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Abstract

The study deals with the application of Bradford's law of scattering on Fluid Mechanics subject. It is found that verbal formulation 1: n: n^2 has not fit with the data on Fluid Mechanics. As Leimkuher model applied for verification of Bradford's law and it fits with 2:57:1462 geometric series with 0.005% of error. Other Scientometrics indicators such as DCI, ICI, author's ranking, the ranking of most preferred journals, author's impacts are used for the qualitative and quantitative analysis of research output in Fluid Mechanics subject. The study found that major 13 highly contributed countries have international collaboration trends. 'Tenduyar, T.E. is the most productive author, and 'Chemical Engineering Science' is the highest preferred journal in the field of Fluid Mechanics.

Keywords: - Bradford's law, Domestic Collaborative Index, International Collaborative Index, Leimkuhler model.

1. Introduction

Every field of knowledge developing tremendously and research are increasing with a variety of multidisciplinary approach. So, the nature of available journals and articles are very complex. In such situation it is very difficult for new researchers to find out relevant research materials. Even libraries have to think very carefully to procure the relevant reading materials to serve the users optimum. It is found that in every subject there are some journals which are referred frequently by researchers. It means these frequently cited journals are closer to the subject or research works. These highly cited journals are called as 'Central set of Journals. These journals are relevant and clearly reflect the conceptual essence of the research being carried out in the discipline. Generally, the number of these central journals are very less. These journals are reflecting not only the relevant materials but also interdisciplinary fields that are closely related to the subjects. Articles in such a central set of journals are concentrated on the content of related fields. Other rarely relevant journals are much in number and they only reflect the application of the subject in other disciplines.

[1]Samuel C. Bradford was first who described the scatteredness of journals in 1934. [2]Vickery, B.C. (1948) and [3]Brookes, B.C. (1969) described in their studies how information was scattered for a given subject based on the distribution of references. Bradford discovered that if all references of articles of a scientific journal divide into 3 equal parts or zones. The citations for the first zone would come from a small 'core' group of journals. The second zone would require more journals to achieve the same number of citations and the third zone exponentially more than the second. In moving from zone 1 to zone 3 there is a 'diminishing productivity' described by Bradford which has become known as 'Bradford's law of scattering' or 'Bradford's distribution'.

In the present study, Bradford's law applies on 'Fluid Mechanics' subject to identify the core journals of this subject and assess whether Bradford's law of scattering applies to the scattering of journals in this subject. Apart from this law, the study deals with authors ranking, authors impact calculation with h-index, g-index, and m-index, the ranking of productive preferred journals and year wise and document wise analysis.

Fluid Mechanics is an important branch of Physics. It is the study of the effect of forces and energy on liquids and gases. Liquids and gases are classified together as fluid because over a wide range of situations they have been the identical equation of motion and thus exhibit the same flow phenomena. Fluid Mechanics has divided into two branches one is classical mechanics (hydrostatics) and other is fluid dynamics (hydrodynamics). The development of fluid dynamics has been strongly influenced by its numerous applications. So, it has varied use in Mechanical Engineering, Civil Engineering, Environmental Engineering, Marine Engineering, Meteorology, Oceanography, etc. This subject is studied both theoretically and experimentally, that's why the result is described both mathematically and physically. Since 1840 the research in fluid mechanics increases continuously. Many journals are purely devoted to this subject.

2. Review of Literature: -

[4]Batcha, M. Sadik studied Scientometric analysis on oral cancer in India. It is found that 2606 articles from India published during 2010-2012. It is 6.92% of the global share. The study reveals the fact that 'Tata Memorial Hospitals', 'All India Institute of Medical Science', and 'Annamalai University' are three intuitions that published a higher number of papers. The study shows 'USA' is the most productive country with 31.34% of the global share. The paper used year-wise, country-wise, and institution wise productive in the cancer field. It is found that research productivity increases continuously and 75% of articles are published during the last three years of study. 'Oral Oncology' is the highest productive journal with 193 articles. The study shows the ranking of the most cited journals and 'Colloids and surfaces B-Biointerfaces' is the highest rank journal in oral cancer with 1180 citations. Collaboration analysis shows that about 50% of Indian publications are a result of international collaboration with 114 countries.

[5]Gunasekaran, S. and et.al. (2006), conducted a study on Chemical Science with bibliometric analysis techniques. The data collected from the CD-ROM version of the Chemistry Citation Index published in 2002. The Impact factor of journals and different rankings are analyzed. The study conveys the fact that more than 45% of articles from India appeared in journals with an impact factor less than 1%, and 2% of papers are published in journals with no impact factor. The study reveals that the 'Asian Journals of Chemistry' published higher articles with 269 papers and 'Journal of Indian Chemical Society' have 0.275 highest impact factor journal in India with 224 papers in Chemical Science. 'The India Institute of Science', Bangalore ranks first with 345 papers. The largest contributions came from Mumbai, Bangalore, Hyderabad, and Kolkata. The paper denotes that year-wise, country-wise analysis has been carried out. The distribution of impact factors on the research output of India has been analyzed. The collaborative index is used and domestic and international collaboration is stated in the study.

[6]Elango, B., and et.al. studies the Scientormetic dimension to analysis Tribology research output in BRIC countries. BRIC is an acronym that refers to Brazil, Russia, India, and China. The study identifies the pattern of Tribology research output. The study used a variety of aspects such as country wise analysis, growth rate, collaboration index, co-authorship pattern, relative research index, and different ranking with h-index for journals. The study reveals the highest publications by 'China' with 80% of total output. The highest growth of rate in publications found by 'Russia' with 63%. The collaboration rate of all countries is better.

[7]Pattanashetti, D.M., and Harinarayana N.S (2017) studied 'Assessment of Medical Engineering research output using Scientometrics indicators from Japan and South Korea'. Different parameters are used including growth collaboration indices and activity index. The finding shows that there is a decline in Japanese publication in Mechanical Engineering at the same time, the other two countries have recorded an increasing trend. South Korea has doubled its publications in the study period. Collaboration treads are increased. Bradford's law of scattering applied on cited journals and each zone covers one third of articles. The study provides a list of core journals from studied countries.

[8]Krishnamoorthy, G., and et.al. (2009) studied 'Bibliometrics analysis of Literature on diabetes during 1995-2004'. The study examined the literature indexed in the MEDLINE database. It is found

that the relative growth rate of literature decreasing year wise and doubling time increase Every year. The USA is the largest contributor to diabetes research.

[9]Neelamma, G. (2016) applied Bradford's law in the field of Botany literature from 2005 to 2014. A total of 12051 references are given in 1183 articles and 572 journals are cited. The study reveals that Bradford's law well fitted in the given data and the percentage of error is found 1.5%. The study explained various bibliometrics components such as the distribution of citations for document types, language-wise and country-wise distribution of citations, most productive journals in the field of Botany. 'USA' is the most productive country with 235 records and 'Annals of Botany' is the most productive journal in the field of Botany.

[10]Amsaveni, N. (2016) assess Bradford's law of Scattering to Neural Network literature. It is found that in the theoretical aspect this law does not fit, but the alternative such as the Leimkuhler model holds good for neural network literature. The study also provides the different types of ranking such as highly cited articles, institute wise ranking, most productive journals, relative growth rate, and doubling time indicators are also used in the study.

