



Scientometric analysis of research publications of Organic Farming in the Global Scenario

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Abstract: This paper depicts the organic farming research performance during from 1989-2021, totally 22963 records were retrieved and downloaded during the study period. In this study highlight research publications shows an increasing trend and received 578036 citations in this study period. The study evaluates the growth of publications, citations, annual growth rate, compound annual growth rate, average citations per publication and H- index of top scientists/researchers, research organizations, funding agencies and countries in the organic farming during study period as per web of science database. The data was coded and tabulated with the help of various Scientometric techniques.

Key Words: Organic farming, AGR, scientometrics.

1. INTRODUCTION :

The long-term implementation of the Green Revolution trend in agriculture has begun to have an impact on agricultural production and productivity. The growing population necessitates a higher pace of food production that is both nutritious and does not disrupt the ecosystem's balance. Farmers, scientists, and extension people have faced numerous hurdles in boosting food production while maintaining sustainability as a result of this dilemma. Organic farming has been chosen by scientists, farmers, and the government to address these issues. Organic agricultural education and awareness are desperately needed among both producers and non-producers. Because supply can be made depending on market demands for organic food, benefiting farmers, consumers, and the environment as a whole. Organic farming is one of the methods for achieving the goals of sustainable agriculture. Many organic farming techniques, such as intercropping, mulching, and crop-livestock integration, are not new to diverse agriculture systems, including traditional agriculture in nations like India. Organic farming, on the other hand, is based on a variety of laws and certification programmes that limit the use of practically all synthetic inputs and recognize soil health as a fundamental element of the system. The negative impacts of current agricultural practices have been thoroughly documented all over the world, not only on the farm but also on the health of all living beings and consequently on the ecosystem. People have been encouraged to think aloud by the use of technology, notably in terms of the use of chemical fertilizers and pesticides everywhere around us. Soil erosion, water scarcity, salination, soil contamination, genetic erosion, and other detrimental consequences on the environment are all examples.

The use of scientometric techniques to measure research performance is a useful way for identifying and evaluating the strengths and weaknesses in scientific achievements. Over the last few years, the development of new scientific and technical knowledge/information has accelerated. As scientists, scholars, and library professionals struggle to stay up with new breakthroughs in their fields, the growth of literature has become a key issue for them, and information professionals endeavor to organize this knowledge. The managers of scientific activities in government industry and academia are very concerned about how the growth, origin, and language of literature reflect in various national level activities in R & D. The present study aims to analyzing the research output of researchers in the field of organic farming. The growth rate of research output in terms of productivity is analyzed from 1989-2021. The scientific production in the field of organic farming is investigated to determine the pattern of research contribution. The



performance of research in each area is examined in order to determine the most promising research areas in a certain field. Furthermore, an attempt is made to measure the performance of researchers and scientists in the field of biochemistry and molecular biology, and it is also analytical in character in terms of enhancing the empirical validity through the use of appropriate statistical methods.

2. Objectives of the study

- ❖ To determine the year-wise growth of publications and citations.
- ❖ To determine the Annual growth rate & CAGR.
- ❖ To analyze the document type-wise distribution of publications.
- ❖ To identify the highly productive scientists and citations.
- ❖ To identify the top organizations wise publications and citations.
- ❖ To know the top funding agency-wise publications and citations.
- ❖ To find out the top most source of publications.
- ❖ To know the top country-wise publications and citations.
- ❖ To assess the top research areas.
- ❖ To analysis the highly cited articles.

3. Methodology :

We retrieved articles from Web of Science© Core Collection Database by entering keywords “organic farming. This study considered the published literature data during 01 January 1989 to 31 December, 2021 for this analysis which were indexed in WoS. A total of 22963 papers were extracted, the data downloaded and analyzed using MS office-Excel as per objectives of the present study. In this research paper cover the different science mapping tools such as year wise growth in global level, document types, top ten authors, preferred sources, distribution of articles among research areas, institution, wise productivity, international collaboration and highly cited papers were analyzed displayed in tables and scientographs by using VOSviewer data visualization.

