Contribution and Impact of Karnataka University Publications during 1999-2008: A Comparative Study with Three Other Universities of Karnataka

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Abstract

The paper attempts to study the performance of Karnatak University in terms of its research output during 1999-2008 including the number of papers published annually, its growth rate, international collaborative publication share and major collaborative partner countries, citation quality and impact of publications. The publication productivity and impact of university under broad subject areas and departments are also analyzed. This study also identifies and evaluates the characteristics of prolific authors and high-cited papers and pattern of research communication in productive journals. The study also compares the performance of Karnataka University with three other major universities of Karnataka, such as University of Mysore, Mangalore University and Bangalore University on some of the indicators discussed below.

1. Introduction

Karnatak University, Dharwad celebrated its diamond jubilee in 2009. The sprawling main campus of Karnatak University is spread over an area of 750 acres on the Chhota Mahabaleshwar Hill, on the western frontiers of Dharwad. The name Chhota Mahabaleshwar reminds the historical legacy of Dharwad with the erstwhile Bombay Province. The Chhota Mahabaleshwar Hill presents a salubrious climate and the tranquil and sublime neighborhood is as much congenial as awe inspiring for the seat of knowledge. Eradication of illiteracy among the masses is the avowed mission of the University and well reflected in its emblem: a Banyan tree, a rising sun and the legend Arive Guru, i.e. Wisdom is Guru, implying that both wisdom and knowledge should be all pervading like the ramifying Banyan tree and lit up the world. The architects of the University were as much committed to the development of the University as for unification of the scattered Kannada speaking peoples. The majestic Vidya Soudha that stands at the head of the campus, is a magnificent memorial of their dedicated efforts, chiefly that of the late Dr. D.C. Pavate. Today it is an icon of higher education and

operation literacy that was launched 60 years ago. This is the second oldest university in Karnataka that has produced many eminent men of letters. There are 50 PG Departments, 350 teachers and 4000 students (PG, M. Phil. and Ph. D.).

The Karnatak University today is rated as one of the handful universities in the country with a Potential for Excellence, as identified by NAAC by giving 'A' grade status. For its R&D activities, the university receives funds in the form of extra-mural funding from number of Indian research agencies, such as UGC, DST, CSIR, ICAR, NSC, DOD, DBT and BRNS.

The assessment of research performance using scientometric techniques is valuable method for identification and evaluation of strength and weakness in scientific achievements. In the present study an attempt has been made to examine the contribution and performance of Karnatak University Dharwad. It also compares the performance of Karnataka University with University of Mysore, Mangalore University, and Bangalore University. Some of the notable studies from India were Gupta and Dhawan[1,2],Arunnachalam[3],Balram[4] and Sangam[5,6].

2. Objectives of the study

The main objective of the study is to analyze the research activities of Karnataka University during 1999-2008. In particular, the study focuses on: (i) annual research output, its growth rate and impact, (ii) patterns of international collaboration and productive partner countries, (iii) research output, impact and collaborative papers under different subject areas, (iv) characteristics of prolific authors, productive departments and high cited papers and (v) patterns of research communication in productive journals. It also compares the performance of Karnataka University with University of Mysore, Mangalore University, and Bangalore University on some of the indicators described earlier.

3. Methodology & Database Used

The present study uses the 10 years publications output data retrieved from Scopus international multidisciplinary database during 1999-2008 to analyze the research performance of Karnatak University and three other major universities of Karnataka. Three-year citation window is used for counting the citations for the year 1999-2006 and a 2-year and 1-year citation window is used for the year 2007 and 2008 for the cumulative research output of the these four universities. To access the impact per paper of papers published

under broad subject areas and impact of prolific authors, again the fixed citation window of three years is used for counting total citations received by these papers. The Scopus database classification of broad subjects has been used for evaluating the publication productivity under different subject areas. There is some overlapping of papers under these subject areas. As a result, if we count the number of papers published under these subjects, it comes out more than the cumulative publication output of Karnatak University.