[11]Sudhier, K.G (2010) applied Bradford's law of Scattering to the Physics literature. The study used cited articles by doctoral theses at the Indian Institute of Science. The study provides research contributions on the various facets of Bradford's law. It covered the analysis of theoretical aspects of law as well as the application of the law in various subject fields. The Bradford multipliers were calculated and the law found to be applicable with the value of K as 1.2. When multiplier for the first two zones was calculated, where n=5, this modification fits the Bradford law for the data set. But when the mean of multiplier is considered (13.4), this law did not fit the journal distribution and the percentage of error found 68.66. The study used Leimkuhler. Model for verifications of Bradford's law and found valid. Only 0.072% found which is negligible.

3. Objective of the study: -

1. To examine the year-wise and document-wise distribution of articles.
2. To evaluate the impact of authors on Fluid Mechanics.
3. To prepare, rank lists of most preferred journals and most productive authors.
4. To analyse country wise domestic and international collaboration patterns.
5. To examine the applicability of Bradford's law of scattering in the field of Fluid Mechanics.

4. Methodology: -

The data is collected from the Web of Science. "Fluid Mechanics" OR "Mechanics of Fluid" OR "Fluid behaviour" terms are used for retrieving data in plain text format. The duration of data is from 2001 to 2019. 'Topic' is the metadata category select for retrieving data. A total of 7653 documents are taken for study. The following are the indicators and principals used to analyse and evaluate data on Fluid Mechanics.

4.1 Domestic Collaborative Index: -

The types of collaborations are local, domestic and international collaboration. [12]Katz and Martin in 1997 discussed about domestic, and international collaboration and its impact. Similarly, [13]Katz and Hicks (1997) explored how the impact varies with different types of collaboration. If the collaboration of the authors for an article belongs to the same countries is called domestic collaboration. To analysis the degree of domestic collaboration, the Domestic Collaborative Index is used. The following formula used to get DCI.

$$\mathrm{DCI} = \frac{\mathrm{D}i/\mathrm{D}io}{\mathrm{D}o/\mathrm{D}oo}\ X\ 100$$

Where Di= number of domestically co-authored paper for block 'i'

Dio = number of domestically co-authored paper for all the blocks

Do= Total number of co-authored papers

Doo= Total output

4.2 International Collaborative Index: -

If an article having at least one foreign address is called international collaboration. To analyse the degree of International Collaboration the following formula of ICI is used.

$$ICI = \frac{Ii/Iio}{Io/Ioo} X\ 100$$

Where I*i*= number of internationally co-authored papers for block 'i'

I*io* = number of internationally co-authored paper for all the blocks

I*o* = Total number of co-authored papers for block

I*oo*= Total output

If the value of DCI or ICI is equal to 100 it means a given country's collaborative efforts correspond to the World average. If DCI or ICI >100 indicates collaboration efforts higher than World's average and if DCI or ICI<100 it means less than average collaboration.

4.3 Bradford's law of scattering: -

Bradford's law of scattering (of subjects in information sources) is often mentioned together with Zipf's law (of word occurrences) and Lotka's law (of authors productivity) is one among the three important bibliometric laws. Bradford states that if scientific journals are arranged in order of decreasing productivity of articles on a given subject, they may be divided into a nucleus of periodical more particularly devoted to the subject and several other group of zones as the nucleus'. It means that if we arrange journals with highest to lower citation, we found there are very less journals in core with large citation and in the second zone a large number of journals required to achieve the same number of citation in the core zone and even the number of journals increases in the third zone to get same citations. The number of groups of journals to produce a nearly equal number of articles is roughly in proportion to 1: n: n^2 …. where 'n' is calling the Bradford multiplier.

In the present study, Bradford's law is being tested on the Fluid Mechanics subject, and this law again verified with the Leimkuhler's model. This model was explained by [14]Leikuhers, F.F. in 1967.

5. Analysis of Data: -

5.1 Details of publication: -

The data reveals the fact that there are 19 types of documents published on Fluid Mechanics from 2001 to 2019. A total of 7653 scholarly documents are published. In this document types, 6689 are research articles with 87.40% of total published documents. 444 are proceeding papers and 275 (3.59%) are review articles. 66 book chapters are also published with 0.86% contribution to the total.

Sr. No	Document Type	Records	% of 7653
1	Article	6689	87.40
2	Article; Proceedings Paper	444	5.80
3	Review	275	3.59
4	Editorial Material	113	1.48
5	Review; Book Chapter	66	0.86
6	Meeting Abstract	20	0.26
7	Letter	11	0.14
8	Biographical-Item	10	0.13
9	Editorial Material; Book Chapter	5	0.07
10	Correction	4	0.05
11	Article; Book Chapter	3	0.04
12	Article; Data Paper	3	0.04
13	Book Review	3	0.04
14	News Item	2	0.03
15	Article; Retracted Publication	1	0.01
16	Biographical-Item; Book Chapter	1	0.01
17	Dance Performance Review	1	0.01
18	Reprint	1	0.01
19	Software Review	1	0.01
Total		7653	100.00

Table No. 1 Distribution of Published Documents

5.2 Year wise distribution of articles and received citations: -

The study analyses the published articles on Fluid Mechanics during 19 years span. Table No. 2 represents year-wise distribution of published articles. As per data, the highest publications found in

558 in the year 2019 with 7.29% contribution to the total published articles. Data shows continuous growth in publications. Only a decrease of publication found in 2017. The highest citation received in the year 2006 with 7.94% to the total citations received by 7653 articles. In 2006 average citations per article is 28.77 and the average citation per year are 566.37. A total of 7653 articles received 135538 citations.

Sr. No.	Year	Articles	% of 7653	Citation	% Total Citation	ACPA	ACPY
1	2001	275	3.59	9095	6.71	33.07	478.68
2	2002	294	3.84	6458	4.76	21.97	339.89
3	2003	300	3.92	7547	5.57	25.16	397.21
4	2004	302	3.95	8135	6.00	26.94	428.16
5	2005	374	4.89	9109	6.72	24.36	479.42
6	2006	374	4.89	10761	7.94	28.77	566.37
7	2007	359	4.69	8963	6.61	24.97	471.74
8	2008	370	4.83	8621	6.36	23.30	453.74
9	2009	423	5.53	9123	6.73	21.57	480.16
10	2010	381	4.98	9335	6.89	24.50	491.32
11	2011	392	5.12	8826	6.51	22.52	464.53
12	2012	411	5.37	8552	6.31	20.81	450.11
13	2013	439	5.74	8152	6.01	18.57	429.05
14	2014	441	5.76	6340	4.68	14.38	333.68
15	2015	456	5.96	5600	4.13	12.28	294.74
16	2016	517	6.76	5097	3.76	9.86	268.26
17	2017	475	6.21	3048	2.25	6.42	160.42
18	2018	512	6.69	2046	1.51	4.00	107.68
19	2019	558	7.29	730	0.54	1.31	38.42
Total		**7653**	**100**	**135538**	**100**		