4. Data analyses & Interpretation :

Year-wise distribution of publications

The world publication research output on organic farming is published 22963 papers and received 578036 citations during the period of 1989-2021. According to the WoS database the first research outcome on organic farming was indexed in the year 1989. Hence over period of 33 years every year total number of publication is in increased order. The highest number of citations are recorded in the year 2012 i.e. 33592 citations, followed by 32173 citations in the year 2009 and 31840 citations in the year 2010. In the form of ACPP wise in the year 2002 was recorded 60.94 average citation per paper followed by in the year 2004 was 58.77 average citation per paper and least is 1.62 average citation per paper in the year 2021.

Table- 1 Year-wise distribution of publications in Organic Farming

Year	TP	TC	ACPP
1989	10	68	6.80
1990	23	551	23.96
1991	64	1557	24.33
1992	96	2785	29.01
1993	112	2961	26.44
1994	139	4656	33.50
1995	153	5368	35.08
1996	155	5847	37.72
1997	199	8368	42.05
1998	204	8927	43.76
1999	232	11808	50.90
2000	277	15151	54.70
2001	328	17995	54.86
2002	349	21267	60.94
2003	375	18455	49.21
2004	431	25329	58.77



2005	484	26241	54.22
2006	539	25390	47.11
2007	695	26926	38.74
2008	795	28589	35.96
2009	842	32173	38.21
2010	863	31840	36.89
2011	969	30021	30.98
2012	1019	33592	32.97
2013	1100	26992	24.54
2014	1035	27071	26.16
2015	1243	29761	23.94
2016	1288	25713	19.96
2017	1429	26533	18.57
2018	1522	23317	15.32
2019	1682	17068	10.15
2020	2057	12073	5.87
2021	2254	3643	1.62
Total	22963	578036	

(TP: Total Publications; TC=Total Citations; ACP: Average Citation per Publication)

Annual Growth Rate (AGR) of publications

The Annual Growth Rate (AGR) is calculated on the formula given by Gracio et al. (2013). AGR is a simple and standard for measuring the growth in a particular year using only two parameters, i.e. First Value and End Value. According to Choi et al. (2011), the Growth rate is measured with the Compound Annual Growth Rate (CAGR). The top most AGR, i.e 178.3 was recorded for 1991 followed by 130 in 1990 and 50 in 1992. While the minimum AGR was recorded, i.e. -5.91 in 2014. The Compound Annual Growth Rate (CAGR) for the total period has appeared at 0.26.

Table 2: Annual Growth Rate (AGR) of publications

Year	TP	AGR
1989	10	0
1990	23	130
1991	64	178.3
1992	96	50
1993	112	16.67
1994	139	24.11
1995	153	10.07
1996	155	1.31
1997	199	28.39
1998	204	2.51
1999	232	13.73
2000	277	19.40
2001	328	18.41
2002	349	6.40
2003	375	7.45
2004	431	14.93
2005	484	12.30
2006	539	11.36
2007	695	28.94
2008	795	14.39
2009	842	5.91
2010	863	2.49
2011	969	12.28
2012	1019	5.16



2013	1100	7.95
2014	1035	-5.91
2015	1243	20.10
2016	1288	3.62
2017	1429	10.95
2018	1522	6.51
2019	1682	10.51
2020	2057	22.29
2021	2254	9.58
	CAGR	0.26