4. Analysis

4.1 Analysis of the Overall Research Profile

The Karnatak University total cumulative publications output during 1999-2008 consist of 1219 papers, with average number of papers per year as 122. Compared to Karnatak University, the publications output of universities of Mysore, Mangalore and Bangalore consists of 1930 papers, 1177 papers and 1059 papers, with average number of papers per year as 193, 118 and 106 papers. The cumulative number of publications of Karnatak University increased from 463 to 756 papers from 1999-03 to 2004-08, witnessing a growth of 63.28% growth. Compared to Karnatak University, the cumulative publications of universities of Mysore, Mangalore and Bangalore have increased from 605 to 1325 papers, 325 to 852 papers and 405 to 654 papers, witnessing a growth rate of 119.01%, 162.15% and 61.48%. The annual average growth rate of Karnatak University publications during 1999-2008 was 7.51. As compared to Karnataka University, all other three universities under consideration have higher annual average growth rate: Mangalore University (25.38%), University of Mysore (14.0%), and Bangalore University (7.70%). In terms of impact and quality, the average citations per paper registered by Karnatak University publications during 1999-06 was 2.62. In comparison, Mangalore University has registered a comparative higher citation impact of 2.73, followed by Bangalore University (2.15) and University of Mysore (2.14). The average citations per paper registered by Karnatak University cumulative publications decreased from 2.90 in 1999-03 to 2.45 in 2004-08. In comparison, the average citations per paper has decreased for cumulative publications of University of Mysore from 2.18 to 2.13 and Bangalore University from 2.42 to 1.98, as against increase from 1.77 to 3.10 in case of Mangalore University from 1999-03 to 2004-08. The h-index scored by

Karnatak University papers during 1999-2008 was 30. All other universities had lower h-index than Karnataka University: Bangalore University (26), Mangalore University (25), and University of Mysore (24) (Table 1-2).

Table 1. Contribution and Citations Received by Papers of Four Universities of Karnataka during 1999-08

	Karnataka University		University of Mysore		Mangalore University		Bangalore University	
	TP	**TC**	**TP**	**TC**	**TP**	**TC**	**TP**	**TC**
1999	84	173	121	186	47	69	81	178
2000	72	153	78	200	64	137	74	205
2001	76	327	116	179	65	72	75	148
2002	106	359	167	430	72	12	80	180
2003	125	331	123	322	77	171	95	270
2004	132	451	180	685	70	248	102	254
2005	127	543	216	443	80	245	111	254
2006	190	595	322	915	173	914	135	381
2007	175	257	364	630	335	955	153	294
2008	132	10	243	147	194	277	153	111
99-03	463	1343	605	1317	325	577	405	981
04-08	756	1856	1325	2820	852	2639	654	1294
99-08	1219	3199	1930	4137	1177	3216	1059	2275

Table 2. Impact. Average Growth Rate & h-Index of Four Universities of Karnataka, 1999-08

University Name	Average Citation per Paper (ACPP)			AAGR	H-Index
	99-03	**04-08**	**99-08**		
Karnatak University	2.90	2.45	2.62	7.51	30
University of Mysore	2.18	2.13	2.14	14.00	24
Mangalore University	1.77	3.10	2.73	25.38	25
Bangalore University	2.42	1.98	2.15	7.70	26

4.2 International Collaboration

Based on the publication data, the total cumulative international collaborative papers of Karnatak University during 1999-08 consists of 138, which accounts for 11.32% share in the cumulative output of Karnataka University. Compared to Karnataka University, the international collaborative papers share of Mangalore University in its cumulative publication output during 1999-08 was 45.96%, followed by Mysore University (21.87%) and Bangalore University (11.33%). Karnatak University witnessed an increase in the share of international collaborative papers from 9.72% (45 papers) during 1999-03 to 12.30% (93 papers) during

2004-08. Compared to Karnataka University, the international collaborative publications share of Mangalore University increased from 8.61% to 60.21% and University of Mysore from 10.08% to 27.25%, as against decrease in case of Bangalore University from 12.10% to 10.85% from 1999-03 to 2004-08 (Table 3).

Table 3. Number of International Collaborative Papers by Five Karnataka Universities during 1999-08

Year	Karnatak University	Univ. of Mysore	Mangalore University	Bangalore University
99-03	45	61	28	49
04-08	93	361	513	71
99-08	138	422	541	120

Among the major international collaborative partner countries of Karnataka University during 1999-08, South Korea tops the list with 53 papers (38.41% share), followed by United States (36 papers, 26.09% share), United Kingdom (16 papers, 11.59% share), Switzerland (11 papers, 7.97% share), Taiwan (10 papers, 7.25% share), Italy and Australia (each with 6 papers, 4.35% share), etc.

