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## Indian Wheat Research Output in Two Decades: A Bibliometric Study Based on Scopus Data from 1996-2015

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# **Indian Wheat Research Output in Two Decades: A Bibliometric Study Based on Scopus Data from 1996-2015**

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## **ABSTRACT**

**Purpose:** The purpose of this paper is to explore the Indian wheat research output during 1996 to 2015 from a bibliometric point of view.

**Methodology:** The data for the study was extracted from Scopus database for the 20 years time period from 1996-2015 using the keywords identified through MeSH. A total of 8554 Indian papers on wheat research were selected and analyzed to study the year-wise output, most prolific authors, document types, top journals, top institutions, international collaborations, funding agencies, citation profile and top cited papers.

**Findings:** With 8.52% of the global research output on wheat, India stands at 3<sup>rd</sup> position in the world during 1996-2015, receiving citations at an average of 14.68 citations per paper. The international collaborative papers with 91 countries, accounting for 13.92% of total papers, received more citations in comparison to other papers. IARI New Delhi is the top institution while H.S. Dhaliwal is the top author in terms of publication count. CSIR is the topmost funding agency. Indian Journal of Agricultural Science and Indian Journal of Agronomy were the most preferred journal for publishing Indian wheat research. Almost half of the total papers received upto ten citations. The paper by J.Peng et al published in Nature was the top cited paper.

**Research Limitations:** The study is limited only to the publications indexed in Scopus database.

**Originality:** This study is unique in the sense that no bibliometric study is available on Indian wheat research output till date. The present study will be beneficial for the researchers and policy makers interested in wheat research in India. The study also adds to the corpus of bibliometric literature.

**Keywords:** Wheat, Triticum, India, Bibliometrics, Scientometrics, Research output

## 1. INTRODUCTION

India is an agricultural country and agriculture plays a vital role in India's economy. According to the 2011 census, nearly 55% of the population is engaged in agriculture and allied activities, being the largest source of livelihood in the country. The country is producer of many cereal crops like wheat, rice, jowar, bajra, ragi, maize, etc. Wheat has been under cultivation in the Indian subcontinent from pre-historic times and is an integral part of the country's economy and food security (Ramdas, Singh & Sharma, 2012). After rice, it is the second most common staple food crop in India particularly in northern and north-western parts of the country.

The wheat production in India has increased from 6.46 million ton in 1950 to 98.38 million ton in 2017 (Govt. of India, 2018). As per the second Advanced Estimate for 2018-19, a total production of wheat in the country is estimated at 99.12 million ton (Department of Agriculture Cooperation and Farmers Welfare). The country achieved rapid strides in wheat production during the last four decades resulting in self-sufficiency and surplus production. This has enabled the country to meet domestic demand from its own production and reduce dependence on wheat imports (Ramdas, Singh & Sharma, 2012).

Some bibliometric studies have been conducted on agricultural science and its related topics as well as on some agricultural institutes. Some selected among these are described here. Choudhury & Sarkhel (2011) did bibliometric analysis of agricultural research in West Bengal based on CAB abstracts. Tripathi & Garg (2014) conducted scientometric study of Indian crop science research as reflected by the coverage in Scopus, CABI and ISA databases during 2008-2010. Sagar, Kademani & Bhanumurthy (2014) did scientific mapping of agriculture research in India using Web of Science data for the period 1993-2012. Vanaja & Mudhol (2016) studied communication pattern of agriculture research literature as reflected through legume research from 2009 to 2013. Tripathi & Garg (2016) did scientometric study of cereal crop science in

India. Cabrera, Talamini & Dewes (2017) conducted co-authorship analysis in the agriculture field of literature. Aleixandre-Tudó et al (2018) did bibliometric and social network analysis in scientific research in precision agriculture. Parmar & Siwach (2018) conducted bibliometric analysis of publications of ICAR top ranked agricultural universities of India. Siwach & Parmar (2018) did bibliometric analysis of the research contributions of CCS Haryana Agricultural University, Hisar. Luo et al (2019) conducted an analysis on development trends of research topics in agricultural sciences.

## **2. OBJECTIVES OF THE STUDY**

The major objectives of the study are:

- To identify the top countries in wheat research
- To study the year-wise output of India in wheat research
- To identify the most prolific Indian authors in wheat research
- To explore the document types comprising of Indian wheat research output
- To find out the top journals preferred for publishing Indian wheat research
- To find out the top Indian institutions in wheat research
- To explore the top countries and institutions collaborating with India in wheat research
- To study the top funding agencies for Indian wheat research
- To study the citation profile and highly cited papers of Indian wheat research

## **3. METHODOLOGY**

The study is based on data extracted from Scopus which is the world's largest abstract and citation database of peer-reviewed literature containing more than 22 thousand serial titles from more than 5 thousand publishers covering research topics across all scientific and technical disciplines, ranging from medicine and social sciences to arts and humanities.

To extract correct data from a database, it is necessary to have relevant search terms. Thus, to identify the terms for searching in Scopus database, MeSH (Medical Subject Headings), the controlled vocabulary of NLM was consulted. The terms identified using MeSH were "Triticum turgidum", "Wheat", "Triticum aestivum", "Triticum vulgare", "Triticum spelta", "Durum Wheat", "Durum Wheats", "Wheat, Durum", "Triticum durum". The Scopus

database was searched using these terms in the TITLE-ABSTRACT-KEYWORD field and the results were limited to the years 1996-2015. A total of 100445 results were obtained which was the total world output on wheat research. The results were then confined to Country=India, yielding a total of 8554 publications which were then analyzed from various angles as per the objectives of the study.