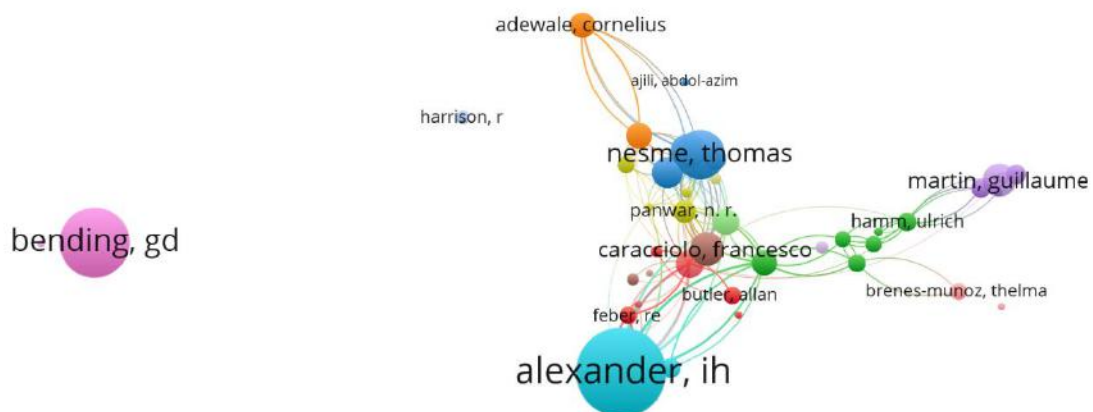
Top ten productive authors in the organic farming research

Distribution of top most productive authors show in this table 3. The research productivity among authors varied from 60 to 143 publications. Finding revealed that out of ten authors, a total number of 143 publications and received 12569 citations were published by Lal, R. they affiliated to Ohio State University, followed by Liu, Guobin was published 85 papers and received 2240 citations, Mader P was published 81 papers and received 6871 citations. This table is also concentrating other scientometric indicators like ACP and H-index.

Table- 3 Top ten productive authors in the organic farming research

Authors	Affiliations	TP	TC	ACP	H-Index
Lal, R.	Ohio State University	143	12569	87.9	51
Liu, Guobin	Shanghai University of Traditional Chinese Medicine	85	2240	26.4	21
Mader P	Forsch Inst Biol Landbau	81	6871	84.8	38
Shao, Ming'an	Northwest A&F University	77	2692	35.0	29
Wang, J	Sun Yat Sen University	76	1105	14.5	15
Liu, Yinong	Shanxi University	74	1073	14.5	16
Wei, Xiaorong	South China University of Technology	70	1699	24.3	20
Leifert, C	Southern Cross University	66	2319	35.1	25
Olesen, Jorgen E.	Aarhus University	61	3345	54.8	32
Shangguan, Zhou-ping	Chinese Academy of Sciences	60	2294	38.2	26

(TP: Total Publications; TC=Total Citations; ACP: Average Citation per Publication)





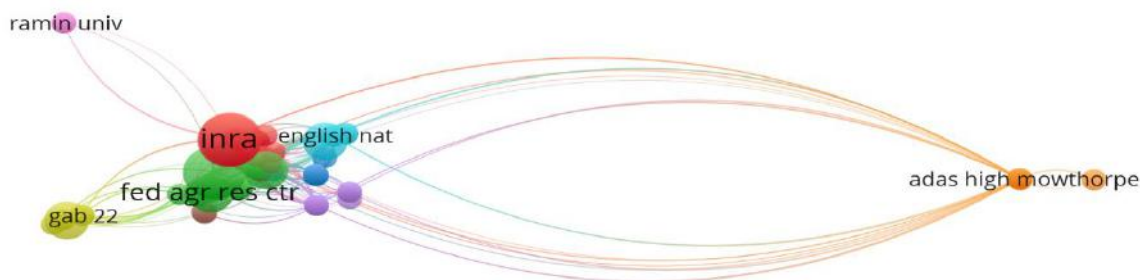
Top ten most prolific institutions in the organic farming research

This table 4 focus on the top 10 highly productive institutions that have contributed total 6667 publications on organic farming during the study period. Among these top 10 global institutions Chinese Academy of Sciences from China has contributed 1190 papers and received 28371 citations, also recorded 23.84 average citation per paper, followed by Northwest A&F University from China has contributed 807 papers , its received 19049 citations & also recorded 23.60 average citation per paper and Wageningen University & Research from Netherlands has contributed 807 papers , it’s received 19049 citations & also recorded 23.60 average citation per paper. Out of the top ten highly contributed institutions, three institutions are based in China, two fro USA followed by alone institutions countries are India, France, Denmark, Sweden and Netherland.

Table- 4 Top ten most prolific institutions in the organic farming research

Institutions	Countries	TP	TC	ACPP	H-Index
Chinese Academy of Sciences	China	1190	28371	23.84	74
Northwest A&F University - China	China	807	19049	23.60	67
Wageningen University & Research	Netherlands	757	33042	43.65	89
United States Department of Agriculture (USDA)	USA	704	28058	39.86	85
INRAE	France	663	19986	30.14	71
Institute of Soil & Water Conservation (ISWC), CAS	China	645	15471	23.99	61
Indian Council of Agricultural Research (ICAR)	India	531	8335	15.70	45
Aarhus University	Denmark	519	16775	32.32	61
Swedish University of Agricultural Sciences	Sweden	445	17003	38.21	62
University of California System	USA	406	26056	64.18	78

(TP: Total Publications; TC=Total Citations; ACPP: Average Citation per Publication)



Top ten most preferred journals in the organic farming research

Table 5 present that selected top most productive journals are listed. The maximum number 692 papers were published by “Agriculture Ecosystems & Environment” and received 33554 citations then “Science of the total Environment” published 420 papers and received 10739 citations and so on. As per the highest ACPP, Agriculture Ecosystems & Environment was recorded 48.39, followed by Soil & Tillage Research was recorded 42.94, Geoderma was recorded 39.38 and so on.

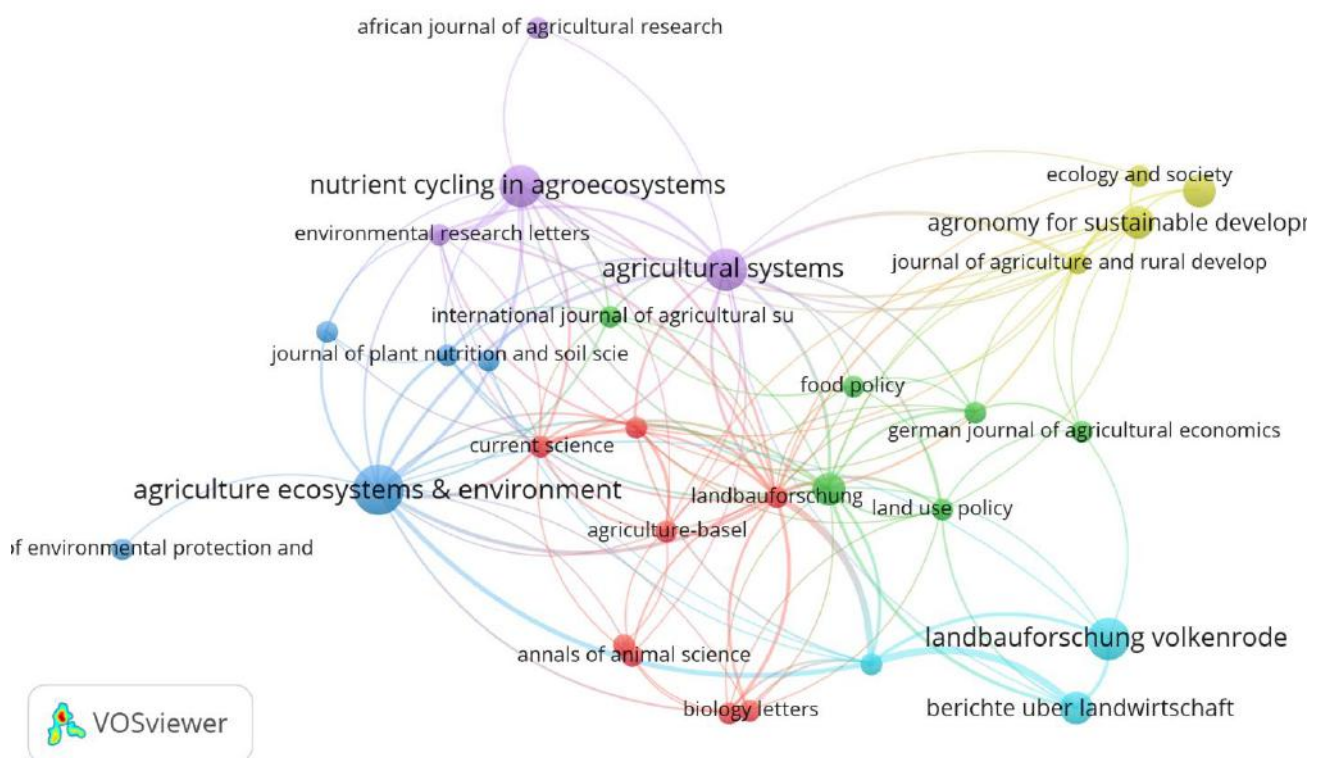
Table 5: Top ten most preferred journals in the organic farming research

