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AUTHORSHIP PATTERN AND COLLABORATIVE RESEARCH IN THE FIELD OF QUALITY MANAGEMENT

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Abstract— *The study grants a widespread analysis of research performance of Quality Management researcher in Africa Continent from 1991-2016. The data used for the study were retrieved from one database sources, namely, ISI Web of Science database. Bibliometric methods have been working to analyses the statistics. The outcomes specify that the development of literature in Quality Management has gradually increased from the average degree of collaboration of authors published during the study period is 8.66. It highlights the fact that the more number of papers by a researcher in any field requires a high degree of interest, ability, productivity, perseverance, and experience to literatures.*

Keywords— *Bibliometrics, Quality Management, Africa Continent, Lotka's law, Authorship pattern; Collaborative research, degree of collaboration.*

INTRODUCTION

Collaborative research is a well-recognized feature of Modern Science, and there has been a consistent trend towards increased collaboration in all branches of science during the present century. The main reason for collaborative research can be attributed to the interdisciplinary nature of investigations, escalating cost of instrumentation, laboratory facilities and common interest of Scientists in the same field. A large number of studies have been conducted to analyse and interpret the trends in collaborative authorship in different disciplines.

Sivasekaran,K (2015) indicated cited by highest times, and cited references during period from 2009, (2899), contributed highest number of authors (9807) in renewable energy research publication from year 2012, which is followed by the year 2011 (7989), 2010 (5931) and 2009 (4667) respectively, Amsaveni and R. Vasanthi(2013) indicated that the highest number, of research articles in the year of 2011 first and second rank from three and four authors contributed papers are which is calculated 780 (37.01%) and 688 (32.65%). The degree of collaboration value is 0.95 as a whole, so collaborative output is in height. Less number of authors was contributing highest number of articles in the carefully chosen area of network security. R. Sevukan and Jaideep Sharma (2008) founded that the growth of literature in Biotechnology has steadily increased from 15 articles in 1997 to 43 articles in 2006; two-authored publications predominate amongst the pattern of authorship; applicability of Lotka's law is validated from the values n = 2.12, C = 0.669, and D = 0.027 obtained using least square method. However, the application of Bradford's law does not fit to the literature analyzed.

OBJECTIVES OF THE STUDY

The definite purposes of the reading are:

- To examine the nature of authorship pattern
- To determine the proportion of single & multi-authored papers
- To find Time series in Single Authorship.
- To indicated Productive authors

DATA ANALYSIS AND METHODOLOGY

There are various sources contributing to the research productivity in the field of Quality Management Research by the researchers all over. The necessary data were collected from the Web of Science (WoS). The WoS is the search raised

area providing by Thomson Reuters (the former Thomson Scientific emerged from the Institute for Scientific Information (ISI) in Philadelphia). The study period 1991 to 2016 is selected as the available database. A total of 1913 records were downloaded and analyzed by using the Histcite software and excel worksheet application as per the objectives of the study.

RESULTS AND DISCUSSION

Table 1 presents the authorship arrangement in the field of Quality Management. More than 10-authored papers comprised the highest percentage (20.74) of the total 1913 papers, the authorship pattern has explained. Year wise output has specified by the quantity of authors donating, like solo research and joint research. Totally 198 single authored contribution is only 2.21 percent; remaining 93.82 percent of articles were from oint authored. Three authored articles is 369, Two authored articles are 326 were high (19.29). Remaining collaborative authored articles are very lowest. More than ten authored collaboration is 1858, three authored collaboration is 1098, four authored collaboration is 1096, five authored collaboration is 960, six authored collaboration is 954 and remaining authors' collaboration is below 900 articles and more than authors' productivity. Totally we observed from the above analysis, number of authors is more than the number of articles. Three and Two author's contribution is very high by seeing (12.26 & 12.23).

