International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

Application of Brodford's Distribution to the Journal 'Energy, Sustainability and Society

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Abstract

Environmental science is field of science that studies the interactions of the physical, chemical, and biological components of the environment and also the relationships and effects of these components with the organisms in the environment. The article is aimed at finding the most potential journals. This paper analysis the citations and create a rank list of journals, Country-wise and chronological distribution of citations.

Keywords: Environmental Science, Energy, society

1. Introduction

The Environmental science is an interdisciplinary academic field that integrates physics, biological and Information science to the study of the environmental and the solution of environmental problem. Environmental science emerged from the fields of nature history and medicine. Today, it provides an integrates, quantitative, and interdisciplinary approach to the study of environmental systems. Environmental science came alive as a substantive, active field of scientific investigation in the 1960 and 1970s driven by the needs for a multidisciplinary approach to analyse the complex environmental problems. Environmental scientists work on subject like the understanding of earth process, evaluating alternative energy system, pollution control and mitigation natural resource management and effects of global climate change.

2. Definitions

Miller: "Environmental science is defined as a branch of biology focused on the study of the

relationships of the natural world and the relationships between organisms and their environments."

3. Citation Analysis

Citation analysis is the study of the impact and assumed quality of an article, an author, or an institution based on the number of times works and/or authors have been cited by others. Citation analysis uses citations in scholarly works to establish links. Many different links can be ascertained, such as links between authors, between scholarly works, between journals, between fields, or even between countries. Citations both from and to a certain document may be studied. One very common use of citation analysis is to determine the impact of a single author on a given field by counting the number of times the author has been cited by others. One possible drawback of this approach is that authors may be citing the single author in a negative context**.**

3.1 About the source journal

Energy, sustainability and society is an interdisciplinary forum for research, development & implementation of sustainable energy systems published yearly by Springer science & Business Media in United States. It was first published in

the year 2011. It covers topics ranging from scientific research to innovative approaches for technology implementation to analysis of economic, social and environmental impacts of sustainable energy systems.

3.2 Need for the study

Being a interdisciplinary subject Environmental Science literature is growing enormously. The study helps to prepare rank list of journals to understand productive journals which are published on Environmental science. As libraries face problems in selecting productive and reputed journals, this study helps to identify productive journals for collection development in general and journal selection in particular.

3.3 Objectives of the study:

The following are some of the objectives for present study.
They are:

1. To find the rank list of frequently cited journals.
2. To understand the Authorship pattern of the journal citation and books citations.
3. To understand the chronological distribution of ranked journal citation.
4. To identify the dominant countries whose literature is of interest to the researchers.

3.4 Scope of the study:

The present study analyses the citations which are appended in the source Journal "Energy, Sustainability and Society" during the year 2012-2016.

3.5 Methodology of Research:

The present study is focused on citations in journals over a period of five years, i.e. 2012 to 2015. These citations were later grouped according to journals, textbooks, thesis etc. There were 3638 citations identified in the study out of which 1348 citations were of journal articles and 1709 citations were from textbooks. The application of Bradford's Law of scattering is testified from the study.

4. Review of Literature

Koteppa Banateppanvar et.al(2013) reveals that journals are the most preferred sources of information used by researchers followed by books and monographs. Scholars are very interested in reviewing periodicals and the libraries have stressed the need to develop those collections aggressively.

Jadhav, Vandana S et al. (2012) found that a large number of obsolescence studies have been reported in the field of science and technology than social sciences and the humanities. The findings are much helpful for librarians and information scientists while taking decisions regarding collection development, removing out dated documents from the shelves and also in maintaining need based collection in the libraries.

5. Analysis and Interpretation of Data

There are five journals from the year 2012 to 2016 consulted for data collection. There are 3638citations which have been distributed on the basis of form as well as the source of the citation. Out of the total citations, 1709 citations are from book and 1348 citations are from books. The rest have been classified into citations from reports, working papers, conference/seminar articles, handbooks, yearbooks and so on.

Table-1: Volume & Year wise distribution of Citations

Year	Volume No.	No. of articles	Number of Citations	Percentage	Cumulative Citations	Cumulative Percentage
2012	2	19	593	16.30%	593	16.30%
2013	3	17	746	20.50%	1339	36.80%
2014	4	17	829	22.78%	2168	59.59%
2015	5	17	916	25.17%	3084	84.77%
2016	6	17	554	15.22%	3638	100%
Total			**3638**	**100%**		

Table 1 identifies the year wise distribution of citations. There are 593 (16.30%) citations in the year 2012, 746 (20.50%) in 2013, 829 (22.78%) in 2014, 916 citation in 2015 and 554(15.22%) citations in the year 2016.

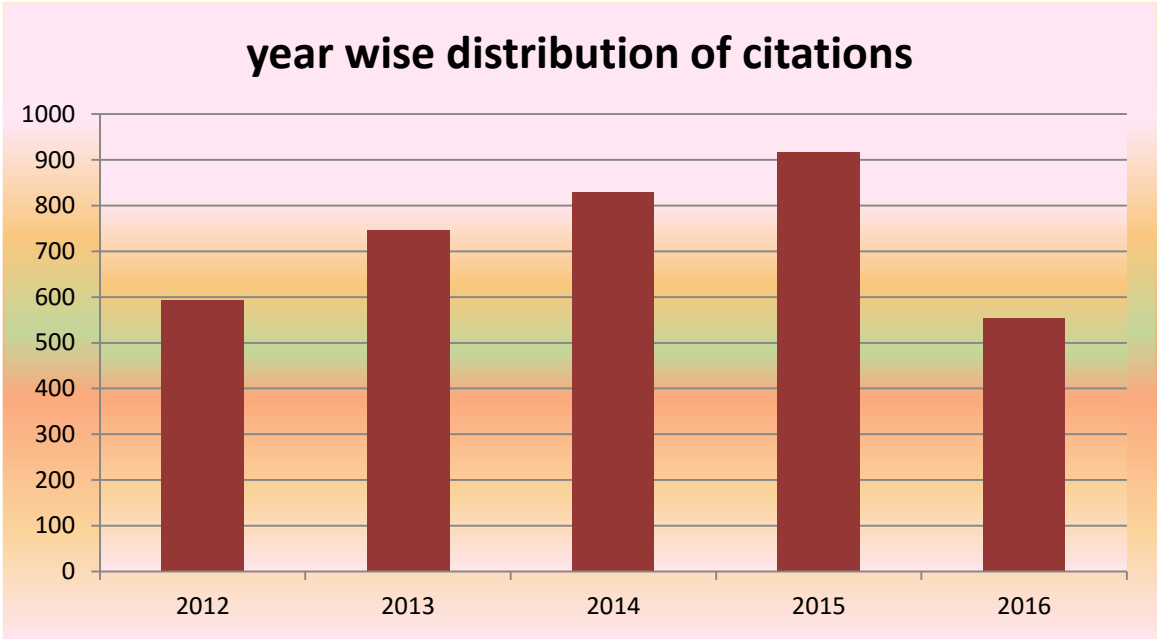

Fig-1 Year wise distribution of citations

Table-2: Form wise distribution of citations

Source material	Rank no	No. Of Citation	Cumulative Citation	% of citations	Cumulative%
Textbooks	1	1709	46.97%	1709	46.97%
Periodicals	2	1348	37.05%	3057	84.02%
Reports	3	278	7.67%	3335	91.67%
Conference/ Seminar Articles	4	134	3.76%	3469	95.35%

Thesis	5	76	2.08%	3545	97.44%
Websites	6	42	1.15%	3587	98.59%
Newspapers	7	26	0.71%	3613	99.31%
Govt Reports	8	11	0.30%	3624	99.61%
Handbooks	9	9	0.24%	3633	99.86%
Yearbooks	10	5	0.13%	3638	100%
TOTAL		**3638**		**100%**	

Table 2 shows the source wise ranking of citations. The highest number of citations are from textbooks 1709 (46.97%) followed by periodicals 1348 (37.95%), reports 278 (7.67%), conference/seminar articles 134 (3.76%), thesis 76(2.08%), websites 42 (1.15%), working papers 26(0.71%), govt reports 11(0.30%), handbooks 9(0.24%) and yearbooks 5 (0.13%) were referred by researchers.

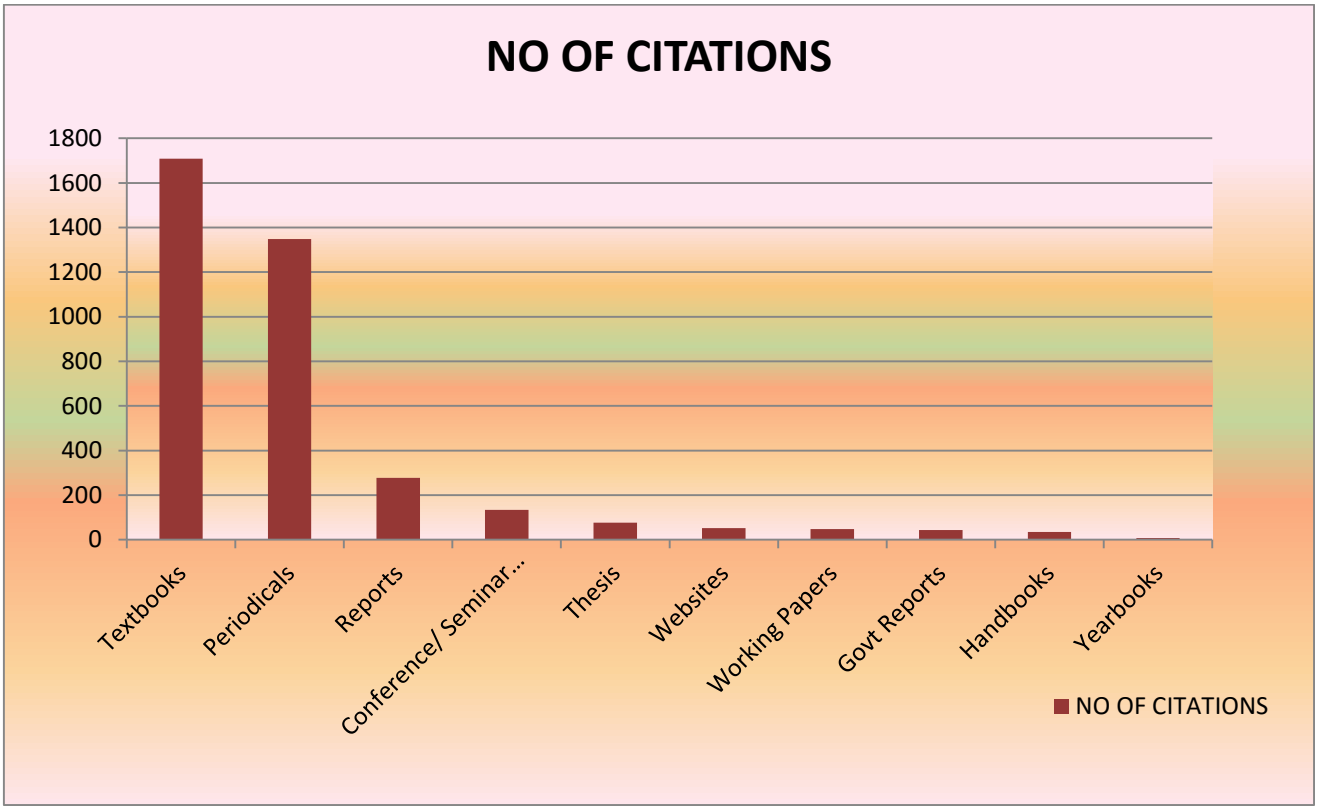

Fig- 2 Form wise distribution of citations

Table-3 Rank list of journals

Sl no	Rank	Title of the journal	No. Of Citations	Cumulative Citations	% of Citations	% Cumulative	Country of Publications
1	1	Solar Energy	53	53	3.93%	3.93%	Germany