Source Title	TP	TC	ACPP	H-Index
Agriculture Ecosystems & Environment	692	33554	48.49	91



Science Of The Total Environment	420	10739	25.57	50
Sustainability	395	3571	9.04	27
Soil & Tillage Research	338	14514	42.94	63
Geoderma	299	11774	39.38	56
Agronomy-Basel	269	1352	5.03	15
Aquaculture	253	9828	38.85	58
Journal Of Cleaner Production	241	6189	25.68	43
Communications In Soil Science And Plant Analysis	220	1942	8.83	21
Nutrient Cycling In Agroecosystems	218	7588	34.81	42

(TP: Total Publications; TC=Total Citations; ACP: Average Citation per Publication)



Top ten most preferred funding agencies in the organic farming research

In table 6 analysis the top most funding agencies on organic farming. Among these agencies National Natural Science Foundation of China has published 1526 papers (received 30772 citations), followed by European Commission has published 967 papers (received 25361 citations), United States Department of Agriculture has published 401bpapers (received 8865 citations) and Chinese Academy of Sciences has published 347 papers (received 9464 citations). As per the highest ACP, i.e National Science Foundation has recorded 45.96, UK Research & Innovation has recorded 39.73, Spanish Government has recorded 30.21 and European Commission has recorded 26.22 and so on.

Table 6: Top ten most preferred funding agencies in the organic farming research

Funding Agencies	Countries	TP	TC		H-Index
National Natural Science Foundation of China (NSFC)	China	1526	30772	20.17	73
European Commission		967	25351	26.22	71
United States Department of Agriculture (USDA)	USA	401	8865	22.11	46
Chinese Academy of Sciences	China	347	9464	27.27	56
UK Research & Innovation (UKRI)	England	335	13309	39.73	62



Conselho Nacional de Desenvolvimento Cientifico e Tecnologico (CNPQ)	Brazil	305	4102	13.45	32
Spanish Government	Spain	253	7643	30.21	45
National Key Research and Development Program of China	China	230	2555	11.11	26
Coordenacao de Aperfeicoamento de Pessoal de Nivel Superior (CAPES)	Brazil	224	2618	11.69	26
National Science Foundation (NSF)	USA	181	8319	45.96	43

(TP: Total Publications; TC=Total Citations; ACP: Average Citation per Publication)

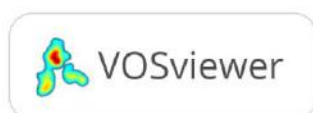
Top 10 most productive countries in organic farming

Table 7 describe the collaboration patterns with different countries in the world. The study find out 17801 research papers from top ten countries. Among these countries output wise USA is the placed 1st rank as compare with other countries i.e 4123 papers (23.16%) and also same as cumulative share, followed by Peoples Republic of China published 2793 papers (15.69%) and cumulative output 6916 papers with 38.15% share, Germany published 2076 papers (11.66%) and cumulative output 8992 papers with 50.51% share and so on.