Table 1: Authorship pattern

Years		*Single*	*Double*	*Triple*	*Four*	*Five*	*Six*	*Seven*	*Eight*	*Nine*	*10 & above*	*Total*
2016	Articles	6	15	24	19	13	11	7	10	4	16	125
	Authors	6	30	72	76	65	66	49	80	36	205	685
2015	Articles	21	38	48	31	31	26	15	9	5	28	252
	Authors	21	76	144	124	155	156	105	72	45	361	1259
2014	Articles	12	31	46	29	20	21	15	8	8	24	214
	Authors	12	62	138	116	100	126	105	64	72	287	1082
2013	Articles	9	24	46	31	18	16	11	8	2	23	188
	Authors	9	48	138	124	90	96	77	64	18	191	955
2012	Articles	15	19	33	22	17	17	14	11	3	12	163
	Authors	15	38	99	88	85	102	98	88	27	151	891
2011	Articles	18	29	30	18	18	7	11	6	7	17	161
	Authors	18	58	90	72	90	42	77	48	63	251	965
2010	Articles	15	27	22	20	10	9	4	3	4	5	119
	Authors	15	54	66	80	50	54	28	24	36	47	454
2009	Articles	8	23	15	15	8	7	6	6	4	9	101
	Authors	8	46	45	60	40	42	42	48	36	94	461
2008	Articles	11	16	10	17	11	8	5	3	4	8	93
	Authors	11	32	30	68	55	48	35	24	36	76	415
2007	Articles	10	18	17	15	7	9	1	2	0	3	82
	Authors	10	36	51	60	35	54	7	16	0	39	308
2006	Articles	6	14	10	11	1	2	2	2	2	4	54
	Authors	6	28	30	44	5	12	14	16	18	30	203
2005	Articles	5	13	10	10	5	7	2	1	0	3	56
	Authors	5	26	30	40	25	42	14	8	0	40	230
2004	Articles	3	6	13	8	12	5	3	1	4	0	55
	Authors	3	12	39	32	60	30	21	8	36	0	241
2003	Articles	6	10	8	1	4		3	0	0	3	35
	Authors	6	20	24	4	20	0	21	0	0	42	137

Years		*Single*	*Double*	*Triple*	*Four*	*Five*	*Six*	*Seven*	*Eight*	*Nine*	*10 & above*	*Total*
2002	Articles	7	6	7	5	4	2	3	3	0	0	37
	Authors	7	12	21	20	20	12	21	24	0	0	137
2001	Articles	6	9	4	6	5	4	1	0	0	2	37
	Authors	6	18	12	24	25	24	7	0	0	4	120
2000	Articles	6	3	4	2		3	2	1	1	2	24
	Authors	6	6	12	8	0	18	14	8	9	4	85
1999	Articles	9	4	4	8	1	2	3	0	0	2	33
	Authors	9	8	12	32	5	12	21	0	0	4	103
1998	Articles	9	2	2	0	1	1	0	0	0	2	17
	Authors	9	4	6	0	5	6	0	0	0	30	60
1997	Articles	3	2	2	3	1	0	0	0	0	1	12
	Authors	3	4	6	12	5	0	0	0	0	2	32
1996	Articles	3	4	3	2	1	1	0	0	0	0	14
	Authors	3	8	9	8	5	6	0	0	0	0	39
1995	Articles	5	4	1	0	0	0	1	0	0	0	11
	Authors	5	8	3	0	0	0	7	0	0	0	23
1994	Articles	2	3	3	0	2	0	0	0	0	0	10
	Authors	2	6	9	0	10	0	0	0	0	0	27
1993	Articles	1	2	2	0	0	0	0	0	0	0	5
	Authors	1	4	6	0	0	0	0	0	0	0	11
1992	Articles	2	4	3	0	1	1	0	0	0	0	11
	Authors	2	8	0	0	5	6	0	0	0	0	21
1991	Articles	0	0	2	1	1	0	0	0	0	0	4
	Authors	0	0	6	4	5	0	0	0	0	0	15
Total	Articles	198	326	369	274	192	159	109	74	48	164	1913
	%	10.35	17.04	19.29	14.32	10.04	8.31	5.70	3.87	2.51	8.57	100.00
	Authors	198	652	1098	1096	960	954	763	592	432	1858	8959
	%	2.21	7.28	12.26	12.23	10.72	10.65	8.52	6.61	4.82	20.74	100.00

