RESEARCH PAPER | Library Science | Volume : 3 | Issue : 1 | January 2013 | ISSN - 2249-555X

Mapping of Global Horticulture Research Output: A Scintometrics Analysis

KEYWORDS: Horticulture, Scientometrics, Exponential Growth, Authorship Pattern, Highly-cited papers

P. Ashok Kumar
Research Scholar, Department of Library and Information Science Bharathidasan University Tiruchirappalli – 620 024

Dr. R. Balasubramani
Assistant Professor, Department of Library and Information Science Bharathidasan University Tiruchirappalli – 620 024.

Santosh A Navalur
Research Scholar, Department of Library and Information Science Bharathidasan University Tiruchirappalli – 620 024.

ABSTRACT *With the augmenting importance of Horticulture various research initiations taken place and they involved in interesting research in the field of Horticulture and allied areas across the world. This study analyze the global research output in the field of Horticulture during the period 1999-2012 and the analyses included year wise growth, Exponential growth rate, author wise contribution, share of top scholarly journals, share of international collaborative papers and major collaborative partner countries, global publications' share, and patterns of research communication in most productive journals. It also analyses the characteristics of most productive institutions, authors and high-cited papers. Web of science Citation database was used for retrieving the publications' output in Horticulture during 1999-2012, where totally 1783 publications found. After analyses we found that there is need to promote research in developing and underdeveloped nations as the research in Horticulture concentrated more in developed world.*

Introduction
Horticulture is an important area of economy in every nation. Horticulture is the base for food basket of every nation and also contribution of horticulture to total agriculture's share to nation's economy is very significant particularly in the nations like India where majority of people still depended on agriculture and allied activities for their livelihood. Realizing the importance of horticulture and the need for research and development support for its further growth many specialized organizations like universities, research centres and other institutions established in every nation and they involved in research and developmental activities to further enhance the horticulture production. Increasing growth and importance of research in Horticulture created enthusiasm to measure its growth and research trends quantitatively for which we took this study and analyzed the research output reflected in the web of science database within the period 1999-2012.

Objective
This study to analyze the global research output in the field of Horticulture during the period 01.01.1999 to 31.10.2012 and the analyses included year wise growth, Exponential growth rate, author wise contribution, share of top scholarly journals, share of international collaborative papers and major collaborative partner countries, global publications' share, and patterns of research communication in most productive journals. It also analyses the characteristics of most productive institutions, authors and high-cited papers.

Methodology
Data was collected from the Web of Science (WoS). The WoS is the search platform provided by Thomson Reuters (the former Thomson Scientific emerged from the Institute for Scientific Information (ISI) in Philadelphia). SCI database is one of the very comprehensive databases covering all aspects of science. The study period (01.01.1999 to 31.10.2012) is selected as the database is available in machine from since 1982. The search string "Horticulture" in the "Basic search" field of for the years 1999-2012 to download the records on the subjects 'E-learning'. A total of 1783 records were downloaded and analyzed by using the web of science website application as per the objectives of the study.

Analysis and Discussion
Table: 1 Global Publications Output Publications Share and Rank of Top 10 Most Productive Countries in Horticulture

S.No	Country	No of Papers			% share of Papers			Rank		
		1999- 2012	1999	2012	1999-2012	1999	2012	1999-2012	1999	2012
1	USA	483	5	29	27.03	2.13	20.42	1	4	1
2	Unknown	161	10	5	9.00	21.28	3.52	2	1	6
3	UK	142	7	7	7.95	14.89	4.93	3	2	5
4	Australia	120	6	10	6.72	12.77	7.04	4	3	2
5	India	118	2	10	6.60	4.26	7.04	5	6	2
6	Germany	79	4	8	4.42	8.51	5.63	6	5	4
7	Spain	75	-	9	4.20	0	6.34	7	-	3
8	Canada	68	1	4	3.81	2.13	2.82	8	7	7
9	Peoples R China	68	1	8	3.81	2.13	5.63	8	7	4
10	Netherlands	67	2	4	3.75	4.26	2.82	9	6	7
	World	1783	47	142						

