Collection Building

Citation analysis of dissertations for collection development

Dilani Kanishka Abeyrathne

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Dilani Kanishka Abeyrathne
Main Library, University of Peradeniya, Peradeniya, Sri Lanka

Abstract

Purpose – This study aims to make recommendations for library collection development because undergraduates expect to satisfy their information need for research activities through library collection. Therefore librarian should assess whether the library is adequately responding their research demands. This can be answered by analyzing citations in the dissertations.

Design/methodology/approach – The study analyzed 8,224 citations from 204 undergraduate dissertations submitted to the Faculty of Agriculture, University of Peradeniya, Sri Lanka, in 2012. The most cited format was determined. Bradford's law was applied to prepare a ranked list of journals. Accessibility of each core journals was observed and recommendations were made for collection development.

Findings – Journals were the most cited format. Data sets were fit with either the verbal formula or mathematical formula of the Bradford's law. Core journals were determined. Core journals were accessible via number of ways. Some journals are subscribed by the Agriculture or via databases through UGC consortia (through University of Peradeniya's library network) or open access journals. There are several journals in which the free access is available through Sri Lanka Journals OnLine. Based on the results, recommendations were made for collection development.

Originality/value – The paper provides useful insight for collection development for research demand, Agriculture Library, University of Peradeniya, Sri Lanka.

Keywords Bradford's law, Citation analysis, Dissertations

Paper type Research paper

Introduction

University libraries focus their collection development activities on literature that support the curricula. When undergraduates undertake research activities, they expect to satisfy their information needs mainly through the library collection. The library should adequately respond to such research demands. How can the librarian assess this? It can be answered by analyzing bibliographic citations in theses. Bibliometrics' is derived from two Greek words "biblio" and "metriko's" meaning book and measurement (Zafrunnisha, 2012). "Citation analysis is a branch of bibliometrics that examines the citations found in publications such as journal articles and books to look for patterns of use" (Hoffmann and Doucette, 2012).

Academic librarians must understand the research and scholarly needs of their students. The citation analysis would allow librarians to make decisions about collection development policy to design and improve services. The common approach of citation analysis is to analyze theses or publications at a particular institution.

For "collection management", the more frequently cited publications are the more valuable and more important ones to have in the library collection. Most and least-cited journals are important to make acquisition or cancellation decisions and examining age of cited references to help develop storage and retention policies. However, "there is a gap in the literature in that there is no consolidated set of guidelines or considerations on the methodology for citation analysis studies" (Hoffmann and Doucette, 2012). These highly cited journals are listed as core journals and the concept of core journals has derived from Bradford's law of scattering (Sudhier, 2010).

At the Faculty of Agriculture, University of Peradeniya, undergraduates are required to complete a research project and submit a report to graduate. The agriculture library deposits these dissertations which provide a convenient source of bibliographies for examination. As an Assistant Librarian, the author needs to make sure that library fulfills the research needs of agriculture undergraduates by analyzing citations in the undergraduate dissertations.

Objectives of this study are to:

- determine the principal formats of literature used for undergraduates dissertations;
- prepare ranked list of periodicals;
- check the accessibility of core journals; and
- make recommendations for collection development.

Literature review

Lo (2007) has examined 13 dissertations submitted to life science-related departments in 2005 and 2006 and journal

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articles were the most cited material type, although books, laboratory manuals and theses were seen in references. Library and Information Science (LIS) dissertations analyzed by Chikate and Patil (2008) identified that nearly half of the citations were from journals (42.2 per cent). Books, Web, reference books, proceedings, reports, theses, newspapers, interviews, pamphlets and manuscripts were also cited. Similar results were obtained by Trigar *et al.* (2013) in their study of graduate dental theses of medical science. Journals were the most popular format. Abut and Babatope (2011) has conducted a similar study with 50 copies of undergraduate projects submitted to departments of LIS and physics. But physics students cited more books, while LIS students cited more journals. Wilson (2012) examined 88 undergraduate honors theses from 2002 to 2009. Books and journals accounted for most of the citations in all disciplines except social sciences, where newspapers and magazines accounted for 32 per cent and 6 per cent respectively. Web sources, magazines, conference proceedings, theses and dissertations and other sources were also cited. Gadd *et al.* (2010) examined final-year projects from MEng Civil Engineering (civil) and BSc Construction Engineering Management (CEM). Journals were frequently cited by MEng students, while CEM students frequently cited books. Brazzeal and Fowler (2005), Kumar and Reddy (2012), Gao *et al.* (2009), Fasae (2012) and Zafrunnisha (2012) have analyzed Masters and/or PhD theses for different disciplines and journal articles were most often cited.