United States tops the list with 140 papers (33.17% share) among the major collaborating partners of Mysore University during 1999-08, followed by Germany (124 papers, 29.38% share), United kingdom (44 papers, 10.43% share), Japan (38 papers, 9.00% share), South Korea and Sweden (13 papers, 3.08% share each), China, Canada, France and Taiwan (5 papers, 1.19% share each), Switzerland (4 papers, 0.95% share), Australia (3 papers, 0.71% share), etc. Among the major collaborating partners of Mangalore University during 1999-08, Germany tops the list with 250 papers (46.21% share), followed by United States (71 papers, 13.12% share), United Kingdom (36 papers, 6.65% share), Canada (15 papers, 2.77% share), Sweden (12 papers, 2.22% share), China (8 papers, 1.48% share), Taiwan (6 papers, 1.11% share), South Korea (4 papers, 0.74% share), Australia (3 papers, 0.55% share), etc. Similarly among the major collaborating partners of Bangalore University during 1999-08, United States tops the list with 48 papers (40% share), followed by France (19 papers, 15.83% share), United Kingdom (15 papers, 12.50% share), South Korea (14 papers, 11.67% share), Germany (10 papers, 8.33% share), Japan and Australia (4 papers, 3.33% share each), etc (Table 4).

Table 4. Number of Collaborative Papers of Four Universities of Karnataka with Partner Countries, 1999-08

Collab. Country	Karnataka Univ			Univ. of Mysore			Mangalore Univ.			Bangalore Univ.		
	99-03	04-08	99-08	99-03	04-08	99-08	99-03	04-08	99-08	99-03	04-08	99-08
USA	15	21	36	36	104	140	4	67	71	26	22	48
U.K.	1	15	16	3	41	44	1	35	36	0	15	15
Japan	1	2	3	10	28	38	0	2	2	2	2	4
Germany	1	1	2	7	117	124	16	234	250	9	1	10
France	1	1	2	0	5	5	0	1	1	7	12	19
China	1	3	4	0	5	5	0	8	8			
Canada				2	3	5	5	10	15	1	1	2
Australia	0	6	6	1	2	3	2	1	3	2	2	4
Italy	3	3	6	0	1	1				1	0	1
Spain				0	2	2	0	2	2	0	1	1
Netherlands				0	2	2	0	1	1			
South Korea	16	37	53	1	12	13	0	4	4	0	14	14
Taiwan	1	9	10	1	4	5	1	5	6			
Switzerland	7	4	11	1	3	4						
Sweden				0	13	13	0	12	12	1	0	1
Total	45	93	138									

4.3 Distribution of Papers by Broad & Narrow Subject Fields

The priorities assigned to broad fields such as physical sciences, life sciences, engineering sciences and health sciences by the four universities of Karnataka, as reflected in their cumulative publications output during 1999-08 is depicted in Table 5. As reflected in Table 5, the maximum emphasis in all the four universities of Karnataka has been in physical sciences, with largest share (84.03%) in their university output of Mangalore University, followed by Bangalore University (64.12% share), University of Mysore (59.79% share) and Karnatak University (57.51% share). In life sciences, the maximum emphasis (48.13% share) has been in the University of Mysore, followed by Mangalore University (47.92% share), Karnatak University (32.16% share) and Bangalore University (25.49% share). In engineering sciences, the maximum emphasis (33.42% share) has been in Bangalore University, followed by Karnatak University (32.16% share), University of Mysore (22.28% share) and Mangalore University (18.61% share). In health sciences, the maximum emphasis (5.29% share) has been in Bangalore University, followed by University of Mysore (4.19% share), Karnatak University (2.62% share) and Mangalore University (2.38% share) (Table 5).

Table 5. Distribution of Papers of Four Universities of Karnataka by Broad Subject Field, 1999-08

Broad Subject Area	Number of Papers, 1999-08				% Share of Papers, 1999-08			
	Mysore	Karnataka	Bangalore	Mangalore	Mysore	Karnataka	Bangalore	Mangalore
Physical Sciences	1154	701	679	989	59.79%	57.51%	64.12%	84.03%
Life Sciences	929	392	270	564	48.13%	32.16%	25.49%	47.92%
Engineering Sciences	430	392	354	219	22.28%	32.16%	33.42%	18.61%
Health Sciences	81	32	56	28	4.19%	2.62%	5.29%	2.38%
Total	1930	1219	1059	1177				

Within physical sciences (comprising of physics, chemistry, mathematics, earth & planetary sciences and environmental sciences according to Scopus database classification), the maximum emphasis in these four universities has been in chemistry (with publication share varying from 29.48% to 50.89%) and physics (with publication share varying from 10.99% to 30.76%). Comparatively much less emphasis has been placed in these four universities in environmental sciences (with publication share varying from 2.28% to 8.12%), mathematics (with publication share varying from 2.21% to 4.15%) and earth & planetary sciences (with publication share varying from 1.72% to 4.62%). In chemistry, the maximum emphasis (599 papers, 50.89% share) has been in Mangalore University, followed by Karnatak University (485 papers, 30.79% share), Bangalore University (336 papers, 31.73% share), and University of Mysore (569 papers, 57.51% share). In physics, comparatively more emphasis (362 papers, 30.76% share) has been placed in Mangalore University, followed by University of Mysore (464 papers, 24.04% share), Bangalore University (232 papers, 21.91% share) and Karnatak University (134 papers, 10.99% share) (Table 6).

In terms of citation impact, the universities of Karnatak, Mysore, Mangalore and Bangalore had scored the impact of 2.34, 2.40, 2.63 and 2.62 in chemistry during 1999-08, followed by 1.51, 1.67, 2.40 and 1.94 in physics; 2.06, 0.99, 1.75 and 1.0 in environmental science; 6.29, 0.31, 1.00 and 0.68 in mathematics; and 5.57, 2.15, 1.46 and 3.16 in earth & planetary sciences. It means that Karnatak University had made highest citation impact in mathematics, environmental science and earth & planetary sciences and lowest citation impact in chemistry and physics among the four universities of Karnataka (Table 9).

Table 6. Number of Papers and Publication Share of Four Universities of Karnataka in Physical Sciences Sub-fields, 1999-08

Broad Subject Area	Number of Papers, 1999-08				% Share of Papers, 1999-08			
	Mysore	Karnataka	Bangalore	Mangalore	Mysore	Karnataka	Bangalore	Mangalore
Chemistry	569	485	336	599	29.48	39.79	31.73	50.89
Physics	464	134	232	362	24.04	10.99	21.91	30.76
Environmental Sciences	44	62	86	64	2.28	5.09	8.12	5.43
Mathematics	70	28	44	26	3.63	2.30	4.15	4.15
Earth & Planetary Sciences	46	21	49	35	2.38	1.72	4.62	2.97

Within life sciences (comprising of agricultural & biological sciences, pharmacology, toxicology & pharmaceutics, immunology & microbiology and neurology according to scopus database classification), the maximum emphasis in these four universities has been n biochemistry, genetics & molecular biology (with publication share varying from 15.75% to 37.81%) and agricultural & biological sciences (with publication share varying from 7.90% to 22.15%). Comparatively much less emphasis has been placed in these four universities in pharmacology, toxicology & pharmaceutics (with publication share varying from 1.98% to 10.17%) and immunology & microbiology (with publication share varying from 1.10% to 2.45%). In biochemistry, genetics & molecular biology, the maximum emphasis (445 papers, 37.81% share) has been in Mangalore University, followed by University of Mysore (575 papers, 29.79% share), Bangalore University (177 papers, 16.71% share), and Karnatak University (192 papers, 15.75% share). In agricultural & biological sciences, comparatively more emphasis (270 papers, 22.15% share) has been in Karnatak University, followed by University of Mysore (297 papers, 15.39% share), Bangalore University (108 papers, 10.20% share) and Mangalore University (93 papers, 7.90% share). In pharmacology, toxicology and pharmaceutics, comparatively more emphasis (124 papers, 10.17% share) has been placed in Karnatak University, followed by University of Mysore (164 papers, 8.50% share), Mangalore University (4.25% share) and Bangalore University (21 papers. 1.98% share). Least emphasis has been placed in these four universities in immunology & microbiology (with publication share varying from 1.72% to 4.62% share) (Table 7).

In terms of citation impact the universities of Karnatak, Mysore, Mangalore and Bangalore had scored the impact of 1.34, 1.64, 2.12 and 1.25 in agricultural and biological sciences;

2.84, 2.33, 2.68 and 2.10 in biochemistry, genetics & molecular biology; 6.94, 3.45, 4.70 and 5.43 in pharmacology, toxicology & pharmaceutics and 1.69, 1.25, 4.38 and 0.46 in immunology & microbiology during 1999-08. It means that Karnatak University had made the highest impact in biochemistry, genetics & molecular biology and pharmacology, toxicology & pharmaceutics, 2nd highest in immunology & microbiology and 3rd highest in agricultural & biological sciences among the four universities of Karnataka during 1999-08 (Table 9).

Within health sciences, the maximum emphasis (5.00% share) has been placed by Bangalore University in medicine, followed by Mysore University (3.89% share), Mangalore University (2.38% share) and Karnatak University (2.05% share). In terms of citation impact, the maximum citation impact (2.96) was made by Karnataka University, followed by Bangalore University (2.51), University of Mysore (1.31) and Mangalore University (1,29) (Table 7 and 9).

Table 7. Number of Papers and Publication Share of Four Universities of Karnataka in Life Sciences & Health Sciences Sub-Fields 1999-08

Broad Subject Area	Number of Papers, 1999-08				% Share of Papers, 1999-08			
	Mysore	Karnataka	Bangalore	Mangalore	Mysore	Karnataka	Bangalore	Mangalore
Agri & Biol. Science	297	270	108	93	15.39	22.15	10.20	7.90
Bioc., Genet. & Mol. Biology	575	192	177	445	29.79	15.75	16.71	37.81
Pharmacology, Toxicology & Pharmaceutics	164	124	21	50	8.50	10.17	1.98	4.25
Immunology & Microbiology	44	29	26	13	2.28	2.38	2.45	1.10
Medicine	75	25	53	28	3.89	2.05	5.00	2.38

Within engineering sciences (comprising of engineering, materials science, computer science, chemical engineering and energy), the maximum emphasis in these four universities has been in engineering (with publication share varying from 3.61% to 23.73%), followed by materials science (with publication share varying from 14.02% to 19.69%), chemical engineering (with publication share varying from 1.70% to 15.04%) during 1999-08. Compared to these three

sub-fields, comparative much less emphasis has been placed in computer science (with publication share varying from 0.50% to 5.42)%) and energy (with publication share varying from 0.73% to 2.16%) (Table 8). In terms of citation impact the universities of Karnatak, Mysore, Mangalore and Bangalore had scored the impact 4.16, 2.18, 1.91 and 2.73 in materials science; 4.47, 1.38, 1.55 and 1.65 in chemical engineering; 0.89, 1.31, 0.41 and 1.39 in engineering; 1,95, 1.38, 2.50 and 1.48 in computer science and 5.89, 1.71, 2.64 and 2.64 in energy. It means that Karnataka University has made the highest impact in materials science, chemical engineering, and energy, 2rd highest in computer science and 3rd highest in engineering among the four universities of Karnataka during 1999-08 (Table 9).

Table 8. Number of Papers and Publication Share of Four Universities of Karnataka in Engineering Sciences Sub-fields, 1999-08

Broad Subject Area	Number of Papers, 1999-08				% Share of Papers, 1999-08			
	Mysore	Karnataka	Bangalore	Mangalore	Mysore	Karnataka	Bangalore	Mangalore
Engineering	458	44	127	34	23.73	3.61	11.99	2.89
Materials Science	225	240	191	165	11.66	19.69	18.03	14.02
Computer Science	103	22	23	6	5.42	1.80	2.17	0.50
Chemical Engineering	103	179	83	20	5.42	15.04	7.83	1.70
Energy	41	9	14	14	2.16	0.73	1.32	1.19

Table 9. Contribution & Citations of Papers of Four Universities of Karnataka by Sub-Fields, 1999-08

Karnataka Univ.			Univ. of Mysore			Mangalore Univ.			Bangalore Univ.		
Sub-Field	TP	TC	Sub-Field	TP	TC	Sub-Field	TP	TC	Sub-Field	TP	TC
Chemistry	485	1133	Bioc	575	1342	Physics	599	1439	Chemistry	336	879
Agri	270	363	Chemistry	569	1365	Bioc	445	1193	Physics	232	450
Materials	240	998	Physics	464	777	Chemistry	362	952	Materials	191	521
Biochemistry	192	545	Engn	458	598	Materials	165	315	Bioc	177	371
Ceng	179	800	Agri	297	486	Agri	93	197	Engn	127	177
Physics	134	203	Materials	225	491	Envir	64	112	Agri	108	135
Pharm	124	860	Pharm	164	566	Pharm	50	235	Envir	86	86
Envir	62	128	Ceng	103	142	Earth	35	51	Ceng	83	137
Engn	44	39	Computer	103	142	Engn	34	14	Medi	53	133
Immu	29	49	Envir	94	93	Medi	28	36	Earth	49	155
Mathematics	28	176	Medi	75	98	Mathematics	26	26	Mathematics	44	30

Medicine	25	74	Mathematics	70	22	Ceng	20	31	Immu	26	12
Computer	22	43	Earth	46	99	Energy	14	37	Computer	23	34
Earth	21	117	Immu	44	55	Immu	13	57	Pharm	21	114
Energy	9	53	Energy	41	70	Computer	6	15	Energy	14	37
Agri = Agricultural & Biological Sciences; Materials = Materials Science; Biochemistry = Biochemistry, Genetics & Molecular Biology; Ceng=Chemical Engineering; Pharm = Pharmacology, Toxicology & Pharmaceutics; Envi = Environmental Science; Engn. =Engineering; Immu = Immunology & Microbiology; Computer= Computer Science; Earth = Earth & Planetary Sciences											

4.4 Performance of Departments of Karnatak University

Based on the publication data, the research output of 14 most productive schools/departments of Karnatak University is analyzed in this section (Table 7). In terms of publications output during 1999-08, the highest number of papers (167) was published by physics department, followed by polymer science (161 papers), chemistry (133 papers), zoology (103 papers), botany (103 papers), biotechnology (41 papers), mathematics 33 papers), biochemistry (27 papers), geology (15 papers), statistics (8 papers), etc. But in terms of citation performance in terms of average citation per paper, the highest impact (13.00) is made by genetics, followed by polymer science (5.89), biochemistry, genetics & molecular biology (3.22), chemistry (2.26), physics (1.96), botany (1.94), zoology (1.68), biotechnology (1.54), mathematics (1.27), geology (1.13), and Statistics (0.50) (Table 10).

Table 10. The Karnatak University Department-Wise Output, 1999-2008

Department	Total Papers			Total Citation			h-index
	99-03	04-08	99-08	99-03	04-08	99-08	
Physics	41	126	167	98	229	327	10
Polymer Science	17	144	161	38	911	949	
Chemistry	84	49	133	167	133	300	12
Zoology	70	56	126	114	98	212	11
Botany	30	73	103	73	127	200	10
Biotechnology	0	41	41	3	60	63	6
Maths	7	26	33	0	42	42	3
Biochemistry	11	16	27	35	52	87	9
Geology	11	4	15	13	4	17	3
Statistics	4	4	8	4	0	4	1
Sericulture	2	2	4	0	0	0	1
Computer	2	0	2	0	0	0	0
Electronics	0	2	2	0	0	0	0
Genetics	1	1	2	18	8	26	2

4.5 Citation Profile & High Cited Papers

Of the total 1219 papers published by Karnatak University faculty during 1999-08, 882 papers (72.35%) received 6880 citations ranging from 1 to 448 citations (since their publication up to October 2009). Of the 882 papers receiving citations, 1 paper received citation of 448, 1 paper 85 citation, 10 papers in citation range of 51 to 75 and 31 papers in citation range of 26 to 50, and the rest 840 in citation range of 1 to 25. Of the 1930 papers from Mysore University, 1248 papers (64.66%) received citations from 1 to 183 (since their publication up to October 2009). Of these, 1 paper is in citation range of 101-200, 4 papers in citation range of 51-75, 18 papers in citation range of 26-50, and the remaining 1125 in citation range from 1 to 25. Similarly out of 1177 papers of Mangalore University, 806 papers (68.48%) received citations from 1 to 97. Of these 806 papers, 1 paper is in citation range of 76-100, 4 papers in citation range of 51-75, 20 papers in citation range of 26-50, and the remaining 1243 papers in citation range of 1-25. In Bangalore University, out of 984 papers, 621 papers (63.11%) received citations in range of 1 to 158. Of these 984 papers, 1 paper is in citation range of 101-200, 1 paper in citation range of 76-100, 21 papers in citation range of 26-50, and the rest of the 961 papers in citation range of 1-25.

Among the top 100 cited papers of Karnatak University, 89 are published as articles, 6 as reviews and 5 as conference papers. Of these 100 high-cited papers, 17 involve international collaboration (13 bilateral and 4 multilateral) and 26 national collaboration. Sixty-three papers did not involve any collaboration. Of the 100 high-cited papers, 84 were from chemistry department, 4 each from botany and zoology departments, 3 from physics department, 2 each from anthropology and mathematics departments and 1 from biochemistry department. The 100 high cited papers were published in 43 journals, of which 18 papers are published in *Journal of Applied Polymer Science*, 10 in *Journal of Chemical & Engineering Data*, 9 papers each in *Journal of Controlled Release* and *Journal of Membrane Science*, 4 papers in *Journal of Pharmaceutical & Biomedical Analysis*, 3 papers each in *Drug Development and Industrial Pharmacy*, *Journal of Microencapsulation* and *Transition Metal Chemistry*, 2 papers each in *Current Anthroology*, *European Journal of Pharmaceutics* and *Biopharmaceutics*, *Farmaco, Industrial Health*, *Plant Cell*, *Tissue & Organic Culture* and *Separation and Purification Technology*, and 1 paper each in 29 other journals.

4.6 Patterns of Research Communication

The staff of Karnatak University had published their total research output in 238 Indian and foreign journals during 1999-08. The contribution of top 20 most productive journals is listed in following Table 11. The cumulative output of these top 20 journals consists of 179 papers during 1999-03, 3001 papers during 2004-08 and 480 papers during 1999-08, accounting for 38.66%, 39.81% and 39.38% of the total university output of Karnatak.

Table 11. Contribution of Karnataka University Staff in Top 20 Journals, 1999-2008

Journal	Total Papers		
	1999-03	2004-08	1999-08
Journal of Applied Polymer Science	28	60	88
Transition Metal Chemistry	16	26	42
Polymer News	23	13	36
Indian Journal of Chemistry Section B. Organic & Medicinal Chemistry	15	18	33
Indian Journal of Chemistry Section A. Inorganic Physical Theoretical & Analytical Chemistry	17	12	29
Journal of Basic and Clinical Physiology and Pharmacology	10	13	23
Acta Crystallographica Section E Structure Reports Online	7	15	22
Oxidation Communications	12	10	22
Journal of the Indian Chemical Society	9	13	22
Journal of Membrane Science	0	21	21
Spectrochimica Acta Part A Molecular & Biomolecular Spectroscopy	5	16	21
Indian Journal of Heterocyclic Chemistry	2	18	20
Journal of Chemical and Engineering Data	5	14	19
Current Science	10	8	18
Carbohydrate Polymers	0	11	11
Separation and Purification Technology	0	11	11
Ecology Environment and Conservation	5	6	11
Journal of Advanced Zoology	5	6	11
Analytical Sciences	9	1	10
Indian Journal of Experimental Biology	1	9	10
Total	179	301	480
Karnatak University Output	463	756	1219
Share of Top 20 journals in Karnatak University Output	38.66	39.81	39.38

4.7 Most Productive Authors

The top 20 most productive authors of Karnatak University together have contributed 998 papers during 1999-08, accounting for 81.87% of the total university output. The average output per author was 49.9. Only four out of 20 authors have published more than the average output per author. These authors are Tejraj M Aminabhavi with 260 papers, followed by Sharanappa Totappa Nandibewoor (133 papers), Jaldappa Seetharamappa (56 papers) and Hosakatte Niranjana Murthy (50 papers). Similarly the average citation per paper recorded by all 20 authors of the university was 3.78. Only five out of 20 authors have recorded the average citation per paper more than the average value. These are: Kumaresh S Soppimath with the average citation per paper value of 12.47, followed by Anandrao R Kulkarni (7.70), Mrityunjaya Aralaguppi (6.73), Mahadevappa Y Kariduraganavar (5.63), Tejraj M Aminabhavi (5.59) and Jaldappa Seetharamappa (3.82). The average h-index of these 20 authors during 1999-08 was 5.85. Only four authors have scored the h-index value more than the average value of all authors. These authors are Hosakatte Niranjana Murthy with h-index value of 41, followed by Tejraj M Aminabhavi (28), Kumaresh S Soppimath (7), and Anandrao R Kulkarni (6) (Table 12).

Table 12. Productivity and Impact of Top 20 Authors, 1999-08

Authors Name	TP 99-08	TC 99-08	h-index 99-08	ICP 99-08
Tejraj M Aminabhavi	260	1454	26	28
Sharanappa Totappa Nandibewoor	133	266	11	1
Jaldappa Seetharamappa	56	214	11	3
Hosakatte Niranjana Murthy	50	125	10	41
Kalagouda B. Gudasi	45	48	7	2
Guru S Gadaginamath	40	63	6	4
Srinivas K Saidapur	39	76	8	4
Kulkarni, Anandrao R	40	308	2	6
Shivamurti A Chimatadar	35	58	6	0
Manohar V Kulkarni	38	40	5	3
Mahadevappa Y Kariduraganavar	35	197	10	2
Bhagyashri A Shanbhag	34	58	7	3
Kumaresh S Soppimath	32	399	17	7
B. Mulimani	31	34	5	4
Basappa Basavanneppa Kaliwal	28	47	6	0
Ramesh S Vadavi	27	64	1	2
Sangamesh Amarappa Patil	26	91	7	2
Ravindra B Malabadi	25	45	6	5

Kallappa Mahadevappa Hosamani	24	36	5	0
Mrityunjaya Aralaguppi	22	148	1	0
Total	996	3771	3.79	5.85

Conclusion

The cumulative publication output of Karnatak University consists of 1219 papers during 1999-08, as against 1930 papers by University of Mysore, 1177 papers by Mangalore University and 1059 papers by Bangalore University during the same period. The annual average growth rate of Karnatak University publications during 1999-08 was 7.51%, compared to 25.38% by Mangalore University, 14.0% by University of Mysore and 7.70% by Bangalore University. In terms of citations impact, the average citations per paper recorded by Karnatak University publications during 1999-08 was 2.62, compared to 2.73 by Mangalore University, 2.15 by Bangalore University and 2.14 by University of Mysore. The h-index of Karnatak University publications during 1999-08 was 30, as against 26 by Bangalore University, 25 by Mangalore University and 24 by University of Mysore.

The cumulative international collaborative papers of Karnatak University during 1999-08 accounted for 11.32% share (138 papers) in the cumulative output of the University, as against 45.96% by Mangalore University, 21.87% by University of Mysore and 11.33% by Bangalore University. South Korea tops the list with 38.41% share among the major international collaborative partner countries of Karnatak University during 1999-08, followed by United States (26.09% share), United Kingdom (11.59% share), Switzerland (7.97% share), Taiwan (7.25% share), Italy and Australia (4.35% share), etc. As against this, among the major international collaborative partner countries of University of Mysore, United States tops the list with 33.17% share, followed by Germany (29.38% share), United Kingdom (10.43% share), Japan (9.00% share), South Korea and Sweden (3.08% share each), etc. Similarly, among the major collaborating partners of Mangalore University during 1999-08, Germany tops the list with 46.21% share, followed by United States (13.12% share), United Kingdom (6.65% share), Canada (2.77% share), Sweden (2.22% share), etc. Amongst the collaborating partners of Bangalore University during 1999-08, United States tops the list with 40% share, followed by France (15.83% share), United Kingdom (12.50% share), South Korea (11.67% share), Germany (8.33% share), Japan and Australia (3.33% share each), etc.

Amongst the priorities assigned to broad fields by these four universities, the maximum emphasis has been in physical sciences with their publication share varying from 57.51% to 84.03% of their university output during 1999-08, followed by life sciences with their publication share varying from 25.49% to 48.13%, engineering sciences with their publication share varying from 18.61% to 33.42% and health sciences with their publication share varying from 2.38% to 5.29%. Amongst research priorities of the four universities: (i) the major productive areas are chemistry (with publication share from 29.48% to 50.89%), biochemistry, genetics & molecular biology (with publication share from 15.75% to 37.81%), physics (with publications share from 10.99% to 30.76%), agricultural & biological sciences (with publications share from 7.90% to 22.15%) and materials science (with publications share from 14.02% to 19.69%); (ii) the medium productive areas are engineering (with publication share from 3.61% to 23.73%), chemical engineering (with publication share from 1.70% to 15.04%), pharmacology, toxicology & pharmaceutics (with publication share from 1.98% to 10.17%) and. environmental sciences (with publication share from 2.28% to 8.12%); and (iii) the low productive areas are mathematics (with publication share from 2.21% to 4.15%), earth & planetary sciences (with publication share varying from 1.72% to 4.62%), immunology & microbiology (with publication share varying from 1.10% to 2.45%), computer science (with publication share from 0.50% to 5.42)%), energy (with publication share from 0.73% to 2.16%) and medicine(with publication share from 2.05% to 5.00%).

In terms of research priorities (as reflected in publication share of each sub-fields among total output of universities) among the four universities of Karnataka, Mangalore University has given highest priority to chemistry, physics, mathematics and biochemistry, genetics & molecular biology, Karnatak University to agricultural & biological sciences, pharmacology, toxicology & pharmaceutics, materials science and chemical engineering, Bangalore University to earth & planetary sciences, environmental sciences, immunology & microbiology and medicine, and University of Mysore in engineering, , computer science, and energy. In terms of raw count of papers during 1999-08, University of Mysore tops the list in all sub-fields, except physics by Mangalore University and in materials science and chemical engineering by Karnatak University.

Amongst the four universities, the Karnatak University had made the maximum citation impact in materials science, biochemistry, genetics & molecular biology, chemical engineering, mathematics, environmental sciences, earth & planetary sciences, medicine and

energy for its publications during 1999-08, Mangalore University in chemistry, physics, agricultural & biological sciences, pharmacology, toxicology & pharmaceutics, immunology & microbiology and computer science and Bangalore University in engineering for all their publications during 1999-08.

Amongst the 14 most productive science departments/centers of Karnatak University during 1999-08, the highest number of papers (167) was published by physics department, followed by polymer science (161 papers), chemistry (133 papers), zoology (103 papers), botany (103 papers), biotechnology (41 papers), mathematics 33 papers), biochemistry (27 papers), geology (15 papers), statistics (8 papers), etc. In terms of citation performance, the highest impact (13.00) is made by genetics, followed by polymer science (5.89), biochemistry, genetics & molecular biology (3.22), chemistry (2.26), physics (1.96), botany (1.94), zoology (1.68), biotechnology (1.54), mathematