

The Scientometrics of *Nature*

Deepjyoti Kalita

Scientific Information Resource Division, Indira Gandhi Center for Atomic Research, Kalpakkam, India.

ABSTRACT

Nature is a weekly journal of multidisciplinary sciences with a huge range of followers in the scientific community. The purpose of the study is to analyse the citations of the full research articles published in *Nature* journal from 2006 to 2015. During this period *Nature* has published 8335 research articles. In the study the weightage of the research articles published in *Nature* were measured through immediacy index comparison of the research articles to the overall journal. The authorship pattern of the articles were measured and a cited references study was also conducted for measuring the self citations generated by *Nature* each year, the references per articles present and identifying core cited journals by *Nature* and their respective subject areas, which libraries in turn may use for collection development policies. Ranking of contributing countries and contributing organizations were also made by % share of article contribution. To check if any kind of biasness is present in *Nature* publications, a comparative evaluation of top contributing countries has also been made based on Nature Index. Web of Science core collection was used as the data source and Bibexcel bibliometric tool was used for data analysis purpose.

Keyword: Citation Analysis, Nature index, Bibexcel, Bibliometrics, Cited references

INTRODUCTION

In today's scientific society *Nature* is one of the most followed weekly scientific journal of multidisciplinary sciences having a impact factor of 41.45 as per journal citation reports 2014. First published in the year 1869, currently in the year 2015 it had a print circulation of 50,200 with a readership of 365,456 excluding the online readership of 8.7 million per month.¹ The rapid increase in its article submission rate, (almost 200 article submission per week)² only suggests its immense popularity and acceptability in the scientific community. Citation analysis of such a journal which is being considered as a world leader of multidisciplinary sciences will help in understanding interactions among scientific disciplines. Basic data were collected for the study with a quantitative approach of no of "citations gained" at article level,

which has been further analysed for studying the self-citations, authorship pattern and identification of core cited journals.

Bibexcel³ software tool was used for conducting the cited references study. Bibexcel tool was developed by Olle Pearson, which is a powerful tool in terms of flexibility for data management and interpretation. Bibexcel can analyse plain text format downloaded data from citation databases like WoS or Scopus, and later those data can be transferred to excel or statistical analysis software or can be used for visualization also through various mapping tools like Pajek, VOS viewer etc.

Review of Literature

Citation analysis of journals is not a new phenomenon, and it has its roots back till 1927 when Gross and Gross⁴ has made an analysis of the prestigious Journal of American Chemical Society for identifying the top cited journals in it, thus preparing a core list of journals which they can use for collection development in Pomona College library, in Southern California. But later with the starting of Science citation index more in depth citation analysis of journals were possible which later were used for establishing network of authors, citations across subjects and papers^{5,6} and connecting informal scholarly communication process.⁷ Glanzel and Moed⁸ have made a review of different contextual and time cluster approaches used for

*Address for correspondence:

Deepjyoti kalita, JRF Enclave, DAE Township, Kalpakkam, Tamilnadu, INDIA.
Email: deepjyoti109@gmail.com

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scientometric measures of journal evaluation. Nebelong-Bonnevie and Frandsen⁹ proposed the journal citation identity (i.e. references per different referenced work) and journal citation image as two indicators for journal evaluation. They analyzed Journal of Documentation (JOD) by using the data of Journal of Information Science (JIS) and Journal of the American Society for Information Science and Technology (JASIST) as standard of reference and comparison. Tsay and Shu¹⁰ have made another approach to Journal of Documentation, where they evaluated the references present in the articles of that journal, and made a bridge that connects the journal to different subject areas. Garg, Srivastava and Bebi¹¹ made a different approach for evaluating journal citations and studied the cited references in the published articles of Journal of intellectual property rights and did a mapping of related subjects based on the references. Other than citation analysis studies conducted for evaluation of journals citations,¹²⁻¹⁴ there are studies¹⁵⁻¹⁷ which are conducted on thesis and dissertations of specific subject areas also to identify their citation patterns.

Objectives of the study

The study was conducted with the following objectives:

1. Analysis of type of items published by *Nature*.
2. Analysing the citation impact of research articles of *Nature* to its overall citations and make a comparison of immediacy index of *Nature* articles to the overall journal's immediacy index. (i.e. understanding the weight age of *Nature* articles in overall impact of the journal)
3. To know about the authorship pattern of *Nature's* research articles.
4. Conducting a cited references study in the references of *Nature* to know about reference pattern and the amount of self citations generated by *Nature* in each year.
5. Identifying the top citing journals in *Nature* articles and identifying their subject areas, and thus identifying the subjects whose articles get more cited in *Nature*.
6. Listing out the top 15 countries and top 15 organizations that have made highest no of research article contribution to *Nature* from 2006 to 2015.

Methodologies and Properties of Collected Data:

The accumulated data for the study comprises of bibliographical record of published items by *Nature* journal from 2006 to 2015 that includes all total of *Nature's*

89 volumes data from volume 439 to 528. The source of data collection was Web of science core collection database. Basic search was made in the web of science core collection database typing "Nature" in the search box selecting "publication type" parameter within the time span of each year from 2006 to 2015. Thus *Nature's* publication for each year was obtained. Then the search result was refined to document type "Article" and then the full record of those refined result were downloaded in plain text format for evaluation through bibexcel software. The citation data of the refined result were also imported to MS Excel format for analysis. Within the period *Nature* has published all total of 26211 items that contains 8335 items under the tag "Article". Its different published items are shown in Table 1. From 2006 to 2010 *Nature* used to combine its one year publication in 6 volumes (i.e. one volume containing two months publication) but from 2010 onwards it used to combine each year's publication in 12 volumes.

Data analysis, Findings and Discussion

Objective 1: Publication profile of Nature from 2006-2015

Nature publishes different items under its eight different sections as maintained in Web of Science database. Full research articles are published under the article section of *Nature*, which is the main concentration of this current article (the author will address these items as research articles from here on in this article). Short communications about ongoing researches are published under letters section. Scientific journalism is also one of the main scopes of *Nature* which it publishes under News section. Reviews, Correction, Biography, Book review and Editorial are other regular columns of *Nature*. From 2006-2015, *Nature* has published all total of 26210 items, highest being published in the year 2006 (2733 items) and lowest being in the year 2009 (2543 items). After going through the items published on record count (Table 1), it is seen that *Nature's* publication under the editorial column has

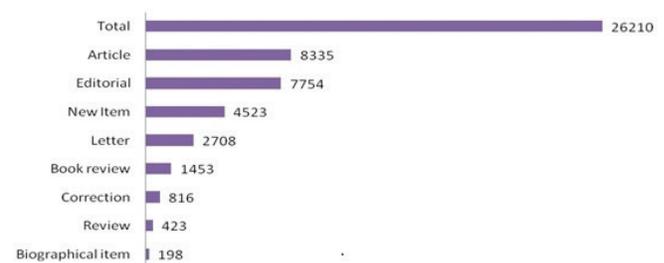


Figure 1: Brief profile of Published items by *Nature* from 2006-2015

Table 1: Brief Profile of *Nature* journal from 2006 to 2015 in terms of published item:

Year	Editorial	News Item	Correction	Review	Article	Letter	Book Review	Biographical Item	Total
2006	623 (22.7%)	601 (21.9%)	83 (3.03%)	57 (2.08%)	906 (33.15%)	270 (9.87%)	181 (6.62%)	12 (0.43%)	2733
2007	636 (23.7%)	624 (23.2%)	63 (2.35%)	57 (2.12%)	786 (29.3%)	258 (9.63%)	230 (8.58%)	25 (0.93%)	2679
2008	701 (26.6%)	490 (18.6%)	54 (2.05%)	39 (1.4%)	868 (32.9%)	277 (10.5%)	180 (6.8%)	22 (0.83%)	2631
2009	780 (30.6%)	381 (14.9%)	78 (3%)	66 (2.5%)	800 (31.4%)	250 (9.8%)	169 (6.6%)	19 (0.74%)	2543
2010	760 (29.4%)	448 (17.3%)	68 (2.6%)	37 (1.4%)	825 (32%)	268 (10.3%)	150 (5.8%)	21 (0.81%)	2577
2011	818 (31.5%)	401 (15.4%)	79 (3%)	37 (1.4%)	804 (31%)	283 (10.9%)	147 (5.6%)	22 (0.84%)	2591
2012	885 (33.3%)	418 (15.7%)	89 (3.3%)	34 (1.2%)	835 (31.4%)	277 (10.4%)	94 (3.54%)	19 (0.71%)	2651
2013	799 (30.6%)	397 (15.2%)	101 (3.8%)	28 (1%)	832 (31.9%)	283 (10.8%)	140 (5.3%)	25 (0.95%)	2605
2014	833 (32.5%)	371 (14.4%)	108 (4.2%)	34 (1.3%)	828 (32.3%)	272 (10.6%)	102 (3.9%)	13 (0.5%)	2561
2015	919 (34.8%)	392 (14.8%)	93 (4.2%)	34 (1.32%)	851 (32.2%)	270 (10.2%)	60 (2.2%)	20 (0.75%)	2639
Total	7754 (29.58%)	4523 (17.26%)	816 (3.11%)	423 (1.61%)	8335 (31.80%)	2708 (10.33%)	1453 (5.54%)	198 (0.76%)	26210

increased significantly from a share of 22.7% of total published items in 2006 to a share of 34.8% to overall published items in 2015, where as its publication under the News item section has gone down from a share of 21.9% in 2006 to 14.8% in 2015 when compared to the overall items published by *Nature*. In other sections evenness was seen in publication counts with insignificant variations in record count. In most of the years Article section occupies a majority of publication except the years 2011, 2012, 2014 and 2014 where publications under editorial section were slightly higher than publications under Article section. Overall from 2006 to 2015 articles occupies highest space (31.8%) followed by editorial items (29.58%) and then news items (17.26%) in terms of total publication share when compared to 26210 published items.

