year-wise research performance of the ICAR for the period 2009 to 2018. It is observed from the data that the research output of ICAR has gradually increased year by year. The ICAR published 9236 papers and received 43876 citations with an average citations per paper was 4.75, the publications reached its peak in the years 2015 and 2017 and thereafter we found that the minor variations in year-wise growth. The numbers of publications were the lowest in initial years. The ICAR published the highest number of articles recorded in the year 2017 i.e. 1073 articles and received 1876 citations with an

average citations per paper is 1.75. The ICAR received the highest number of citations in the year 2010, it has 7457 citations with 9.37 ACP and h-index is 42.

**Table 1: Year-wise research output of ICAR**

<b>Year</b>	<b>Publications</b>	<b>Citations</b>	<b>ACP</b>	<b>H-Index</b>	<b>%</b>
2009	705	5809	8.24	36	7.63
2010	796	7457	9.37	42	8.62
2011	746	6198	8.31	34	8.08
2012	872	5348	6.13	30	9.44
2013	943	5285	5.60	30	10.21
2014	940	4290	4.56	26	10.18
2015	1062	3695	3.48	22	11.50
2016	1054	3052	2.90	20	11.41
2017	1073	1876	1.75	15	11.62
2018	1045	866	0.83	9	11.31
	<b>9236</b>	<b>43876</b>	<b>4.75</b>		<b>100</b>

### **Document wise distribution of publications**

Table 2 deals with the document wise distribution of publications, the maximum 8812 (95.41%) of publications were ‘Article’ type documents, followed by ‘Review’ type document with 284 (3.07%) of publications and remaining document types are published below 1% of publications those are ‘Editorial Material’, ‘Proceedings Paper’, ‘Book Chapter’, ‘Meeting Abstract’, ‘Correction’ and other document types. Whole data of document wise distribution of publication is as shown in Table 2.

**Table 2: Document wise distribution of publications**

<b>Document Types</b>	<b>Publications</b>	<b>%</b>
Article	8812	95.41
Review	284	3.07
Editorial Material	41	0.44
Proceedings Paper	36	0.39
Book Chapter	24	0.26
Meeting Abstract	21	0.23
Correction	12	0.13
Letter	4	0.04
Retracted Publication	2	0.02

### **Most prolific authors**

Table 3 lists the most prolific authors of ICAR during 2009 to 2018. It is observed from the data that the top ten most prolific authors are listed in the table, the highest publications are produced by Kumar, A. i.e. 5.48% of total articles, followed by Kumar, S.

published 497 articles (5.38%), Kumar, R. contributed 334 articles with 3.62%, Singh, A. K. has published 287 (3.11%) papers, Singh, R. has produced 2.87% of articles and Singh, S. contributed 204 papers during the period.

**Table 3: Most prolific authors**

<b>Authors</b>	<b>Publications</b>	<b>%</b>
Kumar, A.	506	5.48
Kumar, S.	497	5.38
Kumar, R.	334	3.62
Singh, A. K.	287	3.11
Singh, R.	265	2.87
Singh, S.	204	2.21
Singh, M.	200	2.17
Kumar, P.	186	2.01
Singh, S. K.	184	1.99
Singh, A.	174	1.88

#### **Subject-wise distribution of articles**

The table 4 highlights the research area-wise distribution of articles, analysis reveals that the maximum articles published in Agriculture Dairy Animal Science i.e. 2765 (29.94%) of the literature is covered, 1766 (19.12 per cent) to Agronomy, 1065 (11.53 per cent) to Agriculture Multidisciplinary, 1112 (12.04 per cent) to Horticulture, to Plant Sciences 835 (9.04 per cent), to Soil Science 577 (6.25 per cent). The other areas such as Veterinary Sciences, Agricultural Engineering, Reproductive Biology and Biotechnology Applied Microbiology shared less than 500 articles/publications, i.e. 391 (4.23 per cent), 299 (3.24 per cent), 215 (2.33 per cent) and 211 (2.28 per cent), respectively.

**Table 4: Research area-wise distribution of articles**

<b>Research Areas</b>	<b>Publications</b>	<b>%</b>
Agriculture Dairy Animal Science	2765	29.94
Agronomy	1766	19.12
Agriculture Multidisciplinary	1065	11.53
Horticulture	1112	12.04
Plant Sciences	835	9.04
Soil Science	577	6.25
Veterinary Sciences	391	4.23
Agricultural Engineering	299	3.24
Reproductive Biology	215	2.33
Biotechnology Applied Microbiology	211	2.28

### List of highly productive research organisations collaborated with ICAR

Table 5 reveals the list of highly productive research organisations which collaborated with ICAR based on their highest publications. Indian Agricultural Research Institute has contributed the highest number of publications i.e. 1218 with 13.19%, followed by Indian Veterinary Research Institute has published 862 (9.33%) articles, National Dairy Research Institute published 654 (7.08%) articles, ICAR-Indian Agricultural Research Institute published 403 (4.36%) articles, ICAR-Research Complex published 306 (3.31%) articles and Indian Council of Agricultural Research has contributed 244 (3.41%) articles.

**Table 5: List of highly productive research organisations collaborated with ICAR**

<b>Organizations</b>	<b>Records</b>	<b>% of 9236</b>
Indian Agricultural Research Institute	1218	13.19
Indian Veterinary Research Institute	862	9.33
National Dairy Research Institute	654	7.08
ICAR-Indian Agricultural Research Institute	403	4.36
ICAR-Research Complex	306	3.31
Indian Council of Agricultural Research	244	2.64
ICAR-Research Complex for NEH Region	235	2.54
National Bureau of Animal Genetic Resources	191	2.07
National Bureau of Plant Genetic Resources	189	2.05
Indian Grassland and Fodder Research Institute	180	1.95

### Preferred Journals by ICAR Scientists

Journals play an important role in scholarly communication. Periodicals are sensitive indicators of the emerging new ideas in any discipline. The table 6 shows the highly preferred journals by the ICAR scientists to publish their research works. Among the top journals, most of the journals published from India. The study shows that the highest publications are published by the scientists from the ICAR is in *Indian Journal of Agricultural Sciences* i.e. 1635 articles with 17.70% of total output. Followed by *Indian Journal of Animal Sciences* has published 1630 articles (17.65%), *Indian Journal of Horticulture* has published 593 articles (6.42%), *Indian Journal of Animal Research* has published 395 articles (4.28%), *Legume Research* has published 219 articles (2.37%) *Range Management and Agroforestry* has published 185 articles (2.00%), *Tropical Animal Health and Production* has published 184 articles (1.99%), *Communications in Soil Science and Plant Analysis* published 169 articles (1.83%).

**Table 6: Preferred Journals by ICAR Scientists**

Source Titles	Records	% of 9236
Indian Journal of Agricultural Sciences	1635	17.70
Indian Journal of Animal Sciences	1630	17.65
Indian Journal of Horticulture	593	6.42
Indian Journal of Animal Research	395	4.28
Legume Research	219	2.37
Range Management and Agroforestry	185	2.00
Tropical Animal Health and Production	184	1.99
Communications in Soil Science and Plant Analysis	169	1.83
Animal Nutrition and Feed Technology	168	1.82
Journal of Agro meteorology	167	1.81

### International Collaboration

Table 7 examines that the USA had the largest number of articles, with 209 (2.26 per cent of total output), 96 (1.04 per cent) contributors are from Australia which stands second among the top contributors. Further, followed by Peoples R China had published 54 articles with 0.59 per cent of total output, Philippines had contributed 47 articles (0.51 per cent), England published 42 articles (0.46 per cent) and Canada had published 36 articles with 0.39 per cent).

**Table 7: International Collaboration**

Countries/Regions	records	% of 9236
USA	209	2.26
Australia	96	1.04
Peoples R China	54	0.59
Philippines	47	0.51
England	42	0.46
Canada	36	0.39
Germany	34	0.37
Mexico	34	0.37
Iran	29	0.31
Japan	26	0.28

### The list of top cited papers of ICAR scientists

The top 10 most cited papers are listed in table from Indian Council of Agricultural Research (ICAR) during 2009 to 2018, the institution has received 1902 citations from these highly cited papers. These 10 high cited papers were published in 9 journals including 2 papers in *Bioresource Technology* journal, most of the papers are published with multiple authors (Three or more authors), only one paper is had two authors. The top cited paper was

‘Microsatellite markers: an overview of the recent progress in plants, authored by Kalia, R. K.; Rai, M. K.; Kalia, S.; Singh, R. & Dhawan, A. K. published in *EUPHYTICA* journal in the year 2011 and this paper received 471 citations, followed by ‘Key issues in life cycle assessment of ethanol production from lignocellulosic biomass: Challenges and perspectives, published by Singh, A.; Pant, D.; Korres, N. E.; Nizami, A. S.; Prasad, S. & Murphy, J. D. published in *Bioresource Technology* journal in the year 2010, and this paper received 250 citations, ‘Oil palm fiber (OPF) and its composites: A review’ authored by Shinoj, S.; Visvanathan, R.; Panigrahi, S. & Kochubabu, M. published in *Industrial Crops and Products* journal in the year 2011 and this paper received 195 citations, ‘Field-evolved resistance to Bt toxin Cry1Ac in the pink bollworm, *Pectinophora gossypiella* (Saunders) (Lepidoptera: Gelechiidae), from India’ authored by Dhurua, S. & Gujar, G. T. published in *PEST Management Science* journal in the year 2011 this paper received 160. This shows that more research activities are being carried on in newly developing fields. ‘Uses and management of poultry litter’, published by Bolan, N. S.; Szogi, A. A.; Chuasavathi, T; Seshadri, B.; Rothrock, M. J. & Panneerselvam, P. published in *Worlds Poultry Science Journal* in the year 2010 and received 156 citations. ‘Optimization and characterization of a new lipopeptide biosurfactant’, published by Kiran, G. S.; Thomas, T. A.; Selvin, J.; Sabarathnam, B. & Lipton, A. P. published in *Bioresource Technology* journal in the year 2010 and received 151 citations and 10<sup>th</sup> paper i.e. ‘Engineered nanoparticles in the soil and their potential implications to microbial activity’ produced by Dinesh, R.; Anandaraj, M.; Srinivasan, V. & Hamza, S. and this paper published *Geoderma* journal in the year 2012.

**Table 8: The list of top cited papers of ICAR scientists**

Sl. No.	Citations Received	Title of the Article	Authors	Source	Year of Publication
1	471	Microsatellite markers: an overview of the recent progress in plants	Kalia, RK; Rai, MK; Kalia, S; Singh, R; Dhawan, AK	<i>EUPHYTICA</i> 77(3), 309-334	2011
2	250	Key issues in life cycle assessment of ethanol production from lignocellulosic biomass: Challenges and perspectives	Singh, A; Pant, D; Korres, NE; Nizami, AS; Prasad, S; Murphy, JD	<i>Bioresource Technology</i> , 101(13), 5003-5012	2010
3	195	Oil palm fiber (OPF) and its composites: A review	Shinoj, S; Visvanathan, R; Panigrahi, S;	<i>Industrial Crops and Products</i> ,	2011



			Kochubabu, M	33(1), 7-22	
4	160	Field-evolved resistance to Bt toxin Cry1Ac in the pink bollworm, <i>Pectinophora gossypiella</i> (Saunders) (Lepidoptera: Gelechiidae), from India	Dhuraa, S; Gujar, GT	<i>PEST Management Science</i> , 67(8), 898-903	2011
5	156	Uses and management of poultry litter	Bolan, NS; Szogi, AA; Chuasavathi, T; Seshadri, B; Rothrock, MJ; Panneerselvam, P	<i>Worlds Poultry Science Journal</i> , 66(4), 673-698	2010
6	151	Optimization and characterization of a new lipopeptide biosurfactant produced by marine <i>Brevibacterium aureum</i> MSA13 in solid state culture	Kiran, GS; Thomas, TA; Selvin, J; Sabarathnam, B; Lipton, AP	<i>Bioresource Technology</i> , 101(7), 2389-2396	2010
7	133	Integration of novel SSR and gene-based SNP marker loci in the chickpea genetic map and establishment of new anchor points with <i>Medicago truncatula</i> genome	Nayak, SN and others	<i>Theoretical and Applied Genetics</i> , 120(7), 1415-1441	2010
8	131	Effects of rice straw and nitrogen fertilization on greenhouse gas emissions and carbon storage in tropical flooded soil planted with rice	Bhattacharyya, P; Roy, KS; Neogi, S; Adhya, TK; Rao, KS; Manna, MC	<i>Soil &amp; Tillage Research</i> , 124, 119-130	2012
9	129	Alleviation of drought stress effects in sunflower seedlings by the exopolysaccharides producing <i>Pseudomonas putida</i> strain GAP-P45	Sandhya, V; Z, ASK; Grover, M; Reddy, G; Venkateswarlu, B	<i>Biology and Fertility of Soils</i> , 46(1), 17-26	2009
10	126	Engineered nanoparticles in the soil and their potential implications to microbial activity	Dinesh, R; Anandaraj, M; Srinivasan, V; Hamza, S	<i>Geoderma</i> , 173, 19-27	2012

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## **Conclusion**

The quantification of the research output will give an idea of the Indian research capacity in agricultural sciences as the literature of science is reasonably a good indicator of a country's level of participation in the worldwide enterprise of scientific research. Journals are playing a dominant role in scientific research, these are the sensitive indices of the emerging new ideas in any discipline. They reveal the existing problems requiring solution, research pattern to solve these problems, the practices fixed to various areas etc.

The study of metric approached the science and technology based on quantitative features and elements of documentary flows. The analysis of the metric study primarily based on the bibliographic data on publications. A careful evaluation of periodical literature may indicate a complete picture of the discipline, the profession with which it repents and everything connected with them.

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