Figure 1 Format distribution of cited literature

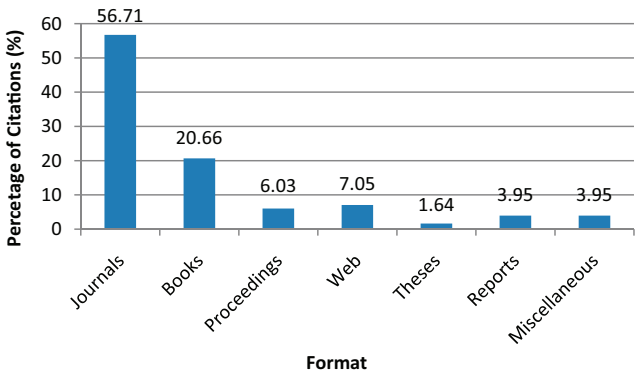
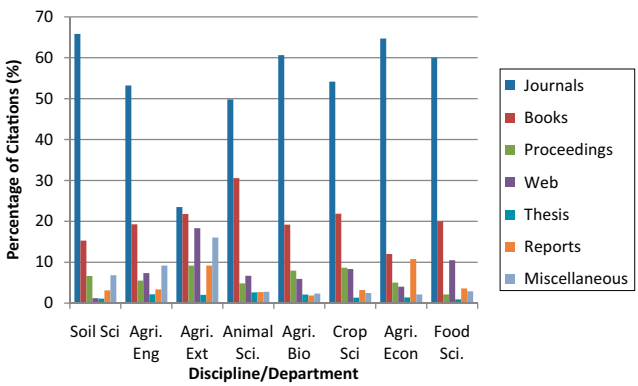


Figure 2 Format distribution of cited literature in eight disciplines



Methodology

This study examined 204 undergraduate dissertations submitted to the Faculty of Agriculture, University of Peradeniya, Sri Lanka, in 2012. They belong to eight major disciplines: soil science, agricultural engineering, agricultural extension, animal science, agricultural biology, crop science, agricultural economics and food science. The reference lists of each work were analyzed individually and citations were categorized into journals, books, proceedings, Web, theses, reports (annual reports, field documents and technical

Table I Distribution of journals in the Department of Soil Science

Rank	No. of Journals	Cumulative number of Journals	No. of citations	Total number of citations	Cumulative number of citations	log *n*	(%) Cumulative citations
1	1	1	50	50	50	0	6.993006993
2	1	2	32	32	82	0.693	11.46853147
3	1	3	23	23	105	1.099	14.68531469
4	1	4	23	23	128	1.386	17.9020979
5	1	5	18	18	146	1.609	20.41958042
6	3	8	16	48	194	2.079	27.13286713
7	2	10	15	30	224	2.303	31.32867133
8	1	11	13	13	237	2.398	33.14685315
9	1	12	11	11	248	2.485	34.68531469
10	5	17	10	50	298	2.833	41.67832168
11	2	19	9	18	316	2.944	44.1958042
12	2	21	7	14	330	3.045	46.15384615
13	7	28	6	42	372	3.332	52.02797203
14	6	34	5	30	402	3.526	56.22377622
15	7	41	4	28	430	3.714	60.13986014
16	16	57	3	48	478	4.043	66.85314685
17	45	102	2	90	568	4.625	79.44055944
18	147	249	1	147	715	5.517	100

reports) and miscellaneous (government documents, circular, patents, standards, laboratory manual, course materials, power point presentations and posters).

A total of 8,224 citations were analyzed quantitatively. Cited journals in each department were then arranged separately in the descending order and Bradford's law was applied to determine core journals in each department. Accessibility of each core journal was checked to make recommendations.

Application of Bradford's law

Bradford Law of scattering is a widely used tool to study the productivity of journals. It describes the quantitative relationship between journals where journals are arranged in descending order of productivity and divided into equal zones. He defined the first zone as "nuclear zone", which is highly productive and a small number of core journals belong to this zone. The second zone is moderately productive, while the third zone is less productive.

Table II Scattering of journals & citations over Bradford zones (Soil science)

Zone	No. of journals	No. of citations	(%) Journals	(%) Citations
1	11	237	4.418	33.147
2	46	241	18.474	33.706
3	192	237	77.108	33.147
Total	249	715	100	100

Figure 3 Bradford plot for journal distribution in department of soil science

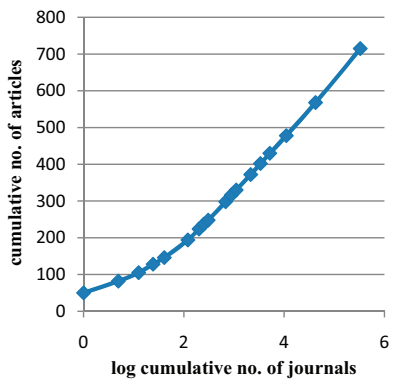
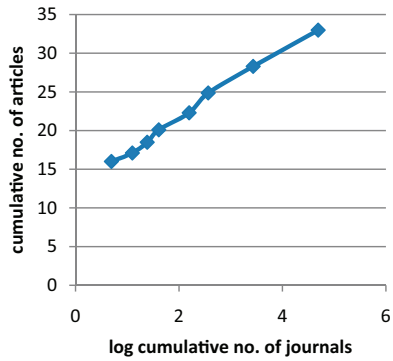


Table IV Scattering of journals and citations over Bradford zones (agricultural engineering)

Zone	No. of journals	No. of citations	(%) Journals	(%) Citations
1	9	50	8.257	28.409
2	22	48	20.183	27.273
3	78	78	71.560	44.318
Total	109	176	100	100

Figure 4 Bradford plot for journal distribution in department of agricultural engineering



Bradford stated his law of scattering as follows:

> [. . .] the law of distribution of papers on a given subject in scientific periodicals may thus be stated: if scientific journals are arranged of decreasing productivity of articles on a given subject, they may be divided into a nucleus of periodicals more particularly devoted to the subject and several groups or zones containing the same number of articles as the nucleus, when the numbers of periodicals in the nucleus and succeeding zones will be as 1: n: n2 [. . .] (Bradford, 1950, p. 116).

Bradford did not give a mathematical model for his law. Models were suggested later by Brookes, Vickery and Leimkuhler. Leimkuhler developed a model based on Bradford's verbal formulation (Sudhier, 2010):

$$R(r) = a \log (1 + br) \quad (1)$$

r = 1, 2, 3 [. . .]

R(r) is the cumulative number of items produced by sources of rank r, and a and b are constants appearing in the law of Leimkuhler. This can be used to calculate the number of articles provided by a journal at a particular rank. $R_{(1)}$ is the number of articles of the top-ranked journal.

Table III Distribution of journals in the Department of Agriculture Engineering

Rank	No. of journals	Cumulative number of journals	No. of citations	Total number of citations	Cumulative number of citations	log *n*	(%) Cumulative citations
1	2	2	8	16	16	0.693	9.090909091
2	1	3	7	7	23	1.099	13.06818182
3	1	4	6	6	29	1.386	16.47727273
4	1	5	5	5	34	1.609	19.31818182
5	4	9	4	16	50	2.197	28.40909091
6	4	13	3	12	62	2.565	35.22727273
7	18	31	2	36	98	3.434	55.68181818
8	78	109	1	78	176	4.691	100

Table V Distribution of journals in the Department of Agricultural Extension

Rank	No. of Journals	Cumulative number of Journals	No. of citations	Total number of citations	Cumulative number of citations	log *n*	(%) Cumulative citations
1	1	1	5	5	5	0	6.097560976
2	1	2	4	4	9	0.693	10.97560976
3	1	3	3	3	12	1.099	14.63414634
4	7	10	2	14	26	2.303	31.70731707
5	56	66	1	56	82	4.19	100

While explaining Leimkuhler's Law, Egghe (1985, 1990a, 1990b) have shown:

$$a = Y_o/\log K \quad (2)$$

$$b = (k - 1)/r_o \quad (3)$$

Where r_o is number of sources in the first Bradford's group, Y_o is the number of items in every Bradford group (all these groups of items being equal size), k is Bradford multiplier.

Egghe (1986) has shown the mathematical formula for k. If journals are ranked in decreasing order of productivity, Ym is the number of items in the top ranked journal, p is number of groups. Once p and Y_m are determined by raw data, k can be calculated:

$$k = (e^{\gamma}Y_m)^{1/p} \quad (4)$$

Where γ is Euler's number ($\gamma = 0.5772$)

$(e^{\gamma} = 1.781)$

$k = (1.781 \times Y_m)^{1/p}$

Then Y_m and r_o are:

$$Y_o = Y_m^2 \log k \quad (5)$$

and:

$$r_o = (k - 1)Y_m \quad (6)$$

These two formulas have limited application because Y_o and r_o can be easily derived using practical data as follows.

Table VI Scattering of journals and citations (agricultural extension)

Zone	No. of journals	No. of citations	(%) Journals	(%) Citations
1	10	26	15.152	31.707
2	28	28	42.424	34.146
3	28	28	42.424	34.146
Total	66	82	100	100

Table VII Scattering of journals and citations based on Leimkuhler model (agricultural extension)

Zone	No. of journals	No. of citations	(%) Journals	(%) Citations
1	9	24	13.636	29.268
2	19	20	28.788	24.390
3	38	38	57.576	46.341
Total	66	82	100	100

Egghe (1990a, 1990b) has shown:

$Y_o = A/P$, where A denotes the total number of articles.

When T is the total number of journals in Bradford's group, there are $r_o k^{i-1}$ sources (i = 1, 2, 3 [. . .] p):

$$T = r_o + r_o k + r_o k^2 + \ldots\ldots r_o k^{p-1} \quad (7)$$

$$\text{So } r_o = T/(1 + k + k^2 + \ldots\ldots k^{r-1}) = T\,(k - 1)/(k^p - 1) \quad (8)$$

As A and T are known from the data set, r_o and Y_o are calculated when k is calculated by formula (4).

Results and discussion

This study revealed 8,224 citations from the 204 undergraduate dissertations submitted to the Faculty of Agriculture in 2012. Major findings are summarized in Figures 1 and 2.

It is obvious from Figure 1 that the journals contribute the highest percentage of citations (56.71 per cent). Books are the second highest group (20.66 per cent). Web citations account for 7.05 per cent, which leads to the third highest percentage. Other formats account for proceedings (6.03 per cent), reports (3.95 per cent), miscellaneous (3.95 per cent) and theses (1.64 per cent).