Objective 2: Citations Record and Immediacy Index Comparison:

In the study a comparison was made among the citations gained by the *Nature* research articles and the overall citations of the whole journal items. As citation is a time dependent variable and it increases with time, so to have a fair comparison among each year's publications, only citations gained during the published year were counted. According to Journal Citations Reports Journal Immediacy

index (JII) is an indicator that shows us how quickly the items published in a journal gets cited. It is an indicator that shows us the higher visibility and acceptance of the researches published in the journal in a shorter period of time.¹⁸ The citation window selected for this indicator is the publication year only, i.e. the immediacy index for a journal for a year is the ratio of the no of citations gained by the journal in a year to the total items published in the journal in that year. Here the immediacy of the *Nature* journal and immediacy index of the research articles published in the journal were calculated for each year from 2006 to 2015 and their variation was compared (if there is any)

From Table 2 it can be seen that articles comprises a large amount of citations of the total citations gained by the journal. From 2006 -2015 articles only generated most of the citations for the journal at an average of 86.24% each year. The Immediacy index of the research articles is on higher side in each year from the overall journal immediacy index. During the study period the average journal immediacy index was 2.75 whereas the same for research articles was 7.49 and their difference was 4.74. Immediacy index of the journal ranged between 2.2-3.09 while that of articles ranged between 6.04-8.52 and their difference ranged between 3.74-5.45 during the study period. This clearly shows that the research articles influence in overall

Table 2: Comparison of citations of articles and overall items (including articles) published by Nature

Year	Total Item	Total Item Citation	Article	Total Article citation	% share of article in total citation	Immediacy Index of The Whole Journal (JII)	Immediacy index of Articles only (AII)	All-JII
2006	2733	6425	906	5518	85.88	2.35	6.09	3.74
2007	2679	5909	786	4753	80.43	2.20	6.04	3.84
2008	2631	7141	868	6305	88.29	2.71	7.26	4.55
2009	2544	7069	800	6152	87.02	2.77	7.69	4.92
2010	2577	7445	825	6523	87.61	2.88	7.90	5.02
2011	2591	7975	804	6857	85.98	3.07	8.52	5.45
2012	2651	7840	835	6824	87.04	2.95	8.17	5.22
2013	2605	6986	832	6054	86.65	2.68	7.27	4.59
2014	2561	7927	828	6800	85.78	3.09	8.21	5.12
2015	2639	7504	851	6583	87.72	2.84	7.73	4.89
Average	2621.1	7222.1	833.5	6236.9	86.24	2.75	7.49	4.74

impact of the *Nature* journal. The highest AII (8.52) and highest value of AII-JII (5.45) was seen in the year 2011 while the lowest AII (6.04) was seen in the year 2007 and lowest value of AII-JII (3.74) was seen in the year 2006. The difference between AII-JII has seen an increasing trend, this only shows the growing impact of *Nature's* research articles.

Objective 3: Authorship Pattern of Articles:

There were all total of 107334 authors distributed in 8335 articles. The total authors in each year have seen a growing trend. The average authorship per paper is also increasing. The collaborative index in each year shows a very high degree of collaboration in the research articles published in *Nature*. For calculating the degree of collaboration formula given by Subramaniyam¹⁹ was used,

$$C = N_m / (N_m + N_s)$$

Here, C= degree of collaboration, C≈1 means high degree of collaboration

N_m= No of multi authored paper, N_s= no of single authored paper

2 to 10 authored papers have highest share each year, while single authored papers have the least share each year. From 2006 to 2015, 67.4% of articles published in *Nature* have 2 to 10 authors, and 20.2% papers have authorship between 11 to 20 authors. There were papers in *Nature* with more than 50 authors also. Papers which have seen authorship between 41 or more is 3.7% of total 8335 papers. From 2006 to 2015, the average authorship was 12.88 authors per article with only 147 single

authored articles out of total 8335 articles with a degree of collaboration of 0.98. Highest average authorship was seen in the year 2015 with 19.92 authors per article and lowest was in the year 2006 with 8.03 authors per article. In the year 2014 only two single author paper was published out of 828 papers. The degree of collaboration was always above 0.95 in the study period. This only shows that the researches published in *Nature* are of highly collaborative nature.