Table:- 7 Top 10 most productive countries in organic farming

Countries	TP	%	Cum	Cum%
USA	4123	23.16	4123	23.16
Peoples Republic of China	2793	15.69	6916	38.85
Germany	2076	11.66	8992	50.51
Italy	1612	9.06	10604	59.57
India	1266	7.11	11870	66.68
England	1237	6.95	13107	73.63
Spain	1228	6.90	14335	80.53
France	1214	6.82	15549	87.35
Australia	1134	6.37	16683	93.72
Netherlands	1118	6.28	17801	100
Total	17801	100		

(TP: Total Publications; Cum= Cumulative)





Distribution of top most communication channels in organic farming

Table 8 depicts the Communication channel of Organic farming in the different forms like Article, review articles, proceedings papers, early access and many more forms. Out of these Articles is the highest i.e 21587 (88.56%) research papers were published, perused by review articles published 1300 papers (5.33%), proceeding papers published 873 papers (3.58%), early access published 190 papers (0.78%), editorial materials published 111 papers (0.46%), meeting abstract published 105 papers (0.43%), book review published 59 (0.32%) papers, letters published 45 papers (0.18%) and news items published 28 papers (0.11%)

Table:- 8 Distribution of top most communication channels in organic farming

Communication Channel	Records	%
Articles	21587	88.56
Review Articles	1300	5.33
Proceedings Papers	873	3.58
Early Access	190	0.78
Editorial Materials	111	0.46
Meeting Abstracts	105	0.43
Book Reviews	77	0.32
Book Chapters	59	0.24
Letters	45	0.18
News Items	28	0.11
Total	24375	100

Top Most Research Areas in organic farming

Based on the analysis of the table 9 show that research area wise published 17105 papers in organic farming during the study period and also same as cumulative share, followed by Plant science published 1767 (10.33%) papers and cumulative output 8275 (48.38%) papers, Science Technology Other Topics published 1704 (9.96%) papers and cumulative output 9979 (58.34%) papers, Food Science Technology published 1476 (8.63%) papers and cumulative output 11455 (66.97%) papers, Engineering published 1142 (6.68%) papers and cumulative output 12597 (73.65%) papers, Chemistry published 1116(6.52%) papers and cumulative output 13713 (80.17%) papers, Marine Freshwater Biology published 1015(5.93%) papers and cumulative output 14728 (86.10%) papers, Veterinary Sciences published 863 (5.05%) papers and cumulative output 15591 (91.15%) papers, Water Resources published 781(4.57%) papers and cumulative output 16372 (95.71%) papers and Fisheries published 733 (4.29%) papers and cumulative output 17105 (100%) papers.

Table:- 9 Top Most Research Areas in organic farming

Research areas	TP	%	Cum	Cum%
Environmental Sciences Ecology	6508	38.05	6508	38.05
Plant Sciences	1767	10.33	8275	48.38
Science Technology Other Topics	1704	9.96	9979	58.34
Food Science Technology	1476	8.63	11455	66.97
Engineering	1142	6.68	12597	73.65
Chemistry	1116	6.52	13713	80.17
Marine Freshwater Biology	1015	5.93	14728	86.10
Veterinary Sciences	863	5.05	15591	91.15
Water Resources	781	4.57	16372	95.71
Fisheries	733	4.29	17105	100
Total	17105	100		

(TP: Total Publications; Cum= Cumulative)



Top ten most influential articles in the organic farming

Table 10 shows that the top most cited article in the organic farming during the study timeline which are also indexed in WoS. The highest number of cited research paper “Does organic farming benefit biodiversity?” was received 899 citations by Hole, DG et.al, followed by “Arbuscular mycorrhizal fungi and organic farming” was received 444 citations by Gosling, P et.al, “Benefits of organic farming to biodiversity vary among taxa” was received 222 citations by Fuller, RJ et.al, “Managing soil organic matter - implications for soil structure on organic farms” was received 122 citations by Shepherd, M.A, Harrison, R & Webb, J, “Technical efficiency of alternative farming systems: the case of Greek organic and conventional olive-growing farms” was received 95 citations by Tzouvelekas, V., Pantzios, C.J & Fotopoulos, C, “The contribution of organic farming to rural development: An exploration of the socio-economic linkages of organic and non-organic farms in England” was received 78 citations by Lobley, M, Butler, A & Reed, M, “Can organic farming help to reduce N-losses? Experiences from Denmark” was received 55 citations by Dalgaard, T, Halberg, N & Kristensen, I.S, “How sustainable is organic farming?” was received 49 citations by Leifeld, J, “Biodiversity and Organic farming: What do we know?” was received 46 citations by Rahmann, G and “Modelling farm-level economic potential for conversion to organic farming” was received 43 citations by Kerselaers, E et.al.