Table No 2: Year wise distribution of published articles with citations details

5.3 Country wise distribution of Domestic and International Collaboration: -

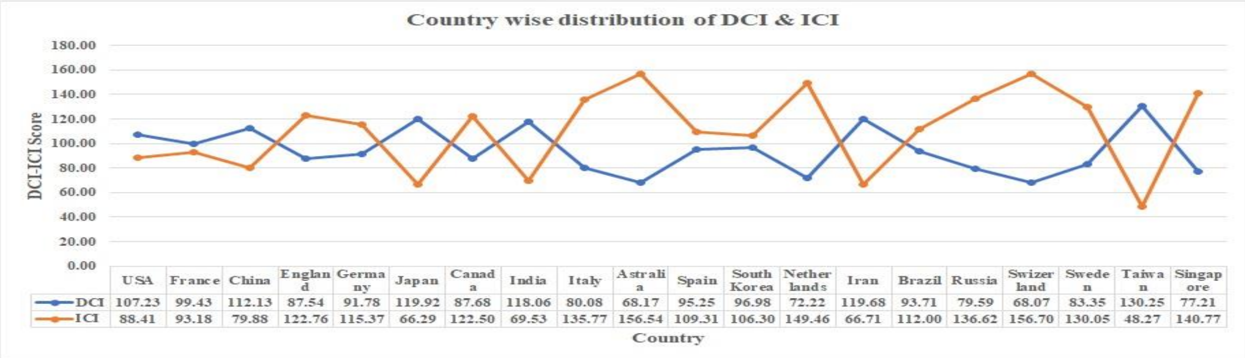
For analysing domestic and international collaboration, Domestic Collaborative Index (DCI), and International Collaborative Index (ICI) are used. As data represents in table No. 3, the highest domestic collaboration found by the authors of 'Taiwan' with 130.25 DCI value, and the lowest found by the authors of 'Australia' with 68.17 DCI value. The table denotes that 'USA' (107.23) 'China' (112.13), 'Japan' (119.92), 'India' (118.06), 'Iran' (119.68) and 'Taiwan' (130.25) have DCI value more than 100. It means these countries' domestic collaboration efforts corresponds to the World average. Table No. 3 also represents the highest international collaboration in Fluid Mechanics subject found by the author of 'Australia' and lowest found by authors of 'Taiwan'. The data expressed that 'England' (122.76), 'Germany' (115.37), 'Canada' (122.50), 'Italy' (135.77), 'Australia' (156.54), 'Spain' (109.31) 'South Korea' (106.30), 'Netherlands' (149.46), 'Brazil' (112.00), 'Russia' (136.62) 'Switzerland' (156.70), 'Sweden' (130/05) and 'Singapore' (140.77) have ICI value more than 100. It means these countries' international collaboration efforts correspond to the World's average.

Sr. No.	Country	Paper in Domestic Collaboration	DCI	Papers in International Collaboration	ICI	Total Paper
1	USA	1508	107.23	713	88.41	2221
2	France	588	99.43	316	93.18	934
3	China	634	112.13	259	79.88	893
4	England	383	87.54	308	122.76	691
5	Germany	240	91.78	173	115.37	413
6	Japan	306	119.92	97	66.29	403
7	Canada	171	87.68	137	122.50	308
8	India	228	118.06	77	69.53	305
9	Italy	144	80.08	140	135.77	284
10	Astralia	101	68.17	133	156.54	234
11	Spain	117	95.25	77	109.31	194
12	South Korea	105	96.98	66	106.30	171
13	Netherlands	75	72.22	89	149.46	164

14	Iran	122	119.68	39	66.71	161
15	Brazil	89	93.71	61	112.00	150
16	Russia	64	79.59	63	136.62	127
17	Swizerland	50	68.07	66	156.70	116
18	Sweden	57	83.35	51	130.05	108
19	Taiwan	80	130.25	17	48.27	97
20	Singapore	44	77.21	46	140.77	90
Total		**5106**		**2928**		**8064**

Table No.3: Country wise Domestic and International collaboration details

The comparison between DCI and ICI shows that in Fluid Mechanics subject major countries have international collaboration trends. The table represents only the first 20 countries which contributed higher than other countries. Out of 20, 13 countries show higher international collaborative trends in research activities.



Graph No.1: country wise representation of Domestic and International collaboration

5.4 Ranking of Authors as per productivity: -

The table No. 4 represents the ranking of authors as per their contributions in Fluid Mechanics. A total of 17413 authors contributed 7287 articles. Out of them most 50 productive authors with their contributions are given. The data shows 'Tezduyar, T.E.', is the most productive author with 46 records. 'Takizawa K.' and 'Wang L.' are second and third authors with 34 and 21 records respectively. As per the citation data, the highest citations are received by 'Tezduyar, T.E.' with 2572 citations. Second, third and fourth authors are 'Takizawa, K.', 'Bazilevs, Y,' and 'Bazilevs Y.' with 1735, 1426, and 962 citations respectively. 'Bazilevs Y.' author received the highest average citation per article with 83.88 ACP.

Sr. No.	Author	Records	Rank	% of Total 7287	Total Citation	ACP
1	Tezduyar TE	46	1	0.63	2572	55.91
2	Takizawa K	34	2	0.47	1735	51.03
3	Wang L	21	3	0.29	140	6.67
4	Yoganathan AP	20	4	0.27	786	39.30
5	Moraga NO	19	5	0.26	213	11.21
6	Delgado A	18	6	0.25	129	7.17
7	Lee SJ	18	6	0.25	435	24.17
8	Wang J	18	6	0.25	99	5.50
9	Bazilevs Y	17	7	0.23	1426	83.88
10	Ishikawa T	17	7	0.23	124	7.29
11	Salant RF	17	7	0.23	350	20.59
12	Woods AW	17	7	0.23	331	19.47
13	Pedrizzetti G	16	8	0.22	804	50.25
14	Pop I	16	8	0.22	678	42.38
15	Liu Y	15	9	0.21	314	20.93
16	Beg OA	15	9	0.21	235	15.67
17	Chhabra RP	15	9	0.21	362	24.13
18	Wang Y	14	10	0.19	78	5.57

19	Dasi LP	14	10	0.19	282	20.14
20	Joshi JB	14	10	0.19	618	44.14
21	Kumar S	14	10	0.19	264	18.86
22	Yap CH	14	10	0.19	214	15.29
23	Smith DJ	13	11	0.18	297	22.85
24	Favelukis M	12	12	0.16	78	6.50
25	Gao YT	12	12	0.16	74	6.17
26	Ishak A	12	12	0.16	603	50.25
27	Liu J	12	12	0.16	242	20.17
28	Liu L	12	12	0.16	88	7.33
29	Saenz J	12	12	0.16	222	18.50
30	Schroder W	12	12	0.16	117	9.75
31	Zhang J	12	12	0.16	87	7.25
32	Blake JR	11	13	0.15	407	37.00
33	Durst F	11	13	0.15	286	26.00
34	Hunt GR	11	13	0.15	157	14.27
35	Li Y	11	13	0.15	191	17.36
36	Sochi T	11	13	0.15	114	10.36
37	Yang C	11	13	0.15	483	43.91
38	Andersson HI	10	14	0.14	158	15.80
39	Brenier Y	10	14	0.14	165	16.50
40	Brenner H	10	14	0.14	205	20.50
41	Carvalho MS	10	14	0.14	68	6.80
42	Grotberg JB	10	14	0.14	266	26.60
43	Hasegawa T	10	14	0.14	91	9.10
44	Hayase T	10	14	0.14	107	10.70
45	Lee J	10	14	0.14	125	12.50
46	Li H	10	14	0.14	48	4.80
47	Linden PF	10	14	0.14	119	11.90
48	Marsden AL	10	14	0.14	364	36.40
49	Onate E	10	14	0.14	556	55.60
50	Thiffeault JL	10	14	0.14	304	30.40