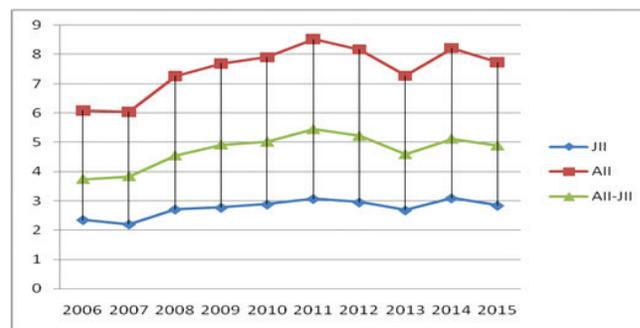


Figure 2: AII vs. JII comparison of *Nature*

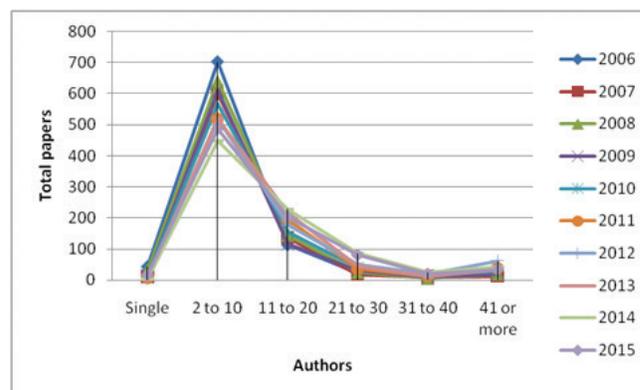


Figure 3: Authorship density of *Nature* research articles

Table 3: Authorship range in research articles and their collaborative index

Year	1	2 to 10	11 to 20	21 to 30	31 to 40	41 or more	Total Authors	total papers	Average author /paper	Collaborative Index
2006	43	702	113	21	11	16	7538	906	8.3	0.95
2007	10	601	136	17	10	12	7027	786	8.94	0.98
2008	31	640	145	25	6	21	8132	868	9.36	0.96
2009	11	610	117	31	9	21	8131	800	10.17	0.98
2010	15	568	157	40	17	28	10564	825	12.8	0.98
2011	7	517	194	36	13	37	10737	804	13.35	0.99
2012	5	521	177	50	18	61	14726	835	17.69	0.99
2013	6	520	215	45	12	34	10349	832	12.43	0.99
2014	2	448	227	86	24	41	13252	828	16	0.99
2015	17	488	204	81	20	35	16878	851	19.92	0.98
Cumulative	147 (1.7%)	5615 (67.4%)	1685 (20.2%)	432 (5.2%)	140 (1.6%)	306 (3.7%)	107334	8335	12.88	0.98

Table 4: Cited references of Nature articles

Year	Article (A)	Total journal Reference (B)	Total Journal Titles in References (C)	Average journal ref/article (D=B/A)	Average journal title referred/article (E=C/A)	Average referred article/ cited journal (F=D/E)
2006	906	21589	2243	23.82	2.47	9.64
2007	786	20965	2101	26.67	2.67	9.99
2008	868	24671	2260	28.42	2.60	10.93
2009	800	23614	2143	29.51	2.67	11.05
2010	825	25103	2346	30.42	2.84	10.71
2011	804	24943	2374	31.02	2.95	10.52
2012	835	25434	2416	30.45	2.89	10.54
2013	832	25846	2416	31.06	2.90	10.71
2014	828	29367	2674	35.46	3.22	11.01
2015	851	29944	2812	35.18	3.30	10.66
Cumulative/ Average	8335	251476	23785	30.2	2.85	10.57

Objective 4: Cited References Study

Citations given by an author to other authors are the motivations taken by any author during conducting a

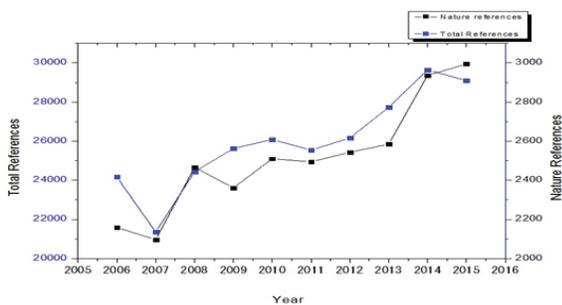


Figure 4: Comparison of self references to overall references data

research and these citations we can trace by studying the references of an article. These references establish a connection between the citing journal and the cited journal through which a type of relation can be established between the articles published between both the journals. For cited references study bibexcel bibliometric tool was used. Downloaded plain text format article data from web of science data were used for analysis through bibexcel. From the records, cited references were pulled out first, after that from the references cited journals were pulled out for each year. During this process de-duplication was not done, i.e. if a journal has multiple presence in the references of a single article then that journal was given a count for each of its article. Cited references study helps us to identify the type of references present in the

Table 5: Self citations generated by Nature in each year

Year	Total reference	Nature	% of Nature citations	Articles	Self citations/article
2006	21589	2417	11.19	906	2.67
2007	20965	2136	10.18	786	2.72
2008	24671	2444	9.9	868	2.82
2009	23614	2563	10.85	800	3.20
2010	25103	2609	10.39	825	3.16
2011	24943	2554	10.23	804	3.18
2012	25434	2617	10.28	835	3.13
2013	25846	2773	10.72	832	3.33
2014	29367	2965	10.09	828	3.58
2015	29944	2909	9.71	851	3.42
Cumulative	251476	25987	10.33	8335	3.12

articles, understanding the self-citations a journal makes listing out the top referred journal in a particular journal's publications.