As dissertations belong to eight major disciplines, citations were analyzed separately and results are summarized in Figure 2. It shows that journals contribute the highest percentage of citations in each department followed by books as the second highest percentage of citations.

Application of Bradford's law

Soil science

In the Department of Soil Science (Tables I and II), total number of citations (715) was divided into equal three zones.

Figure 5 Bradford plot for journal distribution in department of agricultural extension

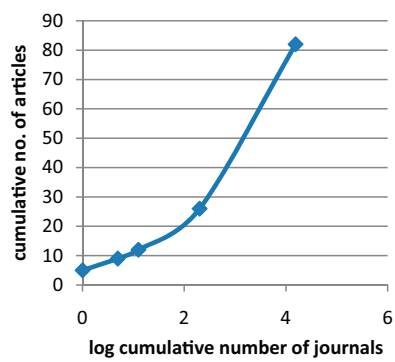


Table VIII Distribution of journals in the Department of Animal Science

Rank	No. of Journals	Cumulative number of Journals	No. of citations	Total number of citations	Cumulative number of citations	log *n*	(%) Cumulative citations
1	1	1	37	37	37	0	5.278174037
2	1	2	31	31	68	0.693	9.70042796
3	1	3	24	24	92	1.099	13.12410842
4	1	4	23	23	115	1.386	16.40513552
5	1	5	22	22	137	1.609	19.54350927
6	1	6	19	19	156	1.792	22.25392297
7	1	7	15	15	171	1.946	24.39372325
8	1	8	11	11	182	2.079	25.96291013
9	3	11	7	21	203	2.398	28.95863053
10	5	16	6	30	233	2.773	33.2382311
11	9	25	5	45	278	3.219	39.65763195
12	6	31	4	24	302	3.434	43.08131241
13	20	51	3	60	362	3.932	51.64051355
14	48	99	2	96	458	4.595	65.33523538
15	243	342	1	243	701	5.835	100

Eleven journals (4.418 per cent, core journals) covered 237 citations (33.147 per cent), the next 46 journals (18.474 per cent) covered 241 citations (33.706 per cent) and the next 192 journals (77.108 per cent) covered 237 citations (33.147 per cent). According to Bradford zones, the relationship between each zone is 11:46:192 ($1:4:4^2$). Therefore, the data set fits with Bradford's distribution. Figure 3 shows the graphical distribution.

Agricultural engineering

When total number of citations (176) in the Department of Agricultural Engineering was divided into equal three zones, 9 journals (8.257 per cent, core journals) covered 50 citations (28.409 per cent), the next 22 journals (20.183 per cent) covered 48 citations (27.273 per cent) and the next 78 journals (71.560 per cent) covered 78 journals (44.318 per cent). The relationship between each zone 9:22:78 = 1:3:9 ($1:n:n^2$), fits with Bradford's distribution (Tables III and IV, Figure 4).

Agricultural extension

In the data set, 10 journals covered 26 citations, the next 28 journals covered 28 citations and the next 28 journals covered 28 citations. According to Bradford zones, the relationship between each zone, 10:28:28, does not fit into Bradford's distribution (Tables V and VI). Therefore the Leimkuhler model was adopted for the verification of Bradford's law of scattering.

Table IX Scattering of journals and citations over Bradford zones (animal science)

Zone	No. of journals	No. of citations	(%) Journals	(%) Citations
1	25	278	7.310	39.658
2	74	180	21.637	25.678
3	243	243	71.053	34.665
Total	342	701	100	100

Number of groups, $p = 5$

Bradford multiplier k,

$k = (e^{y}\, y_m)^{1/P}$

$k = (1.781 \times 5)^{1/3} = 2.07$

Number of items in Bradford group y_o,

$$y_o = A/P = 82/3 = 27$$

Number of sources in the first Bradford group r_o:

$$r_o = T(k-1)/(k^p - 1) = 66(2.07 - 1)/(2.07^3 - 1) = 8.97 = 9$$

Therefore Bradford's distribution:

$$9{:}9 \times 2.07{:}9 \times (2.07)^2 = 9{:}18.63{:}38.56$$

$$\text{Percentage error} = \frac{(9 + 18.63 + 38.56) - 66}{66} = \frac{(66.19 - 66)}{66} \times 100 = 0.28\%$$

Figure 6 Bradford plot for journal distribution in department of animal science

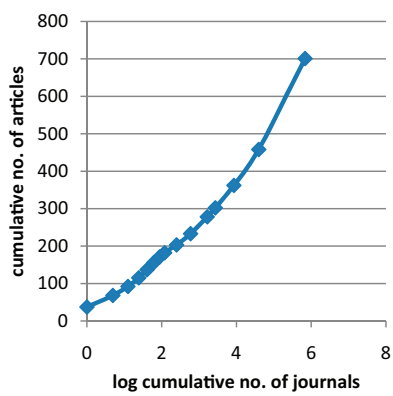


Table X Distribution of journals in the Department of Agricultural Biology

Rank	No. of Journals	Cumulative number of Journals	No. of citations	Total number of citations	Cumulative number of citations	log *n*	(%) Cumulative citations
1	1	1	44	44	44	0	5.43881335
2	1	2	28	28	72	0.693	8.899876391
3	1	3	21	21	93	1.099	11.49567367
4	1	4	14	14	107	1.386	13.22620519
5	3	7	11	33	140	1.946	17.3053152
6	3	10	10	30	170	2.303	21.01359703
7	5	15	9	45	215	2.708	26.57601978
8	6	21	8	48	263	3.045	32.5092707
9	4	25	7	28	291	3.219	35.97033375
10	4	29	6	24	315	3.638	38.93695921
11	9	38	5	45	360	3.638	44.49938195
12	14	52	4	56	416	3.951	51.42150803
13	30	82	3	90	506	4.407	62.54635352
14	49	131	2	98	604	4.875	74.66007417
15	205	336	1	205	809	5.817	100

The percentage error is negligible. Therefore, in the first zone 9 journals, the core journals (13.636 per cent) covered 24 citations (29.268 per cent), the next 19 journals (28.788 per cent) covered 20 citations (24.390 per cent) and the next 38 journals (57.576 per cent) covered 38 citations (57.576 per cent) (Table VII). Graphical distribution is shown by Figure 5.

Animal science

In the data set of department of animal science (701 citations), 25 journals (7.310 per cent, core journals) covered 278 citations (39.658 per cent), the next 74 journals (21.637 per cent) covered 180 citations (25.678 per cent) and the next 243 journals (71.053 per cent) covered 243 journals (34.665 per cent). The relationship between data 25: 74: 243 = 1:3:9 ($1:n:n^2$) fits into Bradford's law of scattering (Tables VIII and IX, Figure 6).

Agricultural biology

In the first zone, 15 journals (4.464 per cent, core journals) covered 215 citations (26.576 per cent), and in the second zone, 67 journals (19.940 per cent) covered 291 citations (35.970 per cent) and the next 254 journals (75.595 per cent) covered 303 citations (37.454 per cent) (Tables X and XI, Figure 7).

Crop science

In the department of crop science, total number of citations (813) was divided into three equal zones. Thirty journals covered 298 citations, the next 104 journals covered 284 citations and the next 231 journals covered 231 citations.

Table XI Scattering of journals and citations over Bradford zones (agricultural biology)

Zone	No. of journals	No. of citations	(%) Journals	(%) Citations
1	15	215	4.464	26.576
2	67	291	19.940	35.970
3	254	303	75.595	37.454
Total	336	809	100	100

According to Bradford zones, the relationship between each zone, 30:104:231, does not fit into Bradford's distribution (Tables XII and XIII). Therefore, Leimkuhler model was adopted for the verification of Bradford's law of scattering. Then $k = 3.5$, $y_o = 271$, $r_o = 21.79$.

Therefore, Bradford's distribution is:

$22: 22 \times 3.5: 22 \times (3.5)^2 = 22: 77: 269.5$

$$\text{Percentage error} = \frac{(368.5 - 365)}{365} \times 100 = 0.95\%$$

The percentage error is negligible. Therefore, in the first zone, 22 journals (6.027 per cent, core journals) covered 249 citations (30.627 per cent), and in the second zone, 77 journals (21.096 per cent) covered 263 citations (32.349 per cent) and the next 266 journals (72.877 per cent) covered 301 citations (37.023 per cent) (Table XIV). Figure 8 represents the graphical distribution.

Agricultural economics.

When total number of citations (517) in the Department of Agricultural Science was divided into equal three zones, 19 journals (core journals, 6.76 per cent) covered 153 citations (29.59 per cent), the next 66 journals (23.49 per cent) covered

Figure 7 Bradford plot for journal distribution in department of agricultural biology

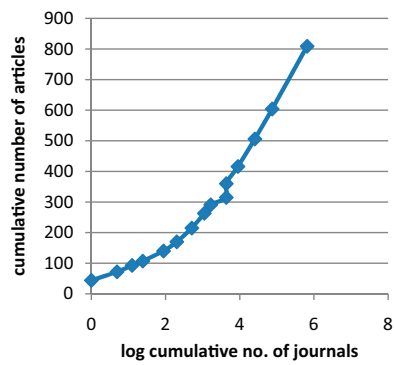


Table XII Distribution of journals in the Department of Crop Science

Rank	No. of journals	Cumulative number of Journals	No. of citations	Total number of citations	Cumulative number of citations	log *n*	(%) Cumulative citations
1	1	1	24	24	24	0	2.95202952
2	1	2	21	21	45	0.693	5.535055351
3	1	3	19	19	64	1.099	7.872078721
4	1	4	17	17	81	1.386	9.963099631
5	1	5	13	13	94	1.609	11.56211562
6	2	7	11	22	116	1.946	14.26814268
7	7	14	10	70	186	2.639	22.87822878
8	2	16	9	18	204	2.773	25.09225092
9	3	19	8	24	228	2.944	28.04428044
10	4	23	7	28	256	3.135	31.48831488
11	7	30	6	42	298	3.401	36.65436654
12	11	41	5	55	353	3.714	43.41943419
13	11	52	4	44	397	3.951	48.83148831
14	21	73	3	63	460	4.29	56.58056581
15	61	134	2	122	582	4.898	71.58671587
16	231	365	1	231	813	5.9	100