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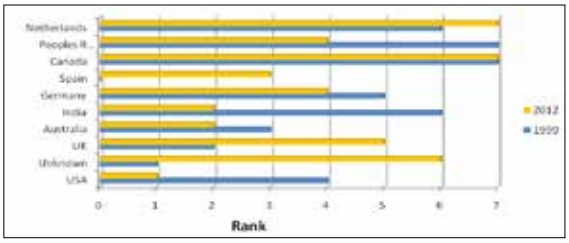

The global publication shares of the top 10 most productive countries in Horticulture research during 1999-2012 varied between 67 and 483 records. United States of America (USA) topped the list, with global publication (1783) share of 483 records during 1999-2012. UK ranked 2nd with the contribution of 142 records if we ignore unknown, followed by, Australia, India, Germany, Spain, Peoples R China and Netherlands. Here the concern is that the research is concentrated in developed world and it need to promote in developing world including India and under developed world.

Table: 2 Yearly Output And Exponential Growth Rate of the Horticulture Research Output in India

	Comprehensive Level				National Level		
S.No	Year	No of Records	Exponential Growth Rate	S.No	Year	No of Records	Exponential Growth Rate
1	1999	47	-	1	1999	2	-
2	2000	62	1.32	2	2000	3	1.5
3	2001	79	1.27	3	2001	5	1.67
4	2002	66	0.84	4	2002	4	0.8
5	2003	87	1.32	5	2003	-	0
6	2004	77	0.89	6	2004	3	0
7	2005	104	1.35	7	2005	3	1.0
8	2006	117	1.13	8	2006	4	1.33
9	2007	144	1.23	9	2007	16	4
10	2008	204	1.42	10	2008	18	1.13
11	2009	201	0.99	11	2009	15	0.83
12	2010	218	1.08	12	2010	14	0.93
13	2011	235	1.08	13	2011	21	1.5
14	2012	142	0.60	14	2012	10	0.48
		1783	14.52(1.04)			118	15.17(1.08)

The Table 2 reveals that the Exponential growth rate of publications in Horticulture research output at comprehensive and national level. An exponential growth in number of publication was observed during 1999-2012, average growth rate at comprehensive level is 1.04 and 1-08 at national level. The highest growth rate at comprehensive level is 1.42 during 2003 at comprehensive level and 4 during 2007 at national level. The total exponential growth rate value is 14.52 at comprehensive level and 15.17 at national level. With this data we can say observe the linear increasing growth at comprehensive level except the year 2009 where the contribution is less than 2008. In case of national level growth there are fluctuations with very less contribution to global output which is a major concern but average growth rate is better than comprehensive level.

Table 3 Showing Authorship Patterns in the Area of Horticulture Research Output

	1999	2000	01	02	03	04	05	06	07	08	09	10	11	12	Total	Percentage
Single authors	18	22	19	21	19	17	34	21	25	49	49	39	28	18	379	21.26
Double authors	11	13	20	14	28	21	25	30	36	42	37	50	31	27	385	21.59
Triple authors	8	11	15	13	19	18	18	21	35	32	43	42	62	21	358	20.08
Four authors	5	8	10	8	7	15	10	17	25	31	35	35	45	24	275	15.42
Five authors	5	8	8	6	5	6	10	11	11	30	21	23	25	15	184	10.32
Six authors	-	-	3	1	6	-	3	11	3	9	8	12	17	15	88	4.94
Seven authors	-	-	2	-	2	-	3	3	3	3	4	7	10	9	46	2.58
Eight authors	-	-	2	-	1	-	-	1	2	2	1	5	8	6	28	1.57
Nine authors	-	-		2	-	-	-	-	1	2	-	1	2	1	9	0.50
Ten authors	-	-		1	-	-	1	-	-	3	1	-	2	3	11	0.62
> ten authors	-	-		-	-	-	-	2	3	1	2	4	5	3	20	1.12
Total	47	62	79	66	87	77	104	117	144	204	201	218	235	142	1783	100

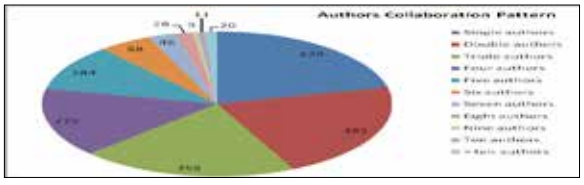

Table 3 reflects the collaboration pattern of authorship. Out of 1783 records 379 are contributed by single authors which are 21.26 percent of total output. 385 records are contributed by double authors which are 21.59 percent of total and which tops percentage wise contribution. Contribution by single author and double authors together stands around 43 percent and remaining 57 percent contribution came from three and more than three authors with the major contribution of three authors. Analysis of this collaborative pattern is though quite good in collaboration but as compare to other areas of research it demands still more collaboration.