2	2	Ecological Applications	50	103	3.70%	7.64%	USA
3	3	Desalination	49	152	3.63%	11.27%	USA
4	4	Biomass & Bioenergy	47	199	3.48%	14.76%	Poland
5	5	Energy, Sustainability & Environment	47	246	3.48%	18.24%	Germany
6	6	Environmental Science &Technology	43	289	3.18%	21.43%	USA
7	7	Bioresource Technology	39	328	2.89%	24.33%	England
8	8	Energy, Sustainability & Society	34	362	2.52%	26.85%	Germany
9	9	Marine Policy	32	394	2.37%	29.22%	England
10	10	Journal of agricultural economics	32	426	2.37%	31.60%	USA
11	11	Ecological Economics	31	457	2.29%	33.902%	USA
12	12	Tellus	30	487	2.22%	36.12%	Sweden
13	13	Journal of Renewable and Sustainable Energy	30	517	2.22%	38.35%	USA
14	14	Journal of Environmental Economics and Management	28	545	2.07%	40.43%	Norway
15	15	Renewable Energy	27	572	2.00%	42.43%	Australia
16	16	Agriculture, Ecosystems and Environment	27	599	2.00%	44.43%	England
17	17	Journal of Urban Technology	25	624	1.85%	46.29%	USA
18	18	Journal of Sustainability Education	23	647	1.70%	47.99%	USA
19	19	Energy, Conservation & Management	23	670	1.70%	49.70%	Germany
20	20	Journal of Environmental Management	23	693	1.70%	51.40%	Australia
21	21	International journal of sustainable economy	23	716	1.70%	53.11%	USA
22	22	Journal of Environmental Protection	21	737	1.55%	54.67%	Norway
23	23	Earth Interactions	21	758	1.55%	56.23%	USA
24	24	Ecosystems	20	778	1.48%	57.71%	USA
25	25	Applied Energy	20	798	1.48%	59.19%	Germany
26	26	Environment and Development Economics	19	817	1.40%	60.60%	Sweden

27	27	Energy for Sustainable Development	18	835	1.33%	61.94%	USA
28	28	Journal of Advanced Engineering technology	18	853	1.33%	63.27%	Sweden
29	29	Global Change Biology Bioenergy	18	871	1.33%	64.61%	Norway
30	30	Ecological Complexity	18	889	1.33%	65.94%	England
31	31	Nature	15	904	1.11%	67.06%	England
32	32	Journal of Agricultural and Environmental Ethics.	15	919	1.11%	68.17%	Netherlands
33	33	Rural Society	15	934	1.11%	69.28%	USA
34	34	Energy	15	949	1.11%	70.40%	Germany
35	35	Renewable & Sustainable Energy Reviews	14	963	1.03%	71.43%	Norway
36	36	Waste Management	14	977	1.03%	72.47%	England
37	37	Theoretical and Applied Climatology	14	991	1.03%	73.51%	Austria
38	3	Energy Policy	13	1004	0.96%	74.48%	Sweden
39	39	Resources, Conservation and Recycling	13	1017	0.96%	75.44%	Netherlands
40	40	Journal of Material Cycles and Waste Management	10	1027	0.74%	76.18%	Japan
41	41	Environmental Earth Sciences	9	1036	0.66%	76.85%	Germany
42	42	Journal of Integrative Environmental Sciences	9	1045	0.66%	77.52%	Denmark
43	43	Atmospheric Environment	8	1053	0.59%	78.11%	Sweden
44	44	Nature Climate Change	8	1061	0.59%	78.70%	Germany
45	45	Ecological Engineering	8	1069	0.59%	79.30%	USA
46	46	Technology in Society	7	1076	0.51%	79.82%	Belgium
47	47	Environmental Science Europe	7	1083	0.51%	80.34%	Germany
48	48	Urban Studies	7	1090	0.51%	80.86%	Netherlands
49	49	Chemical Engineering	7	1097	0.51%	81.37%	Australia
50	50	Waste Management and Research	7	1104	0.51%	81.89%	Japan
51	51	Ecological Applications	7	1111	0.51%	82.41%	USA