Table 2: Standing of authors in Quality Management examination productivity Degree of Collaboration

Year	*No. of Article*	*%*	*No. of Authors*	*%*	*Single authors*	*Multi authored*	*AAPP*	*DC (NM/(NM +NS)*
1991	15	0.17	4	0.21	0	4	3.75	
1992	21	0.23	11	0.58	2	9	1.91	4.50
1993	11	0.12	5	0.26	1	4	2.20	4.00
1994	27	0.30	10	0.52	2	8	2.70	4.00
1995	23	0.26	11	0.58	5	6	2.09	1.20
1996	39	0.44	14	0.73	3	11	2.79	3.67
1997	32	0.36	12	0.63	3	9	2.67	3.00
1998	60	0.67	17	0.89	9	8	3.53	0.89
1999	103	1.15	33	1.73	9	24	3.12	2.67
2000	85	0.95	24	1.25	6	18	3.54	3.00
2001	120	1.34	37	1.93	6	31	3.24	5.17
2002	137	1.53	37	1.93	7	30	3.70	4.29

Year	*No. of Article*	*%*	*No. of Authors*	*%*	*Single authors*	*Multi authored*	*AAPP*	*DC (NM/(NM +NS)*
2003	137	1.53	35	1.83	6	29	3.91	4.83
2004	241	2.69	55	2.88	3	52	4.38	17.33
2005	230	2.57	56	2.93	5	51	4.11	10.20
2006	203	2.27	54	2.82	6	48	3.76	8.00
2007	308	3.44	82	4.29	10	72	3.76	7.20
2008	415	4.63	93	4.86	11	82	4.46	7.45
2009	461	5.15	101	5.28	8	93	4.56	11.63
2010	454	5.07	119	6.22	15	104	3.82	6.93
2011	965	10.77	161	8.42	18	143	5.99	7.94
2012	891	9.95	163	8.52	15	148	5.47	9.87
2013	955	10.66	188	9.83	9	179	5.08	19.89
2014	1082	12.08	214	11.19	12	202	5.06	16.83
2015	1259	14.05	252	13.17	21	231	5.00	11.00
2016	685	7.65	125	6.53	6	119	5.48	19.83
	8959	100.00	1913	100.00	198	1715	4.68	8.66

Table 3: Showing Lotka's (n – value) Law of Author Productivity in Quality Management

No. of contribution X	*No. of contributories*	*Y*	$\sum X = \log x$	$\sum Y = \log y$	$\sum X*Y$	$\sum X*X$
1	198	198	0	2.297	0.000	0.000
2	327	654	0.301	2.816	0.848	0.602
3	366	1098	0.477	3.041	1.451	0.954
4	274	1096	0.602	3.040	1.830	1.204
5	192	960	0.699	2.982	2.085	1.398
6	204	1224	0.778	3.088	2.403	1.556
7	64	448	0.845	2.651	2.241	1.690
8	74	592	0.903	2.772	2.504	1.806
9	48	432	0.954	2.635	2.515	1.908
10	48	480	1.000	2.681	2.681	2.000
11	29	319	1.041	2.504	2.607	2.083
12	28	336	1.079	2.526	2.726	2.158
13	15	195	1.114	2.290	2.551	2.228
14	10	140	1.146	2.146	2.460	2.292
15	7	105	1.176	2.021	2.377	2.352
16	1	16	1.204	1.204	1.450	2.408
17	2	34	1.230	1.531	1.884	2.461
18	8	144	1.255	2.158	2.709	2.511
19	5	95	1.279	1.978	2.529	2.558
20	5	100	1.301	2.000	2.602	2.602
24	1	24	1.380	1.380	1.905	2.760
27	4	108	1.431	2.033	2.911	2.863
28	1	28	1.447	1.447	2.094	2.894
46	1	46	1.663	1.663	2.765	3.326
48	1	48	1.681	1.681	2.827	3.362
383	1913	8920	25.989	3.950	54.954	51.978

Table -2. Indicate that Collaborative Research has become the trend of the day. Subramanian introduced a formula to measure the collaborative research Mr. Subramanian has introduced a formula, which is: - Where DC = Degree of collaboration Nm = Number of Multiple authored papers, NS = Number of Single authored papers. The above table indicates that the degree of collaboration ranges from 4.50 in 1992 to 19.83 in the year 2016. Based on this we can easily come to the conclusion that collaborative research is a preferable one in current studies as well as in future. The average degree of collaboration of authors published during the study period is 8.66.

Table 4: Productive authors producing more than ten articles

Author	*Recs*	*Affiliation address*
Vanlauwe B	23	Int Ctr Trop Agr TSBF CIAT, Trop Soil Biol & Fertil Inst, Watkinsville, GA 30677 USA
Giller KE	18	Wageningen Univ, NL-6700 AK Wageningen, Netherlands
Lal R	14	Ohio State Univ, Sch Nat Resources, Columbus, OH 43210 USA
Thierfelder C	14	CIMMYT Zimbabwe, Harare, Zimbabwe
Ryan J	12	ICARDA, Aleppo, Syria.
Tittonell P	12	Ctr Int Agr Trop, Trop Soil Biol & Fertil Inst, Nairobi, Kenya.
du Preez CC	11	Univ Free State, Dept Soil Crop & Climate Sci, Bloemfontein, South Africa.
Mapfumo P	10	Wageningen Univ, Dept Plant Sci, Wageningen, Netherlands.
Samways MJ	10	Univ Stellenbosch, Dept Conservat Ecol & Entomol, ZA-7602 Matieland, South Africa.

To validate the Lotka's law, a calculation was done using Eqns (Table 3),

P = number of X items in table = 25

N =maximum number of contributors = 8920

N: Observed value

Pao (1989) proposed the way to calculate n-value and c- value of Lotka's law as in (1) and (2)

$$n = \frac{N\Sigma XY - \Sigma X \Sigma Y}{N\Sigma X^2 - (\Sigma X)^2} \tag{1}$$

n = 25 (54.954 – (3.950) (25.989) / 25(51.978) – (25.989) (25.989)

n = 0.020

$$c = \frac{1}{\sum_{1}^{p-1} \frac{1}{x^n} + \frac{1}{(n-1)(p^{n-1})} + \frac{1}{2p^n} + \frac{1}{24(p-1)^{n+1}}} \tag{2}$$

N is the maximum contribution of an author. X is log(x) and Y is log(y) where y are the authors who have x number of contributions.

Where p is the number of publication groups in which the authors contributed the same amount of publications. Besides, Pao also used Kolmogorov–Smirnov (K–S) test to verify if Lotka's law is matched or not under the condition that p-value is greater than twenty.

$$\text{K-S} = \frac{1.63}{\sqrt{N}}$$

Square root of 8920 is 94.446, and verifies K-S statistic value to see if Lotka's law is capable to hold for Quality Management related Publications. For N value is greater than 25, therefore, K-S statistics method can be used to verify if Lotka's law could hold for the sample area publications.

K – S = 1.63 / 0.020

K-S = 81.5 for N = 8920

Totally 8920 authors were contributed to the area of Quality Management research productivity. 343.077 authors were calculating the mean value of every year author's contribution and 4.68 numbers of authors calculated at individual articles. It highlights the fact that the more number of papers by a researcher in any field requires a high degree of interest, ability, productivity, perseverance, and experience to literatures. That is why mainstream of authors have donated to more number of papers. Further, the nature of the institutions in which the researchers work, the research area of knowledge and the availability of structure services consequence the author's productivity.