## **4. ANALYSIS OF DATA**

### **4.1 Top 20 Countries in Wheat Research**

The top 20 countries involved in wheat research are shown in table 1 along with their publications, citations, h-index and average citations per paper (ACPP). A total of 100445 papers were published during 1996-2015 across the globe. These papers received a total of 2192428 citations with an average of 21.83 citations per paper and having an h-index of 318.

United States is the top country in wheat research with 17594 papers accounting for 17.52% of the total world publications on wheat research. The second most productive country is China with 14981 papers which accounts for 14.91% of the total world output. India stands at third position in wheat research with 8554 papers which constitutes 8.52% of the total world output. Australia stands at fourth position (5685 papers) and United Kingdom at fifth position (5683 papers). The 6<sup>th</sup> to 10<sup>th</sup> positions are occupied by Germany (5465 papers), Canada (5412 papers), Japan (4425 papers), France (4100 papers) and Italy (3504) respectively. At the 11<sup>th</sup> to 20<sup>th</sup> positions are the countries namely Spain, Iran, Pakistan, Brazil, Turkey, Russian Federation, Poland, Netherlands, Mexico and Hungary respectively.

Among these top 20 countries, the h-index is highest for United States (h-index= 247). This is followed by United Kingdom (h-index= 173), Germany (h-index= 161), Australia (h-index= 158) China (h-index= 141) and France (h-index= 138). India with h-index of 117 stands at the 10<sup>th</sup> position. In terms of average citations per paper (ACPP), Netherlands tops the list with ACPP of 40.27 which is followed by United Kingdom (39.2), France (33.89), United States (33.6), Australia (33.21) and Germany (32.59). India, with ACPP of 14.68, is at the 14<sup>th</sup> position.

Thus, in terms of publications, India holds the 3<sup>rd</sup> rank but it lacks behind many countries in terms of h-index and ACPP indicating that Indian papers on wheat research received lesser citations than many other countries.

**Table 1: Top 20 Countries in Wheat Research**

Rank	Country	TP					% Share in World Output	TC	ACPP	h-index
		1996-2000 (5 yr)	2001-2005 (5 yr)	2006-2010 (5 yr)	2011-2015 (5 yr)	1996-2015 (20 yr)				
1	United States	3818	4004	4487	5285	17594	17.52	591080	33.60	247
2	China	777	1791	4307	8106	14981	14.91	240242	16.04	141
3	India	1153	1612	2323	3466	8554	8.52	125578	14.68	117
4	Australia	959	1130	1558	2038	5685	5.66	188795	33.21	158
5	United Kingdom	1432	1361	1337	1553	5683	5.66	222784	39.20	173
6	Germany	1024	1168	1349	1924	5465	5.44	178091	32.59	161
7	Canada	1088	1057	1470	1797	5412	5.39	148305	27.40	130
8	Japan	947	1059	1194	1225	4425	4.41	104236	23.56	121
9	France	807	919	1073	1301	4100	4.08	138930	33.89	138
10	Italy	479	590	926	1509	3504	3.49	102060	29.13	123
11	Spain	473	552	779	1080	2884	2.87	84371	29.25	108
12	Iran	46	175	818	1497	2536	2.52	27690	10.92	64
13	Pakistan	134	196	739	1294	2363	2.35	27586	11.67	65
14	Brazil	268	332	714	1012	2326	2.32	26761	11.51	71
15	Turkey	215	382	768	862	2227	2.22	43785	19.66	87
16	Russian Federation	528	558	433	521	2040	2.03	16986	8.33	53
17	Poland	253	368	522	785	1928	1.92	27453	14.24	61
18	Netherlands	351	383	406	548	1688	1.68	67981	40.27	115
19	Mexico	200	284	484	615	1583	1.58	49852	31.49	99
20	Hungary	295	383	426	350	1454	1.45	21278	14.63	64
<b>World</b>		<b>16498</b>	<b>19136</b>	<b>27408</b>	<b>37403</b>	<b>100445</b>	<b>100</b>	<b>2192428</b>	<b>21.83</b>	<b>318</b>
<i>TP= "Total Papers", TC= "Total Citations", ACPP= "Average Citations Per Paper"</i>										

#### 4.2 Year-wise Contribution of India

The year-wise distribution of Indian research output on wheat is shown in table 2. The research output has increased from 198 in 1996 to 772 in 2015. During this time period a total of 8554 papers were published. These have been distributed as 1153 papers from 1996-2000, 1612 papers from 2001-2005, 2323 papers from 2006-2010 and 3466 papers from 2011-2015. There has been almost a gradual increase in Indian publications during the 20 year span under study.

These 8554 papers received a total of 125578 citations with an average of 14.68 citations per paper. The ACPP is highest for the year 2002 (24.57) which is followed by 2007 (23.79), 2003 (22.77), 2000 (22.34) and 2005 (20.43).