52	52	Journal of Research in Marketing	7	1118	0.51%	82.93%	Denmark
53	53	Applied Economics	6	1124	0.44%	83.38%	Austria
54	54	Biofuels, Bioproducts and Biorefining	6	1130	0.44%	83.82%	England
55	55	Journal of Geophysical Research	6	1136	0.44%	84.27%	Netherlands
56	56	Journal of Resource management & technology	5	1141	0.37%	84.64%	USA
57	57	Global Biogeochemical Cycles	5	1146	0.37%	85.01%	Germany
58	58	Journal of Industrial Ecology	5	1151	0.37%	85.38%	Germany
59	59	Journal of Economic Surveys	5	1156	0.37%	85.75%	USA
60	60	Air Quality. Atmosphere and Health	5	1161	0.37%	86.12%	USA
61	61	Ecotoxicology	5	1166	0.37%	86.49%	USA
62	62	Exposure and Health	5	1171	0.37%	86.86%	USA
63	63	Marine Biology	5	1176	0.37%	87.24%	England
64	64	Sustainability Science	4	1180	0.29%	87.53%	Japan
65	65	Journal of Agriculture and Environment for International Development	4	1184	0.29%	87.83%	Italy
66	66	Applied Economics Letters	4	1188	0.29%	88.13%	England
67	67	International journal of public administration	4	1192	0.29%	88.42%	USA
68	68	Progess in Photovoltaics: Research and Application	3	1195	0.22%	88.64%	France
69	69	Journal of Socio-Economics	3	1198	0.22%	88.87%	USA
70	70	Journal of Industrial Ecology	3	1201	0.22%	89.09%	USA
71	71	Land Economics	3	1204	0.22%	89.31%	USA
72	72	European Journal of Operational Research	3	1207	0.22%	89.54%	Germany
73	73	Remaining journals have been cited less than 3	141	1348	10.45%	100%	

		times					

Table-3 gives the rank list of journals cited by the researchers. Out of 213 journals, 72 journals have been cited at least 3 times. These journals account for 1207(89.54%) of the citations.

Analysing the ranking of journals, Solar Energyoccupies the top slot accounting for (3.93%) citations, followed by Ecological Applications (3.70%) and Desalination (3.63%).

6. Application Of Bradford's Distribution

Bradford's law of scattering (of subjects in information sources), first published in 1934, is often mentioned together with Zipf's law (about word frequencies in natural language texts) and Lotka's law (about distribution of authors' productivity) as one among the three most important bibliometric laws, and is often considered the best model or example of scientific research that is available within Library and Information Science (LIS). Bradford's law states that documents on a given "subject" is distributed (scattered) according to a certain mathematical function so that a growth in papers on a subject requires a growth in the number of journals/information sources. The numbers of the groups of journals to produce nearly equal numbers of articles is roughly in proportion to 1: n: n2 …, where n is called the Bradford multiplier 1. Explained in words, Bradford's law states that a small core of, for example, journals have as many papers on a given subject as a much larger number of journals, n, which again has as many papers on the subject as n2 journals.

The law of scattering describes how the literature on a particular subject is scattered or distributed among portions or segments of the journal literature. Bradford formulated the law in the 1930s and claimed that in each subject or domain "there are a few very productive periodicals, a larger number of more moderate producers, and a still larger number of constantly diminishing productivity..." According to Garfield (1980), "...One of the statistical tools related to Bradford's law is the Pratt index. This index purports to measure the degree to which papers on a given subject are concentrated within a journal collection..

Based on Bradford's observations, Brookes suggested the following linear relation to describe the scattering phenomenon as:

$F(x)=a+b \log x$.

Where F(x) is the cumulative number of references contained in the first x most productive journals, and a and b are constants. This is the most widely used formulation of Bradford's Law

Table-4: Bradford's Law of Scattering of periodicals

Zone	Journals	Citations	Percentage
1st Zone	14	545	40.43%
2nd Zone	35	418	31%
3rd Zone	73	385	28.46%
		1348	**100%**

The above table indicated that the first zone contain a small number of productive journals, which are 14 in number contributing 545 citations. The second zone contains moderately productive journals which are21 in number contributing 418 citations. The third zone contains a still large

number of journals of low productivity with 385 citations. The journals are divided in the ratio 14:21:38 which is in agreement with Bradford's law of scattering.

It can be stated that nuclear zone contains a small number of highly productive journals. The second zone contains a large number of moderately productive journals and the third zone (outer zone) contains a much large number of low productivity.

Country wise distribution of citations:

Country wise analysis of citation provides information of the range of countries that actively participate in the subject field and their contribution. Therefore table-7 below presents the country wise distribution of ranked periodicals covering citations.

Table-5: Country wise distribution of citations

Sl No	Rank No	Name of the country	Number of journals	%	Number of citations	%
1	1	USA	24	33.33%	433	35.87%
2	2	Germany	11	15.27%	229	18.97%
3	3	England	9	12.5%	139	11.51%
4	4	Sweden	5	6.94%	88	7.29%
5	5	Australia	4	5.55%	67	5.55%
6	6	Norway	4	5.55%	81	6.71%
7	7	Netherlands	4	5.55%	51	4.22%
8	8	Japan	3	4.16%	28	2.31%
9	9	Austria	2	2.77%	30	2.48%
10	10	Denmark	2	2.77%	26	2.15%
11	11	Poland	1	1.38%	11	0.91%
12	12	France	1	1.38%	3	0.24%
13	13	Belgium	1	1.38%	7	0.57%
14	14	Italy	1	1.38%	4	0.33%
		Total	**72**	**100%**	**1207**	**100%**

The above table 5 shows that there are 433(35.87%) of from periodicals published from USA followed by 229(18.97%) from periodicals published in Germany and 139(11.51%) from periodical published in England. Two of the citations were from Indian journals namely, Indian Journal of Fibre & Textile Resource and Indian Journal of Rural Technology.