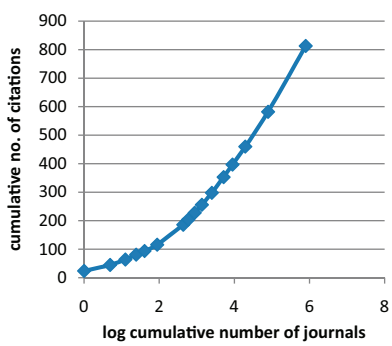
Table XIII Scattering of journals and citations (crop science)

Zone	No. of journals	No. of citations	(%) Journals	(%) Citations
1	30	298	8.219	36.654
2	104	284	28.493	34.932
3	231	231	63.288	28.413
Total	365	813	100	100

Table XIV Scattering of journals and citations based on Leimkuhler model (crop science)

Zone	No. of journals	No. of citations	(%) Journals	(%) Citations
1	22	249	6.027	30.627
2	77	263	21.096	32.349
3	266	301	72.877	37.023
Total	365	813	100	100

Figure 8 Bradford plot for journal distribution in department of crop science



168 citations (32.49 per cent) and the next 196 journals (69.75 per cent) covered 196 citations (37.91 per cent). But the relationship between each zone, 19:66:196 = 1:3:9 (1:n:n^2), fits into the Bradford's distribution (Tables XV and XVI, Figure 9).

Food science

According to Bradford zones the relationship between each zone is 15:106:260. It does not fit into Bradford's distribution (Tables VII and VIII). Therefore, the Leimkuhler model was adopted for the verification of Bradford's law of scattering. Then k = 4.9, y_o = 284.3, r_o = 12.74.

Therefore, Bradford's distribution is:

12.74: 12.74 × 4.9: 12.74 × $(4.9)^2$ = 12.74: 62.426: 305.89

$$\text{Percentage error} = \frac{(381.056 - 381)}{381} \times 100 = 0.015$$

The percentage error is negligible. Therefore, in the first zone, 13 journals (3.412 per cent, core journals) covered 265 citations (31.067 per cent), and in the second zone 62 journals (16.273 per cent) covered 236 citations (27.667 per cent) and the next 306 journals (80.315 per cent) covered 352 citations (41.266 per cent) (Table XIX). Figure 10 represents the graphical distribution.

Core journals determined are listed and accessibility is mentioned below (Table XX).

Percentage accessibility of core journals is summarized in Figure 11.

More than 55 per cent of the core journals are currently accessible for departments of soil science (72.73 per cent), agricultural engineering (55.56 per cent), animal science (80 per cent), crop science (77.27 per cent) and food science (76.92 per cent), while 44.44, 46.67 and 31.58 per cent is accessible for departments of agricultural extension, agricultural biology and agricultural economics, respectively.

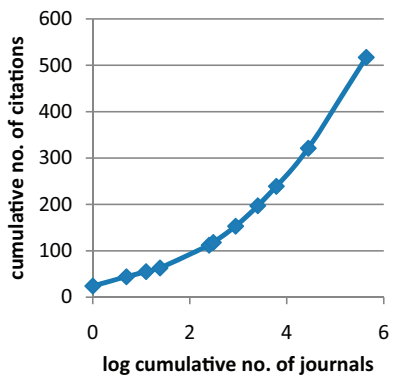
Table XV Distribution of journals in the Department of Agricultural Economics

Rank	No. of journals	Cumulative number of journals	No. of citations	Total number of citations	Cumulative number of citations	log *n*	(%) Cumulative citations
1	1	1	24	24	24	0	4.642166344
2	1	2	20	20	44	0.693	8.510638298
3	1	3	11	11	55	1.099	10.63829787
4	1	4	8	8	63	1.386	12.18568665
5	7	11	7	49	112	2.398	21.66344294
6	1	12	6	6	118	2.485	22.82398453
7	7	19	5	35	153	2.944	29.59381044
8	11	30	4	44	197	3.401	38.10444874
9	14	44	3	42	239	3.784	46.22823985
10	41	85	2	82	321	4.443	62.08897485
11	196	281	1	196	517	5.638	100

Table XVI Scattering of journals and citations over Bradford zones (agricultural economics)

Zone	No. of journals	No. of citations	(%) Journals	(%) Citations
1	19	153	6.762	29.594
2	66	168	23.488	32.495
3	196	196	69.751	37.911
Total	281	517	100	100

Figure 9 Bradford plot for journal distribution in department of agricultural economics



Conclusion

It is clear from the study that journals are the type of literature widely used by undergraduates for their research activities followed by books as the next cited format.

Data sets fit with either the verbal formula or mathematical formula (i.e. Leimkuhler model) of the Bradford's law. Therefore, core journals determined were summarized in Table XX.