**Table 2: India's Year-wise Contribution and International Collaborative Papers**

Year	Total Papers				International Collaborative Papers			
	TP	%age	TC	ACPP	ICP	%age	TC	ACPP
1996	198	2.31	2089	10.55	17	1.43	386	22.71
1997	208	2.43	2703	13.00	27	2.27	612	22.67
1998	236	2.76	3487	14.78	23	1.93	813	35.35
1999	240	2.81	4854	20.23	31	2.60	1772	57.16
2000	271	3.17	6053	22.34	26	2.18	1042	40.08
2001	304	3.55	5324	17.51	31	2.60	801	25.84
2002	293	3.43	7198	24.57	35	2.94	2430	69.43
2003	320	3.74	7287	22.77	42	3.53	1994	47.48
2004	330	3.86	6299	19.09	53	4.45	1993	37.60
2005	365	4.27	7457	20.43	50	4.20	2418	48.36
2006	400	4.68	7655	19.14	51	4.28	1494	29.29
2007	426	4.98	10133	23.79	73	6.13	2161	29.60
2008	499	5.83	8401	16.84	72	6.05	1590	22.08
2009	464	5.42	6976	15.03	66	5.54	1906	28.88
2010	534	6.24	7991	14.96	86	7.22	2375	27.62
2011	557	6.51	7315	13.13	87	7.30	2471	28.40
2012	624	7.29	7234	11.59	108	9.07	2865	26.53
2013	672	7.86	6554	9.75	109	9.15	2744	25.17
2014	841	9.83	6254	7.44	88	7.39	2048	23.27
2015	772	9.03	4314	5.59	116	9.74	1535	13.23
<b>Total</b>	<b>8554</b>	<b>100.00</b>	<b>125578</b>	<b>14.68</b>	<b>1191</b>	<b>100.00</b>	<b>35450</b>	<b>29.76</b>
<i>TP= "Total Papers", TC= "Total Citations", ACPP= "Average Citations Per Paper", ICP= "International Collaborative Papers"</i>								

### 4.3 International Collaborations

The Indian authors collaborated with authors from other countries for wheat research. These international collaborative papers (ICPs) are indicated in table 2. During the period under study, out of the total 8554 papers, 1191 were ICPs accounting for 13.92% of the total papers. The ICPs received more citations in comparison to other Indian papers as indicated by the ACPP of 29.76 for these 1191 papers. For the ICPs the ACPP was highest for the year 2002 (69.43), followed by 1999 (57.16), 2005 (48.36), 2003 (47.48) and 2000 (40.08).

Thus, the papers on wheat research in which Indian authors had collaborations with authors from other countries were cited more.

#### 4.4 Top Collaborating Countries

The major countries collaborating with India for research on wheat are indicated in table 3. In total, India has collaborative research papers with 91 countries. The maximum ICPs are with United States (320 ICPs, 26.87%). This is followed by Australia with 139 ICPs (11.67%), Germany with 137 ICPs (11.5%), United Kingdom with 124 ICPs (10.41%) and Canada with 80 ICPs (6.72%).

In the ICPs, the ACPP is highest for papers with Italy (102.30), France (92.03), Netherlands (62.04) and Switzerland (60.71) while the h-index is maximum for United States (54) followed by Australia (41), Germany (38), United Kingdom (33), Phillipines and Mexico (32 each).

**Table 3: International Collaboration Countries**

Country	ICP	%age	TC	ACPP	h-index
United States	320	26.87	10950	34.22	54
Australia	139	11.67	6563	47.22	41
Germany	137	11.50	7165	52.30	38
United Kingdom	124	10.41	6821	55.01	33
Canada	80	6.72	3773	47.16	28
Mexico	73	6.13	3054	41.84	32
Japan	66	5.54	2937	44.50	27
Philippines	60	5.04	3491	58.18	32
Nepal	52	4.37	1547	29.75	23
Iran	50	4.20	546	10.92	14
China	48	4.03	2156	44.92	24
France	35	2.94	3221	92.03	22
Switzerland	35	2.94	2125	60.71	19
South Korea	33	2.77	556	16.85	13
Pakistan	31	2.60	813	26.23	14
Bangladesh	27	2.27	982	36.37	15
Ethiopia	26	2.18	287	11.04	9
Netherlands	24	2.02	1489	62.04	14
Saudi Arabia	22	1.85	208	9.45	7
Italy	20	1.68	2046	102.30	14
1 country with 19 papers					
2 countries with 17 papers					
1 country with 14 papers					
2 countries with 12 papers					



5 countries with 11 papers					
2 countries with 10 papers					
2 countries with 9 papers					
2 countries with 8 papers					
5 countries with 7 papers					
2 countries with 6 papers					
4 countries with 5 papers					
4 countries with 4 papers					
3 countries with 3 papers					
14 countries with 2 papers					
22 countries with 1 papers					
Total Collaborative Papers	1191*	100	35450	29.76	84
*Total differs due to multiple collaborations ICP= "International Collaborative Papers", TC= "Total Citations", ACPP= "Average Citations Per Paper"					

#### 4.5 Top Collaborating International Institutes

The top 15 international institutes collaborating with India in wheat research are listed in table 4. Among these top 15 institutes, four are from United States, two from Canada, two from Germany and one each from Australia, China, Mexico, Nepal, Philippines, Switzerland and United Kingdom. The highest numbers of ICPs are with Kansas State University (67 papers). This is followed by Centro Internacional de Mejoramiento de Maiz y Trigo, Mexico (61 papers) and International Rice Research Institute, Philippines (58 papers).

**Table 4: Top International Collaboration Institutes**

International Institute	Country	Papers
Kansas State University	United States	67
Centro Internacional de Mejoramiento de Maiz y Trigo	Mexico	61
International Rice Research Institute	Philippines	58
International Maize and Wheat Improvement Center Nepal	Nepal	35
USDA Agricultural Research Service, Washington DC	United States	34
Leibniz Institute of Plant Genetics and Crop Plant Research	Germany	28
University of Adelaide	Australia	27
Chinese Academy of Sciences	China	21
Agriculture et Agroalimentaire Canada	Canada	21
University of Saskatchewan	Canada	19
University of Zurich	Switzerland	17
Washington State University Pullman	United States	17

Universitat Gottingen	Germany	17
Rothamsted Research	United Kingdom	16
Cornell University	United States	16

#### 4.6 Most Prolific Indian Authors

The 20 most prolific Indian authors involved in wheat research are given in table 5. Among these 20 authors, five are from IARI (New Delhi), three from Indian Veterinary Research Institute (Izatnagar), two each from CFTRI (Mysore), Ch. Charan Singh University (Meerut), Directorate of Wheat Research (Karnal) and Punjab Agricultural University (Ludhiana) and one each from Banaras Hindu University (Varanasi), Eternal University Akal (Baru Sahib), G.B. Pant University of Agriculture and Technology (Pantnagar) and International Rice Research Institute (New Delhi).

In terms of total publications, H.S. Dhaliwal of Eternal University is the top author with 63 papers, followed by H. Pathak of IARI with 61 papers, A.K. Joshi of BHU with 60 papers, I. Sharma of Directorate of Wheat Research Karnal with 58 papers and P.K. Gupta of Ch. Charan Singh University Meerut with 55 papers.

The h-index is highest for H. Pathak (30) followed by A.K. Joshi (29), P.K. Gupta (28), J.K. Ladha (25) and H.S. Balyan (24). In terms of Average Citation Per Paper (ACPP), J.K. Ladha (67.18) tops the list and is followed by P.K. Gupta (61.4), H. Pathak (50.59), P. Chhuneja (46.36) and R.K. Gupta (45.9).

**Table 5: Most Prolific Indian Authors in Wheat Research**

Author	Affiliation	TP	TC	ACPP	h-index
Dhaliwal, H.S.	Eternal University Akal, School of Biotechnology, Baru Sahib, Himachal Pradesh	63	1641	26.05	21
Pathak, H.	Center for Env Sc & Climate Resilient Agriculture, Indian Agricultural Research Institute, New Delhi	61	3086	50.59	30
Joshi, A.K.	Dept. of Genetics & Plant Breeding, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi	60	1704	28.40	29
Sharma, I.	Directorate of Wheat Research, Karnal	58	387	6.67	11
Gupta, P.K.	Molecular Biology Laboratory, Dept. of Genetics & Plant Breeding, Ch. Charan Singh University, Meerut	55	3377	61.40	28
Balyan, H.S.	Molecular Biology Laboratory, Dept. of Genetics & Plant Breeding, Ch. Charan Singh University, Meerut	52	2160	41.54	24

Kumar, A.	Dept. of Molecular Biology & Genetic Engineering, G.B. Pant University of Agriculture and Technology, Pantnagar (Uttarakhand)	48	291	6.06	10
Sharma, S.K.	Division of Biochemistry, Indian Agricultural Research Institute, New Delhi	42	456	10.86	11
Gupta, R.K.	Directorate of Wheat Research, Karnal, Haryana	41	1882	45.90	23
Indrani, D.	Dept. of Flour Milling, Baking and Confectionery Technology, CSIR - CFTRI, Mysore, Karnataka	41	626	15.27	16
Singh, G.P.	Division of Genetics, ICAR-Indian Agricultural Research Institute, New Delhi	41	288	7.02	9
Dass, R.S.	Centre of Advanced Studies in Animal Nutrition, Indian Veterinary Research Institute, Izatnagar	40	419	10.48	13
Bains, N.S.	Dept. of Plant Breeding and Genetics, Punjab Agricultural University, Ludhiana, Punjab	39	364	9.33	11
Chhuneja, P.	School of Agricultural Biotechnology, Punjab Agricultural University, Ludhiana	39	1808	46.36	19
Prabhasankar, P.	Flour Milling Baking and Confectionery Technology Department, CSIR - CFTRI, Mysore	39	592	15.18	15
Ladha, J.K.	International Rice Research Institute, Pusa, New Delhi	38	2553	67.18	25
Prabhu, K.V.	Division of Genetics, Indian Agricultural Research Institute, New Delhi	38	502	13.21	12
Tomar, S.M.S.	Division of Genetics, Indian Agricultural Research Institute, New Delhi	38	181	4.76	9
Dutta, N.	Centre of Advanced Faculty Training in Animal Nutrition, ICAR, Indian Veterinary Research Institute, Izatnagar	37	214	5.78	7
Sharma, K.	Division of Animal Nutrition, Indian Veterinary Research Institute, Izatnagar	37	218	5.89	7
TP= "Total Papers", TC= "Total Citations", ACPP= "Average Citations Per Paper"					

#### 4.7 Top Journals for Publication of Indian Wheat Research

The Indian wheat research output appeared in 1384 journals and conferences. Among these, the top 20 journals preferred by authors for publishing their research are listed in table 6. Out of the total 8554 papers, 2674 papers appeared in these 20 journals accounting for 31.26% of the total publications. Among these top 20 journals, 11 are published from India, 5 from Netherlands and 1 each from Hungary, South Korea, United Kingdom and United States.

In terms of total papers, the *Indian Journal of Agricultural Sciences* published by ICAR tops the list with 521 papers. *Indian Journal of Agronomy* closely follows this with 518 papers. The *Journal of Food Science and Technology* and the *Indian Journal of Animal Sciences* have

237 and 199 papers respectively. Rest of the journals published less than 100 papers on Indian wheat research.

The 2674 papers published by the top 20 journals received a total of 25562 citations with an average of 9.56 citations per paper. There is a huge variation in the citations received by papers in different journals as indicated by the ACP values. The maximum citations per paper are received by the journals published by Elsevier and Kluwer Academic Publishers, all 5 journals being published from Netherlands. The ACP is highest for *Bioresource Technology* (54.93 citations per paper) followed by *Soil and Tillage Research* (47.29 citations per paper), *Field Crops Research* (39.48 citations per paper), *Agricultural Water Management* (33.89 citations per paper) and *Euphytica* (33.25 citations per paper). The least citations are received by *Annals of Agri Bio Research* (0.19 citations per paper) and *Annals of Biology* (0.27 citations per paper) both being published by Agri Bio Research Publishers. The top journals in terms of number of papers, i.e., *Indian Journal of Agricultural Sciences* and *Indian Journal of Agronomy* received citations with an average of 3.75 and 4.78 citations per paper respectively. Thus, it was observed that the journals published from India received less citations as compared to the journals published from other countries. The reputation of the publisher also affected the citations as the maximum citations were received by the journals published by Elsevier.

The Scimago Journal Rank (SJR) and Source Normalized Impact per Paper (SNIP) values for these top 20 journals are also provided in the table 6. The SJR value is highest for the 4 Elsevier journals being 2.029, 1.703, 1.474 and 1.272 respectively for *Bioresource Technology*, *Soil and Tillage Research*, *Field Crops Research* and *Agricultural Water Management*. The SNIP value is highest for *Field Crops Research* (1.988) followed by *Soil and Tillage Research* (1.946), *Journal of Agrometeorology* (1.88), *Agricultural Water Management* (1.814) and *Bioresource Technology* (1.799).

**Table 6: Top Journals for Publication**

Journal	Country	Publisher	TP	TC	ACPP	SJR (2017)	SNIP (2017)
Indian Journal of Agricultural Sciences	India	Indian Council of Agricultural Research	521	1955	3.75	0.302	0.541
Indian Journal of Agronomy	India	The Indian Society of Agronomy	518	2475	4.78	0.409	1.292
Journal of Food Science and Technology	India	Springer India	237	1787	7.54	0.689	1.072
Indian Journal of Animal	India	Scientific Publishers	199	506	2.54	0.242	0.465

Sciences							
Annals of Biology	India	Agri Bio Research Publishers	96	26	0.27	0.27	0.193
Current Science	India	Indian Academy of Sciences	91	1365	15.00	0.311	0.709
Bioresource Technology	Netherlands	Elsevier	90	4944	54.93	2.029	1.799
Indian Journal of Genetics and Plant Breeding	India	The Indian Society of Genetics and Plant Breeding	88	194	2.20	0.24	0.494
Annals of Agri Bio Research	India	Agri Bio Research Publishers	86	16	0.19	0.198	0.168
Field Crops Research	Netherlands	Elsevier	84	3316	39.48	1.474	1.988
Research on Crops	India	Gaurav Society of Agricultural Research Information Centre	77	42	0.55	0.152	0.176
Cereal Research Communications	Hungary	Gabonatermesztesi Kutato Kozhasznu Tarsasag/Cereal Research Non-Profit Company	73	362	4.96	0.242	0.341
Euphytica	Netherlands	Kluwer Academic Publishers/ Springer Nature	72	2394	33.25	0.742	1.013
Ecology, Environment and Conservation	India	EM International	70	24	0.34	0.111	0.186
Asian-Australasian Journal of Animal Sciences	South Korea	Asian Australasian Association of Animal Science Production	67	582	8.69	0.727	1.231
Communications in Soil Science and Plant Analysis	United States	Marcel Dekker Inc./ Taylor & Francis	67	421	6.28	0.341	0.559
Journal of Agrometeorology	India	Association of Agrometeorologists	67	144	2.15	0.295	1.88
Agricultural Water Management	Netherlands	Elsevier	61	2067	33.89	1.272	1.814
Archives of Agronomy and Soil Science	United Kingdom	Taylor & Francis	55	341	6.20	0.598	1.117
Soil and Tillage Research	Netherlands	Elsevier	55	2601	47.29	1.703	1.946
<b>Total of top 20 journals (%age)</b>			<b>2674 (31.26)</b>	<b>25562</b>	9.56	-	-
<i>TP= "Total Papers", TC= "Total Citations", ACPP= "Average Citations Per Paper", SJR= "Scimago Journal Rank", SNIP= "Source Normalized Impact Per Paper"</i>							

#### 4.8 Type of Documents

The Indian research on wheat has appeared in various document formats as indicated in table 7. Out of the total 8554 publications, 92.62% are articles, 2.84 % are reviews, 2.48% are conference papers, 1.19% are book chapters and the remaining 0.87% are in the form of notes, short surveys, letters, editorials etc. Thus, the articles accounted for the maximum number of

publications. These 7923 articles received a total of 113422 citations with an average of 14.32 citations per paper. The 243 reviews received 8193 citations having an average of 33.72 citations per paper. Thus, the reviews received more citations in comparison to the articles. The 212 conference papers received 1967 citations with an average of 9.28 while the 102 book chapters received 322 citations with an average of 3.16. The highest ACPP was for short surveys in which 14 short surveys received 1329 citations with an average of 94.93 citations per paper. Thus, the short surveys and reviews attracted more citations.

**Table 7: Document Types**

<b>Document Type</b>	<b>TP</b>	<b>%age</b>	<b>TC</b>	<b>ACPP</b>
Article	7923	92.62	113422	14.32
Review	243	2.84	8193	33.72
Conference Paper	212	2.48	1967	9.28
Book Chapter	102	1.19	322	3.16
Note	18	0.21	61	3.39
Short Survey	14	0.16	1329	94.93
Letter	13	0.15	27	2.08
Erratum	11	0.13	2	0.18
Book	9	0.11	121	13.44
Editorial	8	0.09	88	11.00
Retracted	1	0.01	46	46.00
<b>TOTAL</b>	<b>8554</b>	<b>100.00</b>	<b>125578</b>	<b>14.68</b>
<i>TP= "Total Papers", TC= "Total Citations", ACPP= "Average Citations Per Paper"</i>				

#### **4.9 Top Contributing Indian Institutions**

The top Indian institutions which have contributed 100 or more papers on wheat research are listed in table 8. The highest contributor is Indian Agricultural Research Institute (IARI) with 1021 papers. It is followed by Punjab Agricultural University with 741 papers, CCS Haryana Agricultural University with 460 papers, GB Pant University of Agriculture and Technology with 310 papers and Central Food Technological Research Institute (CFTRI) with 302 papers. Among these top institutions, the ACPP is highest for Guru Nanak Dev University (29.8), followed by University of Delhi (25.96) and Banaras Hindu University (21.52). The h-index is highest for IARI (63), followed by Panjab Agricultural University (53) and Banaras Hindu University (42).

**Table 8: Top Indian Institutions**

<b>Institution</b>	<b>TP</b>	<b>TC</b>	<b>ACPP</b>	<b>h-index</b>
Indian Agricultural Research Institute	1021	18234	17.86	63
Punjab Agricultural University	741	11178	15.09	53
CCS Haryana Agricultural University	460	5400	11.74	32
G B Pant University of Agriculture & Technology	310	2908	9.38	25
Central Food Technological Research Institute	302	4860	16.09	32
Banaras Hindu University	250	5379	21.52	42
Directorate of Wheat Research	214	2882	13.47	28
Indian Veterinary Research Institute	213	1765	8.29	21
Indian Council of Agricultural Research	187	1710	9.14	22
Indian Institute of Soil Science	144	3057	21.23	29
University of Delhi	137	3557	25.96	32
National Dairy Research Institute	122	850	6.97	16
Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishwavidyalaya	108	1236	11.44	20
Guru Nanak Dev University	107	3189	29.80	28
Indian Institute of Technology, Roorkee	103	1697	16.48	20
Central Soil Salinity Research Institute	101	1967	19.48	23
International Crops Research Institute for the Semi-Arid Tropics	100	2149	21.49	26
<i>TP= "Total Papers", TC= "Total Citations", ACPP= "Average Citations Per Paper"</i>				

#### 4.10 Top Funding Agencies

The research work is many times supported through some funding agencies. Such agencies are acknowledged or mentioned in the publications which have been produced through such funding. Table 9 lists some of the top agencies which have funded research on wheat and the number of publications which are results of such funding. 263 papers (3.04% of total) have been published which have been funded by CSIR, 215 papers have been funded by ICAR, 169 by UGC and 120 by DBT-West Bengal.

**Table 9: Top Funding Agencies**

<b>Agency</b>	<b>Papers</b>
Council of Scientific and Industrial Research (CSIR)	263
Indian Council of Agricultural Research (ICAR)	215
University Grants Commission (UGC)	169
Department of Biotechnology, Government of West Bengal (DBT-WB)	120
Indian Agricultural Research Institute (IARI)	67
Department of Science and Technology, Ministry of Science and Technology (DST)	63

Department of Biotechnology , Ministry of Science and Technology (DBT)	58
Department of Science and Technology (DOST)	56

#### 4.11 Citation Profile and Highly Cited Papers

The total 8854 Indian publications during 1996 to 2015 received a total of 125578 citations with an average of 14.68 citations per paper (see table 10). Out of these total publications, 18.54% have not cited at all while the rest 81.46% publications have been cited at least once. Almost half of the papers (48.71%) received upto ten citations. 13.55% papers received citations between 11-20, 6.78% received citations between 21-30, 3.48% received citations between 31-40, 2.36% received citations between 41-50, 4.68% received citations between 51-100 and 1.89% received more than 100 citations. Six papers even crossed the 500 citation mark.

The top 25 cited papers are shown in table 11. Among these top 25 papers, four each were published in the year 2002 and 2003, three in the year 2000, two each in 1999, 2010 and 2013 while one each in 2001, 2005, 2006, 2007, 2009, 2012, 2014 and 2015. The number of years taken by these top 25 papers to accumulate a reasonable number of citations varies. The average citation per year for these papers ranges from 13.5 to 122.4 citations per year. All these top cited papers are multi-authored papers (see table 11).