Table No. 4: Authors ranking as per contributions to the field of Fluid Mechanics

5.5 Authors impact on research in Fluid Mechanics: -

The authors' impact can be calculated with many types of impact factors. The present study has given h-index, g-index, and m-index which are the most popular author's impact factors. h-index always represents the number of papers received equal or more than equal citations to each article of an author. As per data, the highest h-index received by 'Tezduyar, T.E.' with 31 h-index. Second and third higher h-index received by 'Takizawa, K' and 'Yoganathan A.P.' with 26 and 14 h-index respectively. g-index deals with the number of articles of an author to represent equal to squared communitive citations received by them. As per data shown in table No.5, the highest g-index author is 'Tezduyar, T.E.' with 46 g-index. The second and the third authors are 'Takizawa, K.' and 'Yoganathan, A.P.' with 34 and 20 g-index. m-index is the higher version of h-index. It is generally the average of low and high citation received during a long period of career. It includes total year of research as third variable. So that it indicates the authors' impact more precisely. As per data shows highest m-index received by 'Takizawa, K.' with 2.36 m-index score. Second and third higher m-index received by 'Tezduyar, T.E.' and Hatoum, H' with 1.94 and 1.33 m-index respectively.

Sr. No.	Authors	h-index	Authors	g-index	Authors	m-index
1	Tezduyar TE	31	Tezduyar TE	46	Takizawa K	2.36
2	Takizawa K	26	Takizawa K	34	Tezduyar TE	1.94
3	Yoganathan AP	14	Yoganathan AP	20	Hatoum H	1.33
4	Bazilevs Y	12	Lee SJ	18	Ulazia A	1.00

5	Salant RF	12	Bazilevs Y	17	Ali N	1.00
6	Pedrizzetti G	12	Salant RF	17	Gallagher MT	1.00
7	Lee SJ	11	Woods AW	17	Kumar D	1.00
8	Woods AW	11	Pedrizzetti G	16	Liu JG	1.00
9	Pop I	11	Pop I	16	Xie J	1.00
10	Chhabra RP	11	Liu Y	15	Yang K	1.00
11	Moraga NO	10	Beg OA	15	Blocken B	0.90
12	Joshi JB	10	Chhabra RP	15	Bazilevs Y	0.86
13	Blake JR	10	Moraga NO	14	Wu JH	0.86
14	Beg OA	9	Dasi LP	14	Tian SF	0.83
15	Kumar S	9	Joshi JB	14	Yoganathan AP	0.82
16	Yap CH	9	Kumar S	14	Yap CH	0.82
17	Marsden AL	9	Yap CH	14	Da Graca GC	0.80
18	Onate E	9	Smith DJ	13	Marsden AL	0.75
19	Thiffeault JL	9	Ishak A	12	Golestanian R	0.75
20	Blocken B	9	Liu J	12	Salant RF	0.67
21	Momani S	9	Saenz J	12	Pedrizzetti G	0.67
22	Sathe S	9	Wang L	11	Mukhopadhyay S	0.67
23	Yang B	9	Blake JR	11	Mahdy A	0.67
24	Delgado A	8	Durst F	11	Zhao LH	0.67
25	Ishikawa T	8	Hunt GR	11	Brun PT	0.67
26	Dasi LP	8	Li Y	11	Chen XH	0.67
27	Smith DJ	8	Yang C	11	Kadir A	0.67
28	Ishak A	8	Delgado A	10	Kelley DH	0.67
29	Liu J	8	Ishikawa T	10	Li XY	0.67
30	Saenz J	8	Schroder W	10	Anjum A	0.67
31	Durst F	8	Sochi T	10	Barbosa MC	0.67
32	Yang C	8	Andersson HI	10	Bigue JPL	0.67
33	Hayase T	8	Brenier Y	10	Bouchet G	0.67
34	Ovarlez G	8	Brenner H	10	Bratko D	0.67
35	Odibat Z	8	Grotberg JB	10	Cencini M	0.67
36	Wang L	7	Hayase T	10	Charron F	0.67
37	Hunt GR	7	Lee J	10	Cheemaa N	0.67
38	Brenner H	7	Linden PF	10	Crestanello J	0.67
39	Tian B	7	Marsden AL	10	De Pietro M	0.67
40	Wilson DI	7	Onate E	10	Denis L	0.67
41	Domenichini F	7	Thiffeault JL	10	Du T	0.67
42	Randolph MF	7	Zhang TT	10	Du Z	0.67
43	Liu Y	6	Wang J	9	Farooq M	0.67
44	Schroder W	6	Liu L	9	Fournier C	0.67
45	Andersson HL	6	Zhang J	9	Gancedo F	0.67
46	Grotberg JB	6	Hasegawa T	9	Gao XP	0.67
47	Zhang TT	6	Blocken B	9	Grosjean N	0.67
48	Chen X	6	Chen X	9	Javed M	0.67
49	Choi HJ	6	Choi HJ	9	Javed T	0.67
50	Keh HJ	6	He JH	9	Li AG	0.67

Table No. 5: Ranking of Authors as per h-index, g-index, m-index (Authors Impact)

5.6 Most Preferred Journals by Authors in Fluid Mechanics: -

Table No.6 represents the first 50 most preferred journals for publications by authors in the field of Fluid Mechanics. The highest preferred journal is 'Chemical Engineering Science' with 374 published records and 4.89% contribution to total published articles. The second and third preferred journals in ranking are 'Fluid Dynamics Research' and 'Compte Rendus Research' with 358 and 342 published records. The highest citations received by the preferred journal is ‘Chemical Engineering Science’ with 9394 citations. The highest average citation per article received by ‘Annual Review of Fluid Mechanics’ with 81.58 ACPA and the highest average citation per year received by ‘Chemical Engineering Science’ with 492.42 ACPY scores.