Table 4: Single Vs multi-author and collaboration Coefficient of Horticulture research output

Year	Single Authors		Multi Authored		Total	Collaboration Coefficient
	No of Output	%	No. of Output	%		
1999	18	4.75	29	2.07	47	0.62
2000	22	5.80	40	2.85	62	0.65
2001	19	5.01	60	4.27	79	0.76
2002	21	5.54	45	3.21	66	0.68
2003	19	5.01	68	4.84	87	0.78
2004	17	4.49	60	4.27	77	0.78
2005	34	8.97	70	4.99	104	0.67
2006	21	5.54	96	6.83	117	0.82
2007	25	6.60	119	8.48	144	0.83
2008	49	12.93	155	11.04	204	0.76
2009	49	12.93	152	10.83	201	0.76
2010	39	10.29	179	12.75	218	0.82
2011	28	7.39	207	14.74	235	0.88
2012	18	4.75	124	8.83	142	0.87
	379 (21.26)	100	1404 (78.74)	100	1783	0.76

A study of the above data indicates the collaboration coefficient in the research output in Horticulture. The collaboration coefficient is 0.76 during the study period 1999 to 2012.

Volume : 3 | Issue : 1 | January 2013 | ISSN - 2249-555X

i.e., out of the total 1783 records published, 76 percentages of them are published under joint venture. During the year 2011 it was 88 percentages and in 2010 it was 82 percentages to 2010 the collaboration coefficient was of values 0.82 and 0.83 in 2006 and 2007 respectively. It is seen clearly from the above that the collaboration coefficient in producing research output in horticulture research has shown an increasing trend with little variations in between during the study period.

Table: 5 Author wise Contribution at Comprehensive and National

	Comprehensive Level						National Level						
S.No	Author	No of Rec	%	TLCS	TGCS	h-Index	S.No	Author	No of Rec	%	TLCS	TGCS	h-Index
1	[Anonymous]	19	1.07	0	0	0	1	Nandre DR	5	4.23	0	0	0
2	VanDerZanden AM	12	0.67	3	4	1	2	Jadhao BJ	4	3.39	0	0	0
3	Haynes C	11	0.62	3	3	1	3	Kumar S	4	3.39	0	1	1
4	Liu MZ	11	0.62	13	98	6	4	Singh A	4	3.39	0	29	2
5	Waliczek TM	11	0.62	7	41	4	5	Nath P	3	2.54	0	1	1
6	Zajicek JM	10	0.56	7	35	3	6	Ramachandra TV	3	2.54	2	96	3
7	Horrocks M	9	0.50	8	49	5	7	Singh AK	3	2.54	0	1	1
8	Duchovskis P	8	0.45	3	10	2	8	Varma A	3	2.54	0	26	2
9	Janick J	8	0.45	6	18	3	9	Yadav RK	3	2.54	0	0	0
10	Lyons R	8	0.45	0	0	0	10	Anuja S	2	1.69	0	0	0

TLCS-Total Citation Score, TGCS-Total Global Citation Score

Table: 5 reflect the contribution of top 10 most productive authors in Horticulture research at comprehensive and national level. VanDer Zanden AM and Haynes C M tops the list with the contribution of 12 and 11 documents respectively, but in case of total global citation, total local citation and H index VanDer Zanden AM and Haynes C M have 3, 4 and 1 and 3, 3 and 1 respectively and in this case Liu MZ tops the list with H-index 6 with just 11 documents. In case of National level Nandre DR and Jadhao BJ tops the list with 5 and 4 records respectively and they don't have any H-index value. In case of H-index at national Ramachandra TV tops the list with just 3 records and 3 H-index value followed by Varma A who has 3 records and H-index value 2.