Here in Table 4 the column "Total journal references" means the references in the *Nature* articles that gives a backward citation to a journal article and the column "Total Journal titles in references" refers the journals to which those articles belong. From 2006-2015, there was all total of 251476 references present in 8335 articles, with average reference/article 27.46 and average journal title referred/article 2.85. Remember that here in column C of table 4, the problem of journal title repetition was not nullified, i.e. there is great probability that the same journals which are cited in 2006, are also get cited in the article of 2007 and the same continues to other years also. Therefore the no 23785 showing total journals referred from 2006-2015 is actually not right, it's just a cumulative count of each year's record and it contains duplicate counts also and actual unique no of journal count is less than this. But here as we are considering each year's record separately so the data measurement in other columns and rows are accurate. Average ref/article ranged between 23.82-35.46 whereas average journal title referred/article ranged between 2.47-3.3 in the study period. Existence of a significant difference between "average ref/article" and "average journal title referred/article" only suggests that the research articles in *Nature* usually tends to cite multiple articles from a single journal. Therefore to measure the average share of cited items coming from a single journal over the years, we also calculated "average referred article/cited journal", which yields that in research articles of *Nature*, at an average 10.6 items from a single journal is being cited by authors in the study period.

Self-citations generated by Nature in each year: A journal self-citation is that scenario whenever an article published in it refers to an item published in that same journal. These self-citations usually have a great value while calculating the impact factor of the journal. These self-citations can be traced out through the study of references in the articles published in the journal. When the cited references study of the research articles of *Nature* was conducted we also found out the no of references in the articles that refers to articles published in *Nature*. In bibexcel software tool this can be carried out with two options, one removing the duplicates and one including duplicates. For example there is an article in *Nature* which carries reference of three articles already published in *Nature*. Now when we will extract the reference data including duplication, then bibexcel will count three self-citations to *Nature*, and if we do the same removing duplication then bibexcel will count only one self-citation to *Nature* in such a scenario. Here in the study, the references were pulled out including duplication as because all the self-citations carry equal value for calculating impact factor. One of interesting fact that also been found out is that *Nature* remain at top of cited journal list in each year's publications (Table 6).

The amount of self citations in each year has increased in *Nature* journal but the total no of references was also increasing, so while comparing the self citations to the overall references, it hasn't showed a lot of variation (Figure 4). From 2006 to 2015, *Nature* has generated at an average of 10.33% of self citations each year with 3.12 self citations in each article. Self citations/article ranged from 2.67 to 3.58, highest in the year 2014 and lowest in the year 2006.

Table 6: Top 5 cited journals by Nature between 2006-2015

Rank	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Total Refs	21589	20965	24671	23614	25103	24943	25434	25846	29367	29944
1	Nature 11.19%	Nature 10.18%	Nature 9.9%	Nature 10.85%	Nature 10.39%	Nature 10.23%	Nature 10.28%	Nature 10.72%	Nature 10.09%	Nature 9.71%
2	Science 7.17%	Science 7.01%	Science 6.79%	Science 7.25%	Science 6.80%	Science 6.71%	Science 7.14%	Science 6.67%	Science 6.05%	Science 6.02%
3	PNAS 3.80%	PNAS 4.66%	PNAS 4.28%	PNAS 4.52%	PNAS 5%	PNAS 4.78%	PNAS 4.78%	PNAS 4.99%	PNAS 4.62%	PNAS 4.44%
4	Cell 3.29%	Cell 3.64%	Cell 3.74%	Cell 3.83%	Cell 3.83%	Cell 3.50%	Cell 3.52%	Cell 3.07%	Cell 3.51%	Cell 3.29%
5	JBC 2.4%	JBC 2.84%	JBC 2.48%	JBC 2.22%	JBC 2.37%	JBC 2.29%	JBC 2.44%	JBC 2.23%	AstroP J 1.8%	JBC 1.71%
6	AstroP J 2.56%	AstroP J 1.47%	AstroP J 1.63%	AstroP J 1.97%	AstroP J 1.78%	AstroP J 1.94%	AstroP J 1.5%	ACTD 1.23%	JBC 1.62%	AstroPJ 1.57%
Total	30.41%	29.8%	28.82%	30.64%	30.17%	29.45%	29.66%	28.91%	27.69%	26.74%

Prestige transferred to others

Findings from table 4 suggests that research articles of *Nature* tends to cite multiple articles from a single journal (average 10.6 articles from a single journal), therefore in the study an attempt was made to year wise analysis of top 5 journals which got most citations from *Nature*. Bibexcel bibliometric tool was used for this analysis also. So if we proceed through the philosophy of Pinski and Narin,²⁰ we can say that these are the journals to which *Nature* has transferred most of prestige. Table 6 shows that in all the years most of the outgoing citations from *Nature* were circulated among *Science*, *Proceedings of National Academy of Science (PNAS)*, *Cell*, *Journal of Biological Chemistry (JBC)* and *The Astrophysical journal (AstroPJ)*, respectively where *Nature* occupied the top position every year in the list. In the ten year period of study, this list was not altered, except the year 2013, when the sixth position i.e. *The Astrophysical Journal* was replaced by *Acta Crystallographica Section D (ACTD)*. But from next year onwards this position was again retained by *The Astrophysical Journal*. The total amount of outgoing citations consumed by only these six journals is shown in table 6. From 2006 to 2015, on an average these journals only have consumed 29.23% of outgoing citations from *Nature*. So we can clearly say that the researches published in these journals have a great influence in the published researches of *Nature*.