Sr. No.	Sources	Articles	Rank	% of 7653	Total Citation	ACPA*	ACPY**	% of Total Citation 138235
1	Chemical Engineering Science	374	1	4.89	9394	25.12	494.42	6.80
2	Fluid Dynamics Research	358	2	4.68	6241	17.43	328.47	4.51
3	Comptes Rendus Mecanique	342	3	4.47	2420	7.08	127.37	1.75
4	Journal of Fluid Mechanics	220	4	2.87	3922	17.83	206.42	2.84
5	Aiche Journal	103	5	1.35	1663	16.15	87.53	1.20
6	International Journal of Heat and Mass Transfer	79	6	1.03	1596	20.20	84.00	1.15
7	Journal of Computational Physics	71	7	0.93	2256	31.77	118.74	1.63
8	Annual Review of Fluid Mechanics	72	8	0.94	5874	81.58	309.16	4.25
9	Physics of Fluids	66	9	0.86	1524	23.09	80.21	1.10
10	Physical Review E	64	10	0.84	1126	17.59	59.26	0.81
11	Annals of Biomedical Engineering	53	11	0.69	1443	27.23	75.95	1.04
12	Journal of Non-Newtonian Fluid Mechanics	53	11	0.69	1096	20.68	57.68	0.79
13	Computers & Fluids	51	12	0.67	1154	22.63	60.74	0.83
14	Experiments in Fluids	49	13	0.64	1026	20.94	54.00	0.74
15	International Journal for Numerical Methods in Fluids	49	13	0.64	1664	33.96	87.58	1.20
16	Journal of Biomechanics	49	13	0.64	1332	27.18	70.11	0.96
17	Computer Methods in Applied Mechanics and Engineering	41	14	0.54	1397	34.07	73.53	1.01
18	Meccanica	41	14	0.54	941	22.95	49.53	0.68
19	Building and Environment	39	15	0.51	746	19.13	39.26	0.54
20	AIAA Journal	34	16	0.44	354	10.41	18.63	0.26
21	International Journal of Numerical Methods for Heat & Fluid Flow	34	16	0.44	293	8.62	15.42	0.21
22	Computational Mechanics	33	17	0.43	1361	41.24	71.63	0.98
23	Journal of Biomechanical Engineering Transactions of the ASME	33	17	0.43	576	17.45	30.32	0.42
24	Physical Review Letters	33	17	0.43	1413	42.82	74.37	1.02
25	Tribology International	33	17	0.43	465	14.09	24.47	0.34
26	Canadian Journal of Chemical Engineering	31	18	0.41	240	7.74	12.63	0.17
27	International Journal of Engineering Education	31	18	0.41	129	4.16	6.79	0.09
28	Journal of Petroleum Science And Engineering	31	18	0.41	482	15.55	25.37	0.35

29	Applied Mathematics and Computation	30	19	0.39	546	18.20	28.74	0.39
30	Industrial & Engineering Chemistry Research	30	19	0.39	1178	39.27	62.00	0.85
31	Proceedings of The National Academy of Sciences of The United States of America	27	20	0.35	1716	63.56	90.32	1.24
32	Comptes Rendus De L Academie Des Sciences Serie Ii Fascicule B-Mecanique	26	21	0.34	155	5.96	8.16	0.11
33	Journal of Chemical Physics	26	21	0.34	432	16.62	22.74	0.31
34	Proceedings of The Royal Society A-Mathematical Physical and Engineering Sciences	26	21	0.34	381	14.65	20.05	0.28
35	Journal of Fluids Engineering-Transactions Of The Asme	25	22	0.33	283	11.32	14.89	0.20
36	Environmental Fluid Mechanics	24	23	0.31	302	12.58	15.89	0.22
37	International Journal of Heat And Fluid Flow	23	24	0.30	403	17.52	21.21	0.29
38	Powder Technology	23	24	0.30	439	19.09	23.11	0.32
39	Microfluidics and Nanofluidics	22	25	0.29	712	32.36	37.47	0.52
40	Physica D-Nonlinear Phenomena	22	25	0.29	456	20.73	24.00	0.33
41	Scientific Reports	22	25	0.29	198	9.00	10.42	0.14
42	Applied Mathematics And Mechanics-English Edition	21	26	0.27	238	11.33	12.53	0.17
43	Computers & Mathematics With Applications	21	26	0.27	572	27.24	30.11	0.41
44	Heat Transfer Engineering	21	26	0.27	222	10.57	11.68	0.16
45	Ocean Engineering	21	26	0.27	461	21.95	24.26	0.33
46	Siam Journal on Mathematical Analysis	20	27	0.26	255	12.75	13.42	0.18
47	European Journal of Physics	19	28	0.25	45	2.37	2.37	0.03
48	Experimental Thermal and Fluid Science	18	29	0.24	185	10.28	9.74	0.13
49	Journal of Fluids and Structures	18	29	0.24	283	15.72	14.89	0.20
50	Journal of Theoretical Biology	18	29	0.24	181	10.06	9.53	0.13

***ACPA=Annual citations per article, **ACPY=Annual citations per year**

Table No. 6: Most preferred journals by Authors contributed to Fluid Mechanics

5.7 Implementation of Bradford's Law: -

To observe the appropriateness of the distribution of journals using the verbal formulation of Bradford's law following explanation is made and the results are presented. The first part deals with the verbal form of the theory. For this purpose, periodical journals are arranged by their decreasing frequency of citations, and the second part examines the geometric representation based on the same data.

5.7.1 Verbal Formation: -

Table No.7 shows that a total of 1521 cited journals has been arranged by a decreasing number of citations. To test the verbal formation of Bradford's law table is created with the information of journal with their ranks, total journals in each rank, cumulative journals, number of citations received by each journal, cumulative citations, the log of cumulative journals of each rank, percentage of cited journals of each rank. This information is required for testing the verbal formulation of Bradford's law.

For testing the algebraic interpretation of the law, the 1521 journals were divided into three zones. The Bradford's multiplier factor was arrived at by dividing journals of a zone by its preceding zone. Bradford's multiplier was expressed as the ratio of the number of journals in any group to the number of journals in any immediately preceding group. The basis for choosing the three zones was that the percentage error in the distribution of citations among the three-zone be minimum.

Table No 7: Cited Journals with decreasing order of citations

Rank	No of Jour.	Cum of Jour.	No of Citation	Total No. of Citation	Cum. No of Citation	Log N	% of Citation	% of Journal
1	1	1	9554	9554	9554	0.000	6.91	0.07
2	1	2	6304	6304	15858	0.693	11.47	0.13
3	1	3	4157	4157	20015	1.099	14.48	0.20
4	1	4	3512	3512	23527	1.386	17.02	0.26
5	1	5	2480	2480	26007	1.609	18.81	0.33
6	1	6	2281	2281	28288	1.792	20.46	0.39
7	1	7	1920	1920	30208	1.946	21.85	0.46
8	1	8	1758	1758	31966	2.079	23.12	0.53
9	1	9	1702	1702	33668	2.197	24.36	0.59
10	1	10	1617	1617	35285	2.303	25.53	0.66
11	1	11	1584	1584	36869	2.398	26.67	0.72
12	1	12	1546	1546	38415	2.485	27.79	0.79
13	1	13	1531	1531	39946	2.565	28.90	0.85
14	1	14	1484	1484	41430	2.639	29.97	0.92
15	1	15	1405	1405	42835	2.708	30.99	0.99
16	1	16	1401	1401	44236	2.773	32.00	1.05
17	1	17	1251	1251	45487	2.833	32.91	1.12
18	1	18	1193	1193	46680	2.890	33.77	1.18
19	1	19	1185	1185	47865	2.944	34.63	1.25
20	1	20	1129	1129	48994	2.996	35.44	1.31
21	1	21	1109	1109	50103	3.045	36.24	1.38
22	1	22	1035	1035	51138	3.091	36.99	1.45
23	1	23	988	988	52126	3.135	37.71	1.51
24	1	24	985	985	53111	3.178	38.42	1.58
25	1	25	802	802	53913	3.219	39.00	1.64
26	1	26	795	795	54708	3.258	39.58	1.71
27	2	28	720	1440	56148	3.332	40.62	1.84
28	1	29	691	691	56839	3.367	41.12	1.91
29	1	30	672	672	57511	3.401	41.60	1.97
30	1	31	668	668	58179	3.434	42.09	2.04
31	1	32	646	646	58825	3.466	42.55	2.10
32	1	33	592	592	59417	3.497	42.98	2.17
33	1	34	588	588	60005	3.526	43.41	2.24
34	2	36	587	1174	61179	3.584	44.26	2.37
35	1	37	575	575	61754	3.611	44.67	2.43
36	1	38	561	561	62315	3.638	45.08	2.50
37	1	39	555	555	62870	3.664	45.48	2.56
38	1	40	553	553	63423	3.689	45.88	2.63