Table: 6. Most productive Journals (Core Journals)

S.No	Journal	Records	Percent	TLCS	TLCS/t	TGCS	TGCS/t	TLCR	h-Index
1	Hortscience	168	9.4	46	8.84	253	41.85	38	8
2	Horttechnology	127	7.1	63	8.42	227	31.28	58	8
3	Journal of Food Composition and Analysis	19	1.1	0	0.00	48	17.33	0	3
4	Scientia Horticulturae	18	1.0	4	0.63	77	17.05	34	5
5	Journal of Horticultural Science & Biotechnology	16	0.9	0	0.00	43	6.66	3	4
6	Plant Archives	16	0.9	0	0.00	2	0.33	0	1
7	Zemdirbyste-Agriculture	16	0.9	3	0.65	13	3.00	5	3
8	Biosystems Engineering	13	0.7	2	0.83	64	15.85	3	4
9	Journal of Archaeological Science	13	0.7	10	1.86	73	13.13	13	6
10	Journal of Food Agriculture & Environment	13	0.7	1	0.33	4	1.00	2	1

TLCS/t-Total Local Citation Score per year from paper publication to the end of the collection,

TGCS/t- Total Global Citation Score per year from paper publication to the end of the collection

TLCR- Total Local Cited References shows the number of citations in a paper's reference list to other papers within the collection.

These top 10 most productive Journals have contributed 419 papers in total research output, with the contribution of 23.50 % papers per Journal publications output of 1999-2012. Among the top 10 most productive journals, only two journals have published higher number of papers than the group's average. These are Hortscience (168) and Horttechnology (127) In case of total local citation and total global citation Hortscience Journal dominates the list by having 8.84 and 41.85 percent of citations per year respectively with 8 H-index value which indicates the dominated usage of Hortscience followed by Horttechnology which also has 8 H-index value.

Table: 7 Institution wise Contribution to Horticulture Research

S. No	Institution	Records	Percent	TLCS	TGCS
1	Unknown	68	3.8	17	57
2	University of Florida	43	2.4	20	173
3	Iowa State University	28	1.6	6	26
4	Wageningen University and Research Centre	25	1.4	8	227
5	Texas A&M University	23	1.3	8	55
6	Agricultural Research Service | USDA	21	1.2	4	181
7	Kansas State University	18	1.0	8	37
8	Chinese Academy Of Sciences	17	1.0	2	97
9	Michigan State University	17	1.0	14	219
10	University of Auckland	17	1.0	9	89

Table 7 reflects the research profile of the most productive institutions in horticulture research. The top 10 most productive institutions involved in research in horticulture are identified out of these University of Florida tops the list with 43 records 20 TLCS and 173 TGCS followed by Iowa State University with 28 records 6 TLCS and 26 TGCS. In case of TGCS **Wageningen University** and **Research Centre tops the list with 227 TGCS value followed by Michigan State University which has 219 TGCS value it indicates though these two institutions which tops in TGCS are not contributing much number of records but their TGCS is better than all other institutes which a sign of quality research.** Here the focusing point is that Horticulture research is concentrated in universities of developed nations and it demands promoting this research in developing as well as under developed world with the establishment of specific research centres for Horticulture research which can further boost the Horticulture research.

Historiograph of E-learning research

An attempt have been made to trace the evolution of Hor-

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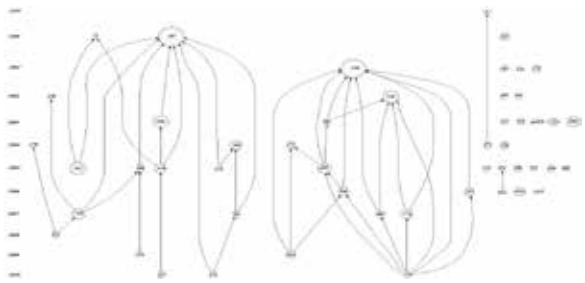
ticulture research by constructing historiography using HistCite software (developed by Garfield and colleagues) in conjunction with Web of Science. All 1783 papers have been considered. All the references quoted in these 1783 papers have been included. All the papers that have cited these 1783 papers as well as all the references quoted in those citing papers have been added. The resulting aggregate is called the Horticulture Global Collection. The collection is exported to HistCite to obtain cited references along with their local and global citation scores (LCS and GCS).

Figure 1: Historiograph of E-learning research based on local citation scores LCS



Nodes:50,Links:45 LCS, top 50; Min: 3, Max: 38 (LCS scaled)

S. No	Records	Author	LCS	GCS
1.	3	Bell DT, 1999, AUST J BOT, V47, P475	3	78
2.	72	Hughes A, 2000, GEOFORUM, V31, P175	3	78
3.	97	Piperno DR, 2000, NATURE, V407, P894	6	120
4.	107	Dolan C, 2000, J DEV STUD, V37, P147	38	209
5.	130	Reichard SH, 2001, BIOSCIENCE, V51, P103	37	191
6.	131	Dolan CS, 2001, J DEV STUD, V37, P39	3	21
7.	145	Ehret DL, 2001, AGRONOMIE, V21, P323	4	60
8.	172	Zerulla W, 2001, BIOL FERT SOILS, V34, P79	6	76
9.	204	Schneider F, 2002, PLAINS ANTHROPOL, V47, P33	3	8
10.	208	Groenewoud GCM, 2002, CLIN EXP ALLERGY, V32, P434	3	24

Figure… is the Historiograph of Horticulture research of world based on the 10 most highly cited papers in the Horticulture research Global Collection based on their LCS. It covers the period from 1999 to 2012. In this historiographs, the story begins with a paper by Bell DT in Journal AUST J BOT, V47, and P475 published in 1999. In this paper no.03 (1999), of Bell DT from University Western Australia, Department of Botany, Australia has studied the Australian species germinate under the combination of environmental conditions. This paper has received 3 local and 78 global citations so far.

Conclusion

As Horticulture opened a new world for research after green revolution, from 1990s to till date there is a curios development in the area of Horticulture research which is realized by this study. This study reflects the linear growth in the research as well as usage of the output. Collaboration pattern found in the Horticulture research is really interesting and optimistic that we can understand by authorship pattern and histogram as there is huge network between researchers. In case of countrywide output it is somewhat disappointing as it is concentrated in developed world and there is a need of huge initiation in developing and underdeveloped world. In case of India it is somewhat unsatisfactory because being a populated and agri-economy of the world failed to place at least in the top 3 position in horticulture research so there is a need of greater initiation to make use of Indian expertise to improve the performance in Horticulture research.

REFERENCE 1. Balasubramani.R, N.Amsaveni, N.Amsaveni, Research Activities in Artificial Cell, 1991-2010: A Scientometric Analysis, Indian Journal of Applied Research, Vol No: 1, Issue: 3, 2011 | 2. S.Srinivasaragavan, M.Surulinathi,R. Balasubramani, Mapping of Harvard Business Review Publications, Smart Journal of Business Management Studies, Vol No: 6, No: 2, 2010 | 3. Balasubramani.R, M. Gunasekaran, Scientometric Analysis of Artificial Intelligence Research Output: An Indian Perspective, European Journal of Scientific Research, Vol.70 No.2 , pp. 317-322, 2012 | 4. Zitt, M., & Bassecoulard, E, Delineating complex scientific fields by an hybrid lexical-citation method: An application to nanosciences. Information Processing & Management, 42(6), 1513–1531, 2006 | 5. Bala, Adarsh and Gupta, B. M. "Research Activities in Biochemistry, Genetics and Molecular Biology during 1998-2007 in India, a Scientometric Analysis", DESIDOC Journal of Library and Information Technology, Vol. 30, No. 1, pp. 3-14, 2010. | 6. Bhatia, Ketki, "Innovations publications productivity of national institute of occupational health: A scientometric study", SRELS Journal of Information Management, Vol. 47, No. 2, pp. 219-227, 2010. | 7. Cavaller, V. "Scientometrics and patent bibliometrics in RUL analysis VINE", The Journal of Information and Knowledge Management Systems, Vol. 39, No. 1, pp. 80-91, 2009. |