Objective 5: Top most cited journals by Nature from 2006-2015 and their subject area

For listing out the top cited journal by *Nature* from 2006-2015, it is necessary that the problem of journal title

duplication is nullified. We need to calculate the no of citations received from *Nature* by its cited journals over the study period, therefore we have merged downloaded .txt data of articles to a single file and analysed it through bibexcel tool. For pulling out the outgoing citations, de-duplication of journal title was not done. There were all total 7992 journals present in the references of 8335 articles with 251476 article references. For being included in the top cited list of journal by *Nature* the minimum threshold value of received citations by a journal was considered as 1000 during the study period. With this criterion 41 journals featured in the top cited list that shared all total of 130232 references among them (i.e. 51.78% of all outgoing references) where the top position was occupied by *Nature* itself, which is followed by the *Science* journal. The subject areas of the journals were also collected from the SCImago journal rank website for identifying the subject areas whose research articles gets most citations from *Nature*. SCImago has its own index of subjects under which it lists different journals. Some journals were listed under two or three subject categories. Those subject categories are shown in Table 7 separated by “|” symbol. Like that it was found that the top 41 journals were representing 11 different subject categories (Figure 5). 40% journals were listed under the subject area of “Biochemistry, genetics and molecular biology”, while 13% belonged to “Medicine”, 12% to “Immunology and microbiology” and 8% each to “Earth and Planetary science” and “Physics and astronomy”. If we consider a macro level analysis of subjects, then we can say that the researches published in *Nature* are little bit inclined to the field of biological and medicinal sciences, as we can list “Biochemistry, genetics

Table 7: Top cited journal by Nature and their related subject areas as per SCImago

Sr No	Citation	Journal	SCImago Subject area
1	25987	Nature	Multidisciplinary
2	16917	Science	Multidisciplinary
3	11572	Proceedings of national Academy of Sciences	Multidisciplinary
4	8736	Cell	Biochemistry, Genetics and Molecular Biology
5	5612	Journal of biological Chemistry	Biochemistry, Genetics and Molecular Biology
6	4327	The Astrophysical Journal	Earth and Planetary Sciences Physics and Astronomy
7	3022	Nature genetics	Biochemistry, Genetics and Molecular Biology
8	2581	Neuron	Neuroscience
9	2545	Nucleic acids research	Biochemistry, Genetics and Molecular Biology
10	2518	Journal of neuroscience	Neuroscience
11	2508	Acta Crystallographica Section D	Biochemistry, Genetics and Molecular Biology Medicine
12	2502	Genes and development	Biochemistry, Genetics and Molecular Biology
13	2477	Embo Journal	Biochemistry, Genetics and Molecular Biology
14	2377	Molecular cell	Biochemistry, Genetics and Molecular Biology
15	1947	Physics review letters	Physics and Astronomy
16	1833	Development	Biochemistry, Genetics and Molecular Biology
17	1830	Journal of molecular biology	Biochemistry, Genetics and Molecular Biology
18	1799	Earth and Planetary Science Letters	Earth and Planetary Sciences
19	1712	Molecular and cellular biology	Biochemistry, Genetics and Molecular Biology
20	1689	Journal of the American Chemical Society	Biochemistry, Genetics and Molecular Biology Chemical Engineering Chemistry
21	1637	Monthly Notices of the Royal Astronomical Society	Earth and Planetary Sciences Physics and Astronomy
22	1608	Current biology	Biochemistry, Genetics and Molecular Biology
23	1565	Journal of cell biology	Biochemistry, Genetics and Molecular Biology Medicine
24	1464	Bioinformatics	Biochemistry, Genetics and Molecular Biology Mathematics Computer Science
25	1423	Journal of Virology	Immunology and Microbiology
26	1373	Genome research	Biochemistry, Genetics and Molecular Biology Medicine
27	1343	Astronomy and Astrophysics	Earth and Planetary Sciences Physics and Astronomy
28	1319	Biochemistry	Biochemistry, Genetics and Molecular Biology
29	1316	Nature neuroscience	Neuroscience
30	1176	The Journal of Experimental Medicine	Immunology and Microbiology Medicine
31	1102	Nature biotechnology	Biochemistry, Genetics and Molecular Biology Immunology and Microbiology Chemical Engineering
32	1102	Icarus	Earth and Planetary Sciences Physics and Astronomy
33	1100	Blood	Biochemistry, Genetics and Molecular Biology Immunology and Microbiology Medicine
34	1057	Nature Cell Biology	Biochemistry, Genetics and Molecular Biology
35	1041	Nature immunology	Immunology and Microbiology
36	1038	Immunity	Immunology and Microbiology Medicine
37	1030	Genetics	Biochemistry, Genetics and Molecular Biology
38	1026	Journal of Immunology	Immunology and Microbiology
39	1016	Nature Medicine	Biochemistry, Genetics and Molecular Biology Medicine
40	1004	Nature Structural and Molecular Biology	Biochemistry, Genetics and Molecular Biology
41	1001	Cancer research	Biochemistry, Genetics and Molecular Biology Medicine

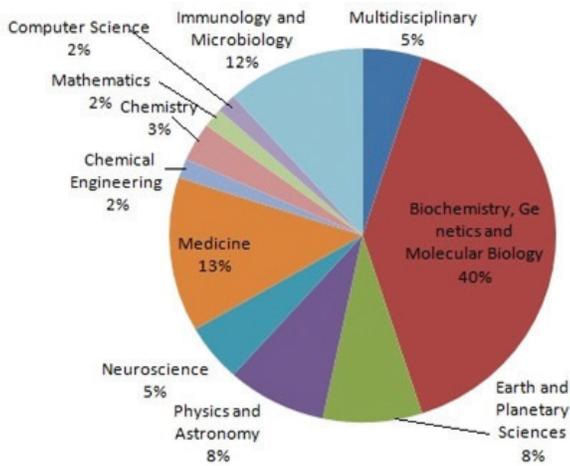


Figure 5: Subject areas of top cited journals by *Nature*

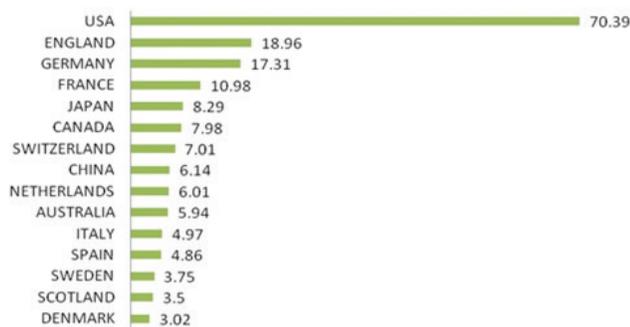


Figure 6: Country ranking in terms of article contribution to % of 8335



Figure 7: Organizations ranking in terms of article contribution % of 8335

and molecular biology”, “Medicine”, “Neuroscience”, “immunology and Microbiology” under the broader subject category of Biological and medicinal science.

Objective 6: Ranking of countries and Organizations

There were total of 107334 authors (table 3) distributed in 111 countries affiliated to 2369 organizations all over the world in the study period. We can make a ranking of the countries and organizations by the authors affiliation address. The ranking was made by % share of paper contribution from each countries and organizations.

USA and England are the top contributing countries with approx 70% and around 19% share of papers out of 8335 research articles. Japan and China are the only Asian countries to be featured in the in the top 15 countries list. Again in top 15 organizations list University of California gained the top position with 16.11 % share of papers and Harvard University got second position with 12.57% of papers. In top 15 organizations list there is 10 organizations from USA, 3 from UK, one from Germany and one from France is featured.

The massive amount of research funding of these countries may be one of the reasons of their performance in research which is reflected in their massive article contribution to *Nature* in the last 10 years. USA and China alone invested almost 26.4% & 19.8% of global research funding in the year 2015 as per the report²¹ of Industrial Research Institute. While the feature of top developed countries in the top contributing countries to *Nature* makes sense, but it also raises question about the non-feature of other developing countries from Asia or Europe in the list when the global research funding share of Asia (41.2%, excluding China) and Europe (21.3%) combined in the year 2015 were 62.5% according to the same report. Some controversial conclusions like presence of biasness in the published articles of *Nature* towards developed countries can also be inferred from findings presented in Figure. 6 & 7. So therefore to have a more clear picture of the status of different countries in world’s other the top performing publications the study was extended beyond the network of Web of Science to Nature Index²², which is a combined index of articles published in worlds top 68 journals and makes a ranking of countries and institutions based on article contribution. Nature Index, gives the prevalence of creating yearly ranking tables (current year yearly table is based on the previous year performance from January-December data) on regional and institutions level which further can be ranked on the basis of two parameters, i.e. subject disciplines and in the journal group of “Nature &Science”. For the current study, two global ranking lists of top 20 countries were pulled out for each year from 2013-2016 (currently yearly tables are available from 2013 only), one (i.e. Table 8.1) based on article contribution in the journal group of Nature and Science and other (i.e. table 8.2) based on overhaul article contribution in all Nature index journals across all subject disciplines. Comparing both the table we can observe that there is not much of difference in the country names except slight changes in their rankings. But in table 8.2 entry of two new countries, India and Chile is observed. India maintained a very good ranking spot over these four year period, while Chile appeared only once in the 2016