39	1	41	545	545	63968	3.714	46.27	2.70
40	1	42	510	510	64478	3.738	46.64	2.76
41	1	43	500	500	64978	3.761	47.01	2.83
42	1	44	489	489	65467	3.784	47.36	2.89
43	1	45	481	481	65948	3.807	47.71	2.96
44	1	46	479	479	66427	3.829	48.05	3.02
45	1	47	474	474	66901	3.850	48.40	3.09
46	1	48	472	472	67373	3.871	48.74	3.16
47	1	49	471	471	67844	3.892	49.08	3.22
48	1	50	459	459	68303	3.912	49.41	3.29
49	1	51	451	451	68754	3.932	49.74	3.35
50	1	52	447	447	69201	3.951	50.06	3.42
51	1	53	441	441	69642	3.970	50.38	3.48
52	1	54	438	438	70080	3.989	50.70	3.55
53	1	55	436	436	70516	4.007	51.01	3.62
54	1	56	433	433	70949	4.025	51.32	3.68
55	1	57	416	416	71365	4.043	51.63	3.75
56	1	58	415	415	71780	4.060	51.93	3.81
57	1	59	406	406	72186	4.078	52.22	3.88
58	1	60	405	405	72591	4.094	52.51	3.94
59	1	61	393	393	72984	4.111	52.80	4.01
60	1	62	388	388	73372	4.127	53.08	4.08
61	1	63	387	387	73759	4.143	53.36	4.14
62	1	64	384	384	74143	4.159	53.64	4.21
63	1	65	383	383	74526	4.174	53.91	4.27
64	1	66	380	380	74906	4.190	54.19	4.34
65	1	67	379	379	75285	4.205	54.46	4.40
66	1	68	378	378	75663	4.220	54.74	4.47
67	1	69	371	371	76034	4.234	55.00	4.54
68	1	70	357	357	76391	4.248	55.26	4.60
69	1	71	354	354	76745	4.263	55.52	4.67
70	1	72	352	352	77097	4.277	55.77	4.73
71	1	73	351	351	77448	4.290	56.03	4.80
72	1	74	349	349	77797	4.304	56.28	4.87
73	1	75	347	347	78144	4.317	56.53	4.93
74	1	76	339	339	78483	4.331	56.78	5.00
75	1	77	338	338	78821	4.344	57.02	5.06
76	2	79	334	668	79489	4.369	57.50	5.19
77	1	80	328	328	79817	4.382	57.74	5.26
78	3	83	327	981	80798	4.419	58.45	5.46
79	1	84	326	326	81124	4.431	58.69	5.52
80	1	85	324	324	81448	4.443	58.92	5.59
81	1	86	322	322	81770	4.454	59.15	5.65
82	1	87	321	321	82091	4.466	59.39	5.72
83	1	88	320	320	82411	4.477	59.62	5.79
84	1	89	314	314	82725	4.489	59.84	5.85
85	2	91	309	618	83343	4.511	60.29	5.98
86	1	92	303	303	83646	4.522	60.51	6.05

87	1	93	299	299	83945	4.533	60.73	6.11
88	2	95	297	594	84539	4.554	61.16	6.25
89	1	96	291	291	84830	4.564	61.37	6.31
90	1	97	288	288	85118	4.575	61.57	6.38
91	1	98	286	286	85404	4.585	61.78	6.44
92	1	99	284	284	85688	4.595	61.99	6.51
93	1	100	283	283	85971	4.605	62.19	6.57
94	1	101	278	278	86249	4.615	62.39	6.64
95	2	103	276	552	86801	4.635	62.79	6.77
96	1	104	273	273	87074	4.644	62.99	6.84
97	2	106	270	540	87614	4.663	63.38	6.97
98	2	108	269	538	88152	4.682	63.77	7.10
99	2	110	100	200	88352	4.700	63.91	7.23
100	1	111	262	262	88614	4.710	64.10	7.30
101	1	112	261	261	88875	4.718	64.29	7.36
102	1	113	258	258	89133	4.727	64.48	7.43
103	1	114	257	257	89390	4.736	64.67	7.50
104	1	115	255	255	89645	4.745	64.85	7.56
105	1	116	254	254	89899	4.754	65.03	7.63
106	1	117	253	253	90152	4.762	65.22	7.69
107	1	118	252	252	90404	4.771	65.40	7.76
108	1	119	251	251	90655	4.779	65.58	7.82
109	2	121	250	500	91155	4.796	65.94	7.96
110	1	122	249	249	91404	4.804	66.12	8.02
111	1	123	248	248	91652	4.812	66.30	8.09
112	1	124	242	242	91894	4.820	66.48	8.15
113	1	125	241	241	92135	4.828	66.65	8.22
114	1	126	238	238	92373	4.836	66.82	8.28
115	1	127	236	236	92609	4.844	66.99	8.35
116	2	129	233	466	93075	4.860	67.33	8.48
117	2	131	230	460	93535	4.875	67.66	8.61
118	1	132	228	228	93763	4.883	67.83	8.68
119	1	133	225	225	93988	4.890	67.99	8.74
120	1	134	224	224	94212	4.898	68.15	8.81
121	1	135	218	218	94430	4.905	68.31	8.88
122	1	136	216	216	94646	4.913	68.47	8.94
123	1	137	215	215	94861	4.920	68.62	9.01
124	1	138	214	214	95075	4.927	68.78	9.07
125	1	139	212	212	95287	4.934	68.93	9.14
126	1	140	209	209	95496	4.942	69.08	9.20
127	1	141	205	205	95701	4.949	69.23	9.27
128	1	142	204	204	95905	4.956	69.38	9.34
129	1	143	200	200	96105	4.963	69.52	9.40
130	1	144	199	199	96304	4.970	69.67	9.47
131	1	145	198	198	96502	4.977	69.81	9.53
132	1	146	198	198	96700	4.984	69.95	9.60
133	1	147	198	198	96898	4.990	70.10	9.66
134	2	149	197	394	97292	5.004	70.38	9.80