Table 5: Collaborative authors Publications – Time Series analysis

Years	*Single authors*	*X*	*X2*	*XY*
1992	2	-12	144	-24
1993	1	-11	121	-11
1994	2	-10	100	-20
1995	5	-9	81	-45
1996	3	-8	64	-24
1997	3	-7	49	-21
1998	9	-6	36	-54
1999	9	-5	25	-45
2000	6	-4	16	-24
2001	6	-3	9	-18
2002	7	-2	4	-14
2003	6	-1	1	-6
2004	3	0	0	0
2005	5	1	1	5
2006	6	2	4	12
2007	10	3	9	30
2008	11	4	16	44
2009	8	5	25	40
2010	15	6	36	90
2011	18	7	49	126
2012	15	8	64	120
2013	9	9	81	81
2014	12	10	100	120
2015	21	11	121	231
2016	6	12	144	72
	198	0	1300	665

The above table-4. depicts prolific authors who have produced more than ten articles in quality management during the period of study. The findings of distribution of authors in terms of their number of contributions expose the fact that Vanlauwe B 23 record published from Int Ctr Trop Agr TSBF CIAT, Trop Soil Biol & Fertil Inst, Watkinsville is in the First place with 23 different publications in Quality Management. The second place is taken by Giller KE from Wageningen Univ, Netherlands with 18 publications; the third place is to two authors from Ohio State Univ and CIMMYT Zimbabwe, namely Lal R, and Thierfelder C, with 14 articles each; the fourth place is to two authors from ICARDA, Aleppo, Syria and Ctr Int Agr Trop, Trop Soil Biol & Fertil Inst, Nairobi, Kenya namely Ryan J and Tittonell P with 12 publications; The fifth place is taken by du Preez CC from Dept Soil Crop & Climate Sci, Bloemfontein, South Africa, Varanasi with 11 publications; the sixth place is to two authors from Wageningen University, Dept Plant Science, Netherlands and University Stellenbosch South Africa Mapfumo P J and Samways MJ with 10 publications.

Table -5. Straight Line equation Yc = a + bX since $\sum x = 0$ a = $\sum Y/N$ = 198/25 = 7.92 b = $\sum XY/\sum x2$ = 198/1330 = 0.14

Estimated literature in 2025 is when X = 2025– 2004= 21 = 7.92 + 0.14 *21 = 10.86 Estimated literature in 2030 is when X = 2030 – 2004 = 26 = 7.92+0.14*26 = 3.64 + 1022.69 = 2462.67 the result of the time series analysis shows that the research production will increase in 2020 and 2025.

CALCULATION

Quality Management is a reasonable field of study having created two decades back. WELCOMME RL reports that only one article was published in Quality Management in 1991 that produced more than 280 articles in 2015. A great number of researchers are pursuing their study in the field of Quality Management, giving confidence that additional works would be distributed on the subject from the world. Totally we observed from the above analysis that number of authors is more than the number of articles. Three and Two author's contribution is very high by seeing (12.26 & 12.23). Lotka's law was tested and Estimated literature in 2030 is when X = 2030 – 2004 = 26 = 7.92+0.14*26 = 3.64 + 1022.69 = 2462.67 the result of the time series analysis shows that the research production will increase in 2020 and 2025. The credit of publishing the maximum number of articles, (23) goes to Vanlauwe B from Int Ctr Trop Agr TSBF CIAT, Trop Soil Biol & Fertil Inst, and Watkinsville is in the First place Different publications in Quality Management followed Giller KE from Wageningen University, Netherlands with 18 publications. The articles donated by the researcher gives the idea in papers distributed from 131 different countries with a maximum from the South Africa (32.50) followed by the US (22.6).

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