These top 25 papers appeared in 21 journals. Three papers are published in *Plant Science* while two each in *Bioresource Technology* and *Nature Climate Change*. These top 25 papers received a total of 10474 citations with an average of 419 citations per paper. Nine papers have scored above this average. The highest number of citations (1024) are received by the paper titled “Green revolution' genes encode mutant gibberellin response modulators” by J. Peng, et al published in the journal *Nature* in the year 1999.

**Table 10: Citation Profile of Papers**

No. of Citations	TP	%age
>500	6	0.07
401-500	3	0.04
301-400	5	0.06
201-300	22	0.26
101-200	126	1.47
51-100	400	4.68



41-50	202	2.36
31-40	298	3.48
21-30	580	6.78
11-20	1159	13.55
1-10	4167	48.71
Zero Citations	1586	18.54
<b>Total</b>	<b>8554</b>	<b>100.00</b>

**Table 11: Top Cited Papers**

<b>Authors</b>	<b>Year</b>	<b>Source title</b>	<b>Citations</b>	<b>No. of Years</b>	<b>Avg. Citation per Year</b>
Peng J., et al	1999	Nature (Vol. 400, Issue 6741)	1024	20	51.20
Gupta R., Beg Q., Lorenz P.	2002	Applied Microbiology and Biotechnology (Vol. 59, Issue 1)	964	17	56.71
Singh N., et al.	2003	Food Chemistry (Vol. 81, Issue 2)	774	16	48.38
Lukaszewski A.J., et al	2014	Science (Vol 345, Issue 6194)	612	5	122.40
Gupta P.K., Varshney R.K.	2000	Euphytica (Vol. 113, Issue 3)	543	19	28.58
Sairam R.K., Rao K., Srivastava G.C.	2002	Plant Science (Vol. 163, Issue 5)	513	17	30.18
Nigam P., et al	2000	Bioresource Technology (Vol. 72, Issue 3)	482	19	25.37
Asseng S., et al	2013	Nature Climate Change (Vol. 3, Issue 9)	454	6	75.67
Ladha J.K., et al	2005	Advances in Agronomy (Vol. 87)	423	14	30.21
Cavanagh C.R., et al	2013	Proceedings of the National Academy of Sciences of the United States of America (Vol. 110, Issue 20)	399	6	66.50
Binod P., et al	2010	Bioresource Technology (Vol. 101, Issue 13)	388	9	43.11
Gupta P.K., Varshney R.K., Sharma P.C., Ramesh B.	1999	Plant Breeding (Vol. 118, Issue 5)	325	20	16.25
Singh A., Sharma R.K., Agrawal M., Marshall F.M.	2010	Food and Chemical Toxicology (Vol. 48, Issue 2)	310	9	34.44
Asseng S., et al	2015	Nature Climate Change (Vol. 5, Issue 2)	303	4	75.75
Gupta V.K., Jain R., Varshney S.	2007	Journal of Hazardous Materials (Vol. 142)	299	12	24.92
Sairam R.K., Srivastava G.C	2002	Plant Science (Vol. 162, Issue 6)	292	17	17.18
Patra M., Sharma A.	2000	Botanical Review (Vol. 66, Issue 3)	291	19	15.32

Gupta P.K., et al	2003	Molecular Genetics and Genomics (Vol. 270, Issue 4)	290	16	18.13
Gupta P.K., et al	2002	Theoretical and Applied Genetics (Vol. 105)	276	17	16.24
Sukumaran R.K., Singhania R.R., Mathew G.M., Pandey A.	2009	Renewable Energy (Vol. 34, Issue 2)	266	10	26.60
Chandra R., Takeuchi H., Hasegawa T.	2012	Renewable and Sustainable Energy Reviews (Vol. 16, Issue 3)	259	7	37.00
Singh B., Usha K.	2003	Plant Growth Regulation (Vol. 39, Issue 2)	256	16	16.00
Almeselmani M., et al	2006	Plant Science (Vol. 171, Issue 3)	246	13	18.92
Nigam J.N.	2001	Journal of Biotechnology (Vol. 87, Issue 1)	243	18	13.50
Ladha J.K., et al	2003	Field Crops Research (Vol. 81)	242	16	15.13

## 5. SUMMARY AND CONCLUSION

During the 20 year time period from 1996-2015 a total of 100445 papers were published on wheat research which received 2192428 citations with an average of 21.83 citations. United States is the topmost country in terms of number of papers, followed by China at the second place. India, with 8554 papers, stands at the third position accounting for 8.52% of the global research output on wheat. The Indian research output increased from 198 in 1996 to 772 in 2015 with almost a gradual increase each year. The 8554 Indian paper received 125578 citations with an average of 14.68 citations per paper. This average is lesser than that of many other top countries indicating that the Indian papers are receiving fewer citations than papers from many other countries.

Out of the total 8554 papers published by India, 1191 were published having international collaborations. These international collaborative papers, with an average of 29.76 citations per paper, received more citations in comparison to the other papers. India collaborated with 91 countries in publishing wheat research and the top collaborations were with United States, Australia, Germany and United Kingdom. Kansas State University of United States had the maximum collaborative papers.

Among the total publications, 92.62% were articles, 2.84% reviews, 2.48% conference papers, 1.19% book chapters and 0.87% notes, short surveys, letters, editorials, etc. The reviews and short surveys received more citations in comparison to the articles.

The most prolific Indian authors in wheat research came from IARI (New Delhi), IVRI (Izatnagar), CFTRI (Mysore), CCS University (Meerut), Directorate of Wheat Research (Karnal) and Punjab Agricultural University (Ludhiana). H.S. Dhaliwal of Eternal University is the top author with 63 papers and is closely followed by H. Pathak of IARI with 61 papers. The ACPP is the highest for J.K. Ladha (67.18) and the h-index is highest for H.Pathak (30).

The Indian publications on wheat research appeared in 1384 sources including journals and conferences. The top journals publishing the papers are *Indian Journal of Agricultural Sciences* (521 papers) and *Indian Journal of Agronomy* (518 papers). The papers published in the Elsevier and Kluwer Academic Publishers received the highest average citations while the papers published in Indian journals received relatively lesser number of citations. This hints to the fact that Indian authors should focus on publishing their research in journals of reputed publishers as this increases their visibility and value. *Bioresource Technology*, *Soil and Tillage Research*, *Field Crops Research*, *Agricultural Water Management* and *Euphytica* were the top journals in terms of receiving citations and Scimago Journal Ranking.

Among the various Indian institutions engaged in wheat research, IARI with 1021 papers is the top contributor, followed by Punjab Agricultural University with 741 papers. The ACPP is highest for GNDU (Amritsar) and the h-index is highest for IARI. Many agencies have funded wheat research among which the topmost are CSIR, ICAR and UGC.

Out of the total publications, 81.46% were cited by other while the remaining 18.54% were not cited at all. Almost half of the papers received upto ten citations. 162 papers (1.89%) received more than 100 citations. The paper by J. Peng et al titled “‘Green revolution’ genes encode mutant gibberellin response modulators” published in *Nature* in year 1999 is the top cited paper with 1024 citations.

Thus, it was observed through the study that Indian contribution in wheat research is substantial in terms of numbers being the third highest in world, but better attention is required towards quality publications which can contribute towards the scholarly literature on wheat research. Collaborative research producing better output and increasing research funding is the need of the hour.

## REFERENCES

- Aleixandre-Tudó, J.L. et al (2018). Bibliometric and social network analysis in scientific research in precision agriculture. *Current Science*, 115 (9), 1653-1667.
- Cabrera, L., Talamini, E. & Dewes, H (2017). What about scientific collaboration in agriculture? A bibliometric study of publications about wheat and potato (1996-2016). *Brazilian Journal of Information Studies: Research Trends*, 11 (3), 17-25.
- Choudhury, N.R. & Sarkhel, J.K. (2011). Mapping agricultural research in West Bengal- 1993-2007: A bibliometric study. *COLLNET Journal of Scientometrics and Information Management*, 5 (1).
- Department of Agriculture Cooperation and Farmers Welfare. *Second advanced estimates 2018-19*. Retrieved from [http://agricoop.gov.in/sites/default/files/2ndADVEST201819\\_E.pdf](http://agricoop.gov.in/sites/default/files/2ndADVEST201819_E.pdf)
- Govt. of India (2018). *Agricultural statistics at a glance 2017*. New Delhi: Govt. of India, Ministry of Agriculture and Farmers Welfare.
- Luo, C. et al (2019). Analysis on development trends of research topics in agricultural sciences. In Xhafa, Fatos et al. (eds.) *Advances in Intelligent, Interactive Systems and Applications: Proceedings of the 3<sup>rd</sup> International Conference on Intelligent, Interactive Systems and Applications (IISA2018)* (pp. 1104-1112). Switzerland: Springer. doi:10.1007/978-3-030-02804-6\_142
- Parmar, S. & Siwach, A.K. (2018). Bibliometric analysis of publications of ICAR top ranked agricultural universities of India: An Indian Citation Index (ICI) based study. *2018 5th International Symposium on Emerging Trends and Technologies in Libraries and Information Services (ETTLIS)*. doi:10.1109/ettlis.2018.8485200
- Ramdas, S., Singh, R. & Sharma, I. (2012). Exploring the performance of wheat production in India. *Journal of Wheat Research*, 4 (2), 37-44.
- Sagar, A., Kademani, B.S. & Bhanumurthy, K. (2014). Agriculture research in India: A scientometric mapping of publications. *DESIDOC Journal of Library and Information Technology*, 34(3), 206-222.
- Scopus. Retrieved from <https://www.elsevier.com/solutions/scopus>

- Siwach, A.K. & Parmar, S. (2018). Research contributions of CCS Haryana Agricultural University, Hisar: A bibliometric analysis. *DESIDOC Journal of Library and Information Technology*, 38(5), 334-341.
- Tripathi, H.K. & Garg, K.C. (2014). Scientometrics of Indian crop science research as reflected by the coverage in Scopus, CABI and ISA databases during 2008-2010. *Annals of Library and Information Studies*, 61 (2), 41-48.
- Tripathi, H.K. & Garg, K.C. (2016). Scientometrics of cereal crop science research in India as seen through Scopus database during 1965-2010. *Annals of Library and Information Studies*, 63 (3), 222-231.
- Vanaja & Mudhol, M.V. (2016). Communication pattern of agriculture research literature as reflected through 'legume research' 2009-2013: A bibliometric study. *Gyankosh- The Journal of Library and Information Management*, 7 (1), 40-45.