135	1	150	196	196	97488	5.011	70.52	9.86
136	1	151	195	195	97683	5.017	70.66	9.93
137	1	152	193	193	97876	5.024	70.80	9.99
138	1	153	192	192	98068	5.030	70.94	10.06
139	2	155	191	382	98450	5.043	71.22	10.19
140	3	158	189	567	99017	5.063	71.63	10.39
141	1	159	188	188	99205	5.069	71.77	10.45
142	1	160	187	187	99392	5.075	71.90	10.52
143	2	162	184	368	99760	5.088	72.17	10.65
144	2	164	183	366	100126	5.100	72.43	10.78
145	1	165	182	182	100308	5.106	72.56	10.85
146	1	166	181	181	100489	5.112	72.69	10.91
147	1	167	177	177	100666	5.118	72.82	10.98
148	1	168	176	176	100842	5.124	72.95	11.05
149	2	170	172	344	101186	5.136	73.20	11.18
150	2	172	171	342	101528	5.147	73.45	11.31
151	1	173	167	167	101695	5.153	73.57	11.37
152	1	174	166	166	101861	5.159	73.69	11.44
153	3	177	165	495	102356	5.176	74.04	11.64
154	2	179	163	326	102682	5.187	74.28	11.77
155	1	180	162	162	102844	5.193	74.40	11.83
156	1	181	161	161	103005	5.198	74.51	11.90
157	1	182	160	160	103165	5.204	74.63	11.97
158	1	183	158	158	103323	5.209	74.74	12.03
159	1	184	157	157	103480	5.215	74.86	12.10
160	1	185	156	156	103636	5.220	74.97	12.16
161	1	186	155	155	103791	5.226	75.08	12.23
162	3	189	154	462	104253	5.242	75.42	12.43
163	1	190	153	153	104406	5.247	75.53	12.49
164	1	191	151	151	104557	5.252	75.64	12.56
165	1	192	150	150	104707	5.257	75.75	12.62
166	1	193	146	146	104853	5.263	75.85	12.69
167	2	195	145	290	105143	5.273	76.06	12.82
168	1	196	144	144	105287	5.278	76.17	12.89
169	1	197	143	143	105430	5.283	76.27	12.95
170	1	198	142	142	105572	5.288	76.37	13.02
171	2	200	141	282	105854	5.298	76.58	13.15
172	3	203	140	420	106274	5.313	76.88	13.35
173	2	205	138	276	106550	5.323	77.08	13.48
174	1	206	137	137	106687	5.328	77.18	13.54
175	1	207	136	136	106823	5.333	77.28	13.61
176	1	208	133	133	106956	5.338	77.37	13.68
177	1	209	132	132	107088	5.342	77.47	13.74
178	2	211	129	258	107346	5.352	77.65	13.87
179	1	212	128	128	107474	5.357	77.75	13.94
180	2	214	127	254	107728	5.366	77.93	14.07
181	1	215	126	126	107854	5.371	78.02	14.14
182	1	216	124	124	107978	5.375	78.11	14.20

183	1	217	123	123	108101	5.380	78.20	14.27
184	2	219	121	242	108343	5.389	78.38	14.40
185	3	222	120	360	108703	5.403	78.64	14.60
186	1	223	119	119	108822	5.407	78.72	14.66
187	1	224	118	118	108940	5.412	78.81	14.73
188	3	227	115	345	109285	5.425	79.06	14.92
189	1	228	114	114	109399	5.429	79.14	14.99
190	1	229	113	113	109512	5.434	79.22	15.06
191	4	233	112	448	109960	5.451	79.55	15.32
192	2	235	111	222	110182	5.460	79.71	15.45
193	1	236	110	110	110292	5.464	79.79	15.52
194	1	237	108	108	110400	5.468	79.86	15.58
195	3	240	105	315	110715	5.481	80.09	15.78
196	1	241	103	103	110818	5.485	80.17	15.84
197	2	243	102	204	111022	5.493	80.31	15.98
198	2	245	101	202	111224	5.501	80.46	16.11
199	2	247	100	200	111424	5.509	80.60	16.24
200	3	250	99	297	111721	5.521	80.82	16.44
201	1	251	98	98	111819	5.525	80.89	16.50
202	2	253	97	194	112013	5.533	81.03	16.63
203	6	259	96	576	112589	5.557	81.45	17.03
204	1	260	95	95	112684	5.561	81.52	17.09
205	1	261	94	94	112778	5.565	81.58	17.16
206	2	263	93	186	112964	5.572	81.72	17.29
207	2	265	92	184	113148	5.580	81.85	17.42
208	2	267	91	182	113330	5.587	81.98	17.55
209	2	269	90	180	113510	5.595	82.11	17.69
210	2	271	89	178	113688	5.602	82.24	17.82
211	8	279	88	704	114392	5.631	82.75	18.34
212	1	280	87	87	114479	5.635	82.81	18.41
213	7	287	86	602	115081	5.659	83.25	18.87
214	2	289	85	170	115251	5.666	83.37	19.00
215	4	293	84	336	115587	5.680	83.62	19.26
216	5	298	83	415	116002	5.697	83.92	19.59
217	5	303	82	410	116412	5.714	84.21	19.92
218	1	304	80	80	116492	5.717	84.27	19.99
219	4	308	79	316	116808	5.730	84.50	20.25
220	4	312	78	312	117120	5.743	84.73	20.51
221	1	313	77	77	117197	5.746	84.78	20.58
222	5	318	76	380	117577	5.762	85.06	20.91
223	2	320	75	150	117727	5.768	85.16	21.04
224	1	321	74	74	117801	5.771	85.22	21.10
225	3	324	73	219	118020	5.781	85.38	21.30
226	3	327	72	216	118236	5.790	85.53	21.50
227	4	331	70	280	118516	5.802	85.74	21.76
228	2	333	69	138	118654	5.808	85.83	21.89
229	3	336	68	204	118858	5.817	85.98	22.09
230	8	344	67	536	119394	5.841	86.37	22.62

231	4	348	66	264	119658	5.852	86.56	22.88
232	7	355	65	455	120113	5.872	86.89	23.34
233	3	358	64	192	120305	5.881	87.03	23.54
234	4	362	63	252	120557	5.892	87.21	23.80
235	1	363	62	62	120619	5.894	87.26	23.87
236	4	367	61	244	120863	5.905	87.43	24.13
237	2	369	60	120	120983	5.911	87.52	24.26
238	6	375	59	354	121337	5.927	87.78	24.65
239	6	381	58	348	121685	5.943	88.03	25.05
240	6	387	57	342	122027	5.958	88.28	25.44
241	4	391	56	224	122251	5.969	88.44	25.71
242	5	396	55	275	122526	5.981	88.64	26.04
243	3	399	54	162	122688	5.989	88.75	26.23
244	3	402	53	159	122847	5.996	88.87	26.43
245	7	409	52	364	123211	6.014	89.13	26.89
246	4	413	50	200	123411	6.023	89.28	27.15
247	5	418	49	245	123656	6.035	89.45	27.48
248	3	421	48	144	123800	6.043	89.56	27.68
249	8	429	47	376	124176	6.061	89.83	28.21
250	4	433	46	184	124360	6.071	89.96	28.47
251	9	442	45	405	124765	6.091	90.26	29.06
252	4	446	44	176	124941	6.100	90.38	29.32
253	3	449	43	129	125070	6.107	90.48	29.52
254	11	460	42	462	125532	6.131	90.81	30.24
255	10	470	41	410	125942	6.153	91.11	30.90
256	12	482	40	480	126422	6.178	91.45	31.69
257	10	492	39	390	126812	6.198	91.74	32.35
258	8	500	38	304	127116	6.215	91.96	32.87
259	8	508	37	296	127412	6.230	92.17	33.40
260	8	516	36	288	127700	6.246	92.38	33.93
261	6	522	35	210	127910	6.258	92.53	34.32
262	10	532	34	340	128250	6.277	92.78	34.98
263	8	540	33	264	128514	6.292	92.97	35.50
264	13	553	32	416	128930	6.315	93.27	36.36
265	11	564	31	341	129271	6.335	93.52	37.08
266	9	573	30	270	129541	6.351	93.71	37.67
267	9	582	29	261	129802	6.366	93.90	38.26
268	7	589	28	196	129998	6.378	94.04	38.72
269	6	595	27	162	130160	6.389	94.16	39.12
270	9	604	26	234	130394	6.404	94.33	39.71
271	11	615	25	275	130669	6.422	94.53	40.43
272	12	627	24	288	130957	6.441	94.74	41.22
273	12	639	23	276	131233	6.460	94.93	42.01
274	14	653	22	308	131541	6.482	95.16	42.93
275	32	685	21	672	132213	6.529	95.64	45.04
276	16	701	20	320	132533	6.553	95.88	46.09
277	21	722	19	399	132932	6.582	96.16	47.47
278	18	740	18	324	133256	6.607	96.40	48.65