Table-10 Top ten most influential articles in the organic farming

Title	TC	Authors	Publisher
Does organic farming benefit biodiversity?	899	Hole, DG et.al	2005, ELSEVIER SCI LTD, 122.Vol 1 pp.113-130
Arbuscular mycorrhizal fungi and organic farming	444	Gosling, P et.al	2006, ELSEVIER 113 pp.17-35
Benefits of organic farming to biodiversity vary among taxa	222	Fuller, RJ et.al	2005, ROYAL SOC 1. pp.431-434
Managing soil organic matter - implications for soil structure on organic farms	122	Shepherd, M.A, Harrison, R & Webb, J	2002, C A B I PUBLISHING 18 pp.284-892
Technical efficiency of alternative farming systems: the case of Greek organic and conventional olive-growing farms	95	Tzouvelekas, V., Pantzios, C.J & Fotopoulos, C	2001, ELSEVIER SCI LTD 26 pp.549-569
The contribution of organic farming to rural development: An exploration of the socio-economic linkages of organic and non-organic farms in England	78	Lobley, M, Butler, A & Reed, M	2009, ELSEVIER SCI LTD 26 pp.723-735
Can organic farming help to reduce N-losses? Experiences from Denmark	55	Dalgaard, T, Halberg, N & Kristensen, I.S	1998, SPRINGER 52 pp.277-287
How sustainable is organic farming?	49	Leifeld, J	2012, ELSEVIER SCIENCE BV 150 pp.121-122
Biodiversity and Organic farming: What do we know?	46	Rahmann, G	2006, JOHANN HEINRICH VON THUNEN INST-VTI 61 pp.189-208
Modelling farm-level economic potential for conversion to organic farming	43	Kerselaers, E et.al	2007, ELSEVIER SCI LTD 94 pp.671-682

5. Discussion and Conclusion :

The present paper analysis publication pattern in organic farming research has continuously increased during 1989-2021 and the study has shown that a total number of 22963 research papers and received 578036 citations. This study observed and analyzed following bibliographical tools, i.e as per annual growth rate concerned in the year 1991 is recorded 178.3 and overall CAGR is 0.26. In the selected top ten authors wise Lal, R. was published 143 articles and others details are listed in the table, as per institution wise Chinese Academy of Sciences from China has contributed 1190 papers and received 28371 citations and others details are listed in the table, among the source title wise Agriculture Ecosystems & Environment” is the top most tile in table, in the funding agency pattern National Natural Science



Foundation of China has published 1526 papers (received 30772 citations) is the top most one, in the international collaboration USA is the highest productive country among the other countries, in observation of the study in the communication channel wise almost research papers are published in articles type of channel, Environmental Sciences Ecology is the top most research area in the organic farming i.e 6508 (38.05%) papers are published and finally highest number of cited research paper is “Does organic farming benefit biodiversity?” was received 899 citations by Hole, DG et.al.

Organic farming produces food that is more nutritious and safe. Organic food is becoming increasingly popular as consumers seek for meals that are perceived to be healthier and safer. As a result, organic food may ensure food safety from farm to fork. Organic farming is more environmentally friendly than conventional farming. Organic farming promotes consumer health by keeping soil healthy and maintaining environmental integrity. Furthermore, the organic produce market is now the world's fastest expanding market, including in India. Organic agriculture enhances a nation's consumer health, its ecological health, and its economic growth by generating income in a holistic manner.

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