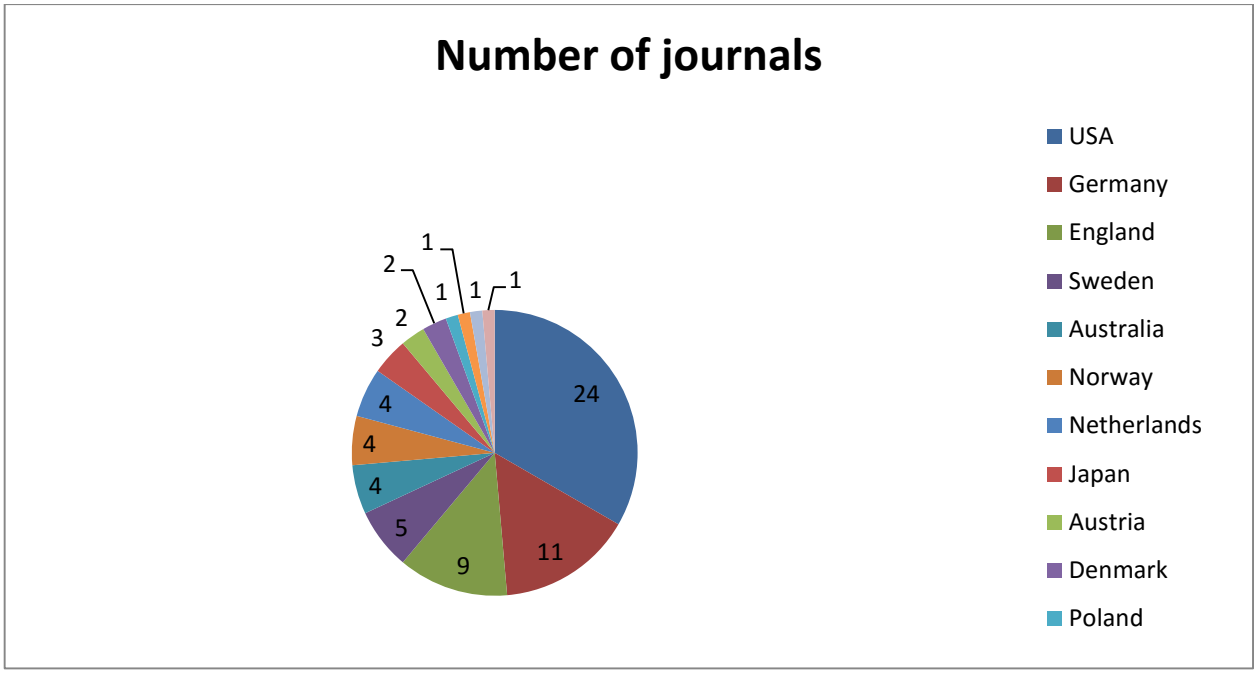

Fig-5Country wise distribution of citations

Table-6 Chronological distribution of journal citations

Year	Number of citations	Percentage	Cumulative Citations	Cumulative Percentage
1995-2000	107	7.93%	107	7.93%
2001-2005	190	14.09%	297	22.03%
2006-2010	636	47.18%	933	69.21%
2011-2015	415	30.78%	1348	100%
Total	**1348**	**100%**		

Table-6 reveals the chronological distribution of journal citations. The periodicity of the citations is divided into 4 parts. Chronological distribution of the journal citations shows that more than 47.18% of the citations are from the period between 2006 and 2010. The remaining citations are scattered between1995-2000 (7.93%), 2001-2005 (14.09%) and 2011-2015 (30.78%). This indicates that the researchers referred the latest source of information for their research work and the older sources were cited less often compared to latest articles.

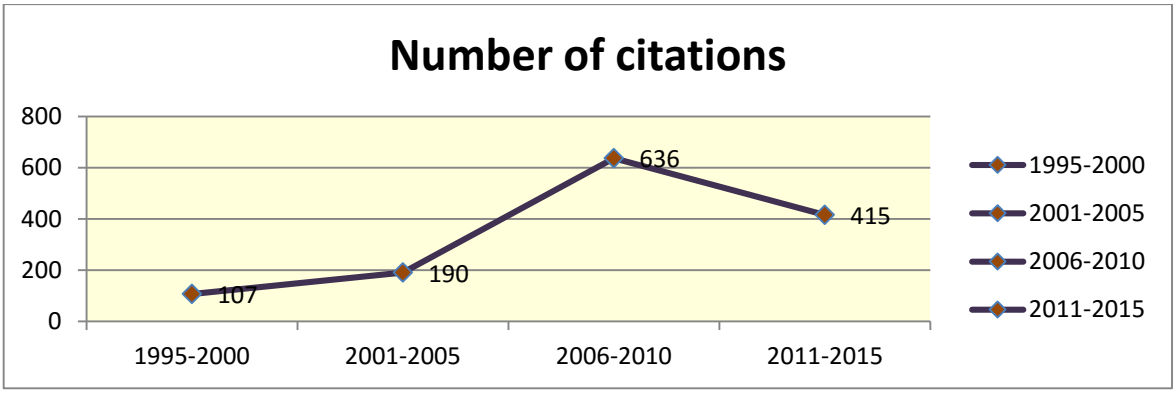

Fig-6 Chronological distribution of journal citations

7. Major Findings

7.1 Findings

From the study the following major conclusions were identified.

7.2 Rank list of Journals

It is observed in the table 3 that Solar Energy (3.39%), Ecological Applications (3.27%) and Desalination (3.10%) are the three journals most frequently cited by the researchers among the ranked list of journals.

7.3 Country wise distribution of Ranked Journal

Table 7 indicated that 24(33.33%) of journals preferred by the researcher was published in USA.

7.4 Chronological distribution of Journal Citations

Chronological distribution of journal citations in table indicates that % of the citations are from the period between 2006 and 2010.

8. Conclusion

The study was aimed to describe the dimension of Environmental Science literature. In the citation analysis it analyse the productiveness of periodicals, the study identifies and brings out the list of core journals which are most productive in the field of Environmental Science.The Bradford's Law of Scattering has its own importance, however as stated by many scientists it is not accurate, but this has method accepted in the world to discover the core collection of any subject. It has cost beneficial, provide perfect collection at minimum cost. The findings and suggestions of the study may be used by the faculty of the department of Environmental Science and also may recommend these sources to post graduate students and research scholars.

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