279	19	759	17	323	133579	6.632	96.63	49.90
280	21	780	16	336	133915	6.659	96.87	51.28
281	21	801	15	315	134230	6.686	97.10	52.66
282	21	822	14	294	134524	6.712	97.32	54.04
283	22	844	13	286	134810	6.738	97.52	55.49
284	31	875	12	372	135182	6.774	97.79	57.53
285	30	905	11	330	135512	6.808	98.03	59.50
286	41	946	10	410	135922	6.852	98.33	62.20
287	42	988	9	378	136300	6.896	98.60	64.96
288	43	1031	8	344	136644	6.938	98.85	67.78
289	38	1069	7	266	136910	6.974	99.04	70.28
290	54	1123	6	324	137234	7.024	99.28	73.83
291	44	1167	5	220	137454	7.062	99.44	76.73
292	65	1232	4	260	137714	7.116	99.62	81.00
293	76	1308	3	228	137942	7.176	99.79	86.00
294	80	1388	2	160	138102	7.236	99.90	91.26
295	133	1521	1	133	138235	7.327	100.00	100.00

5.7.2 Bradford's Zone (as per Verbal Formulation): -

Bradford's Zone	Number of Journals	% of Journals(1521)	Number of Citation
Zone 1 (core)	18	1.18	46680
Zone 2	110	7.23	45693
Zone 3	1393	91.58	45862
Total	1521	100	138235

Table No. 8: Bradford's zone of citied journals in Fluid Mechanics

The present data given in table No. 8 shows that 18 journals (1.18% to the total cited journals) cover 46680 articles, next 110 journals cover 45693 articles and zone three shows 1393 journals having 45,862 articles. It means one-third of the total citations have been covered by each group. According to Bradford's law, zone wise distribution will form an approximately geometric series in the form 1: n: n^2. But it is found that the relationship of each zone in the present study is 18:110:1393. This does not fit Bradford's distribution.

Here 18 present the number of periodicals in the nucleus and n=11.83 as a multiplier. The mean value of the multiplier is 11:83.

Therefore, 1: n: n^2

= 20:20*11.83:20*$(11.83)^2$

= 20:236.6:2798.98

percentage of error = [(2798.98-1521) /1521] *100 = 84.02%

Since the percentage error is high 84.02 data does not fit the Bradford's law.

5.7.3 Application of Egghe's Leimkuhler Model: -

Bradford's law does not fit the given data in the study, therefore, the Leimkuhler model was employed for verification of Bradford's law. For the present study the citation distribution was divided into three zone, so p=3 where p denotes the number of Zone. Then the following formula is used

To find out K

$k = (e^y * Ym)^{1/p}$

Where y is Euler's number having value 0.57772

E =2.718

Ym is the number of citations of rank one journal

P is Bradford group or number of zones i.e., p=3

From the table the highest citations are 9554.

Hence Y_m =9554

So that $K = (2.718^{0.57772} * 9554)^{1/3}$
$= (1.781 * 9554)^{1/3}$
$= (17015.674)^{1/3}$
$=25.7206$
Using K, we can calculate different Bradford groups. The nucleus zone r_o can be defined as
$r_o = T(K-1)/(k^p-1)$
Where, T represents the total number of journals in this study are 1521.
So, $r_o = 1521*(25.7206-1) / (25.7206^3 -1)$
$= (1521* 24.7206)/ (17015.44-1)$
$= 37600.03 / 17014.44$
$= 2.21$
Different Bradford zones can be obtained using the value of k and r_o
Nucleus zone $r_o = r_o * 1 = 2.21$
First zone $r_1 = r_o * k$
$= 2.21 * 25.7206$
$= 56.84$
Second zone $r_2 = r_o * k^2$
$= 2.21 * (25.7206)^2$
$= 2.21 * 661.55$
$= 1462.03$
As Bradford's zones represent 2.21: 56.84: 1462.03
Total numbers of journals as per above = 2.21 + 56.84 + 1462.03 = 1521.08
Percentage of error = (1521.08-1521) / 1521 = 0.005%
Theoretical value is very near to the observed value and 0.005% of error is very small. It follows the Bradford's law of scattering in the area of Fluid Mechanics.
As per the Leimkuher model Bradford's zone of cited journals are as follow:

Bradford's Zone	Number of Journals	% of Journals(1521)	Number of Citation
Zone 1 (core)	2	0.13	15858
Zone 2	57	3.75	56328
Zone 3	1462	96.12	66049
Total	1521	100	138235

Table No. 9 Bradford's distribution of cited journals as per Leimkuhler model

Table No.9 shows that 2 journals are cited 15858 which are core journals in the subject of Fluid Mechanics. The next 57 journals are in zone 2 of Bradford's law which are nearest to the subject and zone 3 represents 1462 journals in which the information of Fluid Mechanics scattered.

6. Finding and Conclusion: -

From the different Scientometrics indicators and use of Bradford's law of scattering following facts come to know:

1. Document analysis found that 87.40 % are research articles. 3.59% are proceeding papers and 0.86% are book chapters.
2. In the year wise distribution highest publications found in 2019 with 558 (7.29%) articles and highest citations received in 2017 with 7653 citations.
3. In collaboration analysis, it is found that major 13 highly contributed countries have international collaboration trends.
4. Ranking of authors told that 'Tezduyar, T.E.' is the most productive author with 46 records. He has received the highest citations for the records with 2572 citations.
5. The author's impact on the research of Fluid Mechanics expressed that 'Tezduyar, T.E.' received the highest h-index and g-index with 31 and 46 score respectively. 'Takizawa, K.' received the highest m-index score with 2.36.
6. 'Chemical Engineering Science' is the highest preferred journals with 374 publications.

7. As per the three zones of cited periodicals with equal cited articles has not been fit in Bradford's law of Scattering. But the analysis given by Eggle's Leimkuher model shows that Bradford's law will be fit with 2:57:1462 geometric series of cited periodicals with 0.005% of error.

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