Based on the results, recommendations would be made for collection development. Accessibility is through databases through UGC consortia or e-resources through library network (AGORA) or Agriculture Library subscriptions or Sri Lanka Journals OnLine. There are core journals in which the full-text accessibility is only available for open access articles which belong to the Departments of Agricultural Economics and Food Science. Agriculture Library has subscribed to *Agricultural Economics, Experimental Agriculture, Indian Food Packer, Indian Horticulture, Journal of Animal Science, Journal of Food Science, Journal of Plantation Crops, Microbiology and Molecular Biology Review* and *Soil Science Society of America Journal* in 2014. But according to the study, *Indian Food Packer, Indian Horticulture, Journal of Plantation*

Table XVII Distribution of journals in the Department of Food Science

Rank	No. of Journals	Cumulative number of Journals	No. of citations	Total number of citations	Cumulative number of citations	log *n*	(%) Cumulative citations
1	1	1	66	66	66	0	7.737397421
2	1	2	33	33	99	0.693	11.60609613
3	1	3	29	29	128	1.099	15.00586166
4	1	4	27	27	155	1.386	18.17116061
5	1	5	17	17	172	1.609	20.16412661
6	2	7	15	30	202	1.946	23.68112544
7	1	8	14	14	216	2.079	25.32239156
8	2	10	11	22	238	2.303	27.90152403
9	1	11	10	10	248	2.398	29.07385698
10	1	12	9	9	257	2.485	30.12895662
11	3	15	8	24	281	2.708	32.94255569
12	3	18	7	21	302	2.89	35.40445487
13	4	22	6	24	326	3.091	38.21805393
14	7	29	5	35	361	3.367	42.32121923
15	13	42	4	52	413	3.738	48.41735053
16	22	64	3	66	479	4.159	56.15474795
17	57	121	2	114	593	4.796	69.51934349
18	260	381	1	260	853	5.943	100

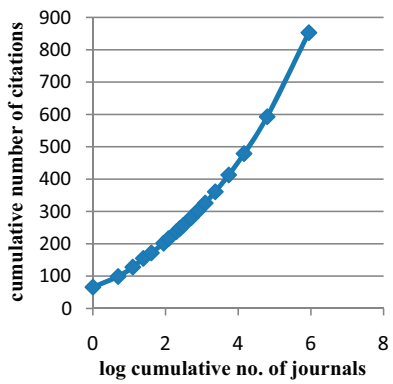
Table XVIII Scattering of journals and citations (food science)

Zone	No. of journals	No. of citations	(%) Journals	(%) Citations
1	15	281	3.937	32.942
2	106	312	27.822	36.577
3	260	260	68.241	30.481
Total	381	853	100	100

Table XIX Scattering of journals & citations based on Leimkuhler model (food science)

Zone	No. of journals	No. of citations	(%) Journals	(%) Citations
1	13	265	3.412	31.067
2	62	236	16.273	27.667
3	306	352	80.315	41.266
Total	381	853	100	100

Figure 10 Bradford plot for journal distribution in department of food science



Crops and Microbiology and *Molecular Biology Review* have not been determined as core journals. Subscription to *Agricultural Economics*, *Experimental Agriculture*, *Journal of Animal Science*, *Journal of Food Science* and *Soil Science Society of America Journal* should be continued. *Journal of Agricultural Economics* and *Journal of Food Science* have been subscribed to by the Agriculture Library and UGC consortium. Therefore, Agriculture Library can cancel their subscription to these two journals, as they are subscribed by UGC consortia.

This study will provide useful insight for collection development policy. Priority for subscriptions should be given to core journals. Therefore, it is recommended to subscribe to core journals which are currently not accessible. If there is a budget limitation, subscription of least cited journals will be cancelled. User education program on current library resources should be incorporated with current and latest subscriptions. Online resources have advantage of accessing several users at once. Therefore, focus on online subscriptions would be important. Bibliography of dissertations would be checked to see what types of resources are used. But authors of dissertations use local library resources and library uses the bibliography of dissertations to check the type of materials cited. Therefore, it is self-reflective. The study depends on final

Table XX Core journals and accessibility

Department	Rank	Journal
Soil Science	1	*Soil Science Society of America*
	2	*Environmental Quality*
	3	*Soil Biology & Biochemistry*
	4	*Soil Science*
	5	*Geoderma*
	6	*Soil Science Society of Sri Lanka*
	6	*Science of the Total Environment*
	6	*Tropical Agricultural Research*
	7	*Agricultural Sciences*
	7	*National Science Foundation*
	8	*Soil Use and Management*
Agriculture Engineering	1	*Agricultural Water Management*
	1	*Bioresource Technology*
	2	*Food Engineering*
	3	*Transactions of the ASAE*
	4	*Starch*
	5	*Field Crops Research*
	5	*Journal of American Water Works Association*
	5	*Plant & Soil*
	5	*Tropical Agriculturist*
Agriculture Extension	1	*Agricultural Economics*
	2	*Pesticide Safety Education*
	3	*Communication*
	4	*American Journal of Agricultural Economics*
	4	*Asia Pacific Business*
	4	*Environmental Protection Research*
	4	*Integrated Pest Management*
	4	*Personality & Social Psychology*
	4	*Plant Molecular Biology*
Animal Science	1	*Animal Science*
	2	*Food Science*
	3	*Meat Science*
	4	*Dairy Science*
	5	*Poultry Science*
	6	*Aquacuture*
	7	*Nutrition*
	8	*Food Chemistry*
	9	*American Journal of Clinical Nutrition*
	9	*Science of the Total Environment*
	9	*World's Poultry Science Journal*
	10	*Critical Reviews in Food Science and Nutrition*
	10	*Food Technology*
	10	*Agriculture & Food Chemistry*
	10	*Science of Food & Agriculture*
	10	*Tropical Animal Health & Production*
	11	*Animal Feed Science & technology*
	11	*Food Additive Contaminants*
	11	*American Diet Association*
	11	*Ethnopharmacology*
	11	*Food Engineering*

(*continued*)

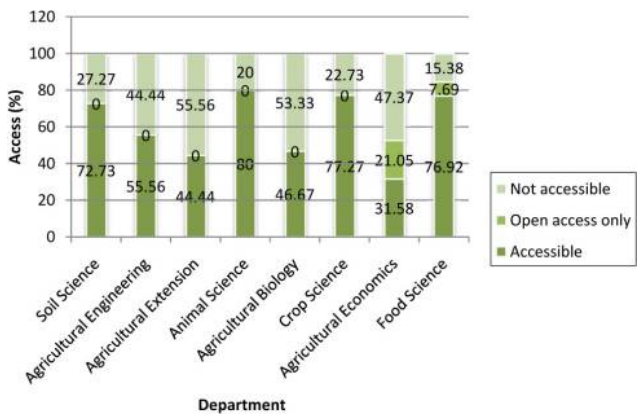
Table XX

Department	Rank	Journal
	11	*Food Science & Technology*
	11	*Pakistan Journal of Nutrition*
	11	*Toxicology & Applied Pharmacology*
	11	*Tropical Agricultural Research*
Agriculture Biology	1	*Phytopathology*
	2	*Plant Pathology*
	3	*Plant Diseases*
	4	*Tea Quarterly*
	5	*General Virology*
	5	*Tropical Agriculturist*
	5	*Virology*
	6	*Annals of Applied Biology*
	6	*Crop Protection*
	6	*Plant Molecular Biology Reporter*
	7	*African Journal of Biotechnology*
	7	*Bulletin of the Rubber Research Institute of Malaysia*
	7	*Physiological & Molecular Plant Pathology*
	7	*Rubber Research Institute of Sri Lanka*
	7	*Tea Science*
Crop Science	1	*Hort Science*
	2	*Plant Physiology*
	3	*Acta Horticulturae*
	4	*Scientia Horticulturae*
	5	*Field Crops Research*
	6	*American Society for Horticultural Science*
	6	*New Phytologist*
	7	*Agricultural Science*
	7	*Annals of Botany*
	7	*Experimental Agriculture*
	7	*National Science Foundation*
	7	*Physiologia Plantarum*
	7	*Plant Nutrient*
	7	*Postharvest Biology & Technology*
	8	*Ecology*
	8	*Tropical Agricultural Research*
	9	*Agronomy*
	9	*Crop Science*
	9	*Experimental Botany*
	10	*Landscape & Urban Planing*
	10	*Plant & Soil*
	10	*Trends in Plant Science*
Agriculture Economics	1	*Academy of Management*
	2	*Applied Psychology*
	3	*Agricultural Economics*
	4	*Econometrics*
	5	*Agroforestry Systems*
	5	*American Dietetic Association*
	5	*American Journal of Agriculture Economic Association*
	5	*Marketing Research*
	5	*Marketing Science*
	5	*Productivity Analysis*
	5	*World Development*
	6	*Public Health Nutrition*
	7	*Australian Journal of Nutrition & Dietetics*
	7	*Ecological Economics*
	7	*Economic Literature*
	7	*Energy*
	7	*Human Relations*
	7	*Strategic Management*
	7	*Vocational Behaviour*
Food Science	1	*Food Science*
	2	*Food Science & Technology*
	3	*Nutrition*
	4	*Food Chemistry*
	5	*Agricultural & Food Chemistry*
	6	*Dairy Science*
	6	*Nutrition & Food Science*
	7	*Food Engineering*
	8	*Food Technology*
	8	*New Phytologist*
	9	*Critical Reviews in Food Science & Nutrition*
	10	*Science of the Food & Agriculture*
	11	*Food Microbiology*

(*continued*)

Notes: Accessible; open access articles only; not accessible

Figure 11 Accessibility of core journals



year research projects; thus resources used are mainly for research purposes. Collection development based on this study mainly focuses research needs. Therefore, it is important to continue the faculty recommendations to check whether current system meets the undergraduate requirements. In addition, interlibrary loan requests and CAB abstracts available in the library can be incorporated further to improve results.

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About the author

Dilani Kanishka Abeyrathne obtained BSc degree with First Class Honours, University of Peradeniya, Sri Lanka, and is following Masters degree in Library & Information Science, National Institute of Library & Information Science, University of Colombo, Sri Lanka. Dilani Kanishka Abeyrathne can be contacted at: dilanidka@gmail.com