Table 8: Global Ranking of Top 20 countries in Nature Index**Table 8.1: Global Ranking of top 20 countries based on Article Contribution in Journal Group "Nature And Science"^{23, 24, 25, 26}**

Rank	2016		2015		2014		2013	
1	USA	1143	USA	1150	USA	1115	USA	1139
2	UK	350	UK	332	Germany	294	UK	325
3	Germany	312	Germany	309	Ukraine	275	Germany	267
4	France	199	France	201	France	157	France	173
5	Switzerland	157	China	147	China	133	Canada	148
6	China	147	Canada	141	Japan	123	Japan	129
7	Canada	139	Japan	137	Canada	121	Switzerland	112
8	Japan	122	Australia	129	Switzerland	106	Netherlands	107
9	Netherlands	106	Switzerland	113	Netherlands	97	China	100
10	Australia	105	Netherlands	112	Australia	86	Australia	98
11	Italy	90	Spain	94	Spain	67	Spain	75
12	Spain	79	Sweden	76	Italy	67	Italy	74
13	Sweden	78	Italy	65	Denmark	62	Sweden	63
14	Denmark	56	Denmark	65	Sweden	59	Austria	54
15	Belgium	51	Belgium	48	Israel	34	Denmark	54
16	Austria	47	Austria	45	Singapore	32	Belgium	40
17	Israel	45	Israel	45	Belgium	31	Israel	34
18	South Korea	40	South Korea	38	Russia	31	South Korea	24
19	Taiwan	34	Russia	33	Austria	30	Finland	24
20	Russia	32	Finland	29	South Korea	28	Brazil	24

Table 8.2: Global Ranking of top 20 countries based on Article contribution to top 68 Nature Index journals^{27,28,29,30}

Rank	2016		2015		2014		2013	
1	USA	26639	USA	26718	USA	27302	USA	27434
2	China	9666	China	8802	Germany	8664	Germany	8462
3	Germany	9142	Germany	8627	China	7631	UK	7203
4	UK	8377	UK	7641	UK	7352	China	6587
5	France	5483	France	5259	France	5239	France	5325
6	Japan	5033	Japan	5003	Japan	5093	Japan	5212
7	Italy	3414	Canada	3248	Canada	3217	Canada	3211
8	Canada	3319	Italy	3055	Italy	3080	Italy	3074
9	Spain	3215	Spain	2909	Spain	2968	Spain	3048
10	Switzerland	2955	Switzerland	2725	Switzerland	2544	Switzerland	2537
11	Australia	2683	Australia	2513	Australia	2434	Australia	2267
12	Netherlands	2486	Netherlands	2195	Netherlands	2215	Netherlands	2173
13	South Korea	2061	South Korea	1989	South Korea	1953	South Korea	1966
14	Sweden	1614	India	1502	India	1375	Sweden	1244
15	India	1589	Sweden	1411	Sweden	1297	India	1190
16	Russia	1390	Russia	1151	Russia	1061	Belgium	1059
17	Israel	1236	Belgium	1084	Belgium	1019	Israel	1033
18	Denmark	1182	Denmark	1038	Israel	1010	Taiwan	1006
19	Belgium	1157	Israel	1017	Taiwan	937	Russia	964
20	Chile	1029	Taiwan	897	Denmark	930	Denmark	842

list. Country like Taiwan has only appeared once in table 8.1, but has appeared in all the four years in table 8.2. The interesting co appearance of similar countries in both the list may only suggest that what world's other top journals are publishing is also published by *Nature & Science* journal, so the question of biasness is nullified. The reason for non-appearance of India in table 8.1 besides having a good ranking spot in table 8.2 may only suggest that India maintained a good performance rate in other top journals but not in *Nature & Science*.

CONCLUSION

The study throws light on some of the basic facts related to the *Nature* journal. The very high immediacy index of the research articles only means the widespread visibility and quick acceptability of the research articles which actually have great influence in the overall journals impact factor. *Nature* tends to cite multiple articles of a single journal and except *Nature* itself its most of the outgoing citations are absorbed by five other journals as shown in Table 6. Though *Nature* generates a very high amount of self-citation (10.33% of total journal references) but it may only mean the higher value of its own published articles. The average authorship of the research articles has seen a growing trend over the period of the study, with highest average authorship per paper seen in the year 2015 with 19.92 authors per paper and the average being 12.88 in the study period (Table 3). Research articles of *Nature* cites articles from the field of biological and medical sciences more, which in turn we can say that the published researches are also from this domain only (Figure 5) and *Nature* has a good strength in these domains.

To check the regional biasness of *Nature* articles, comparative analysis was carried out using Nature Index for top performing countries in the journal group "Nature and Science" and that in world's other top journals from 2013-2016. Presence of biasness would have resulted in significant difference in the country names of both the group, but the analysis didn't found any significant variation in the country names in both the group except relative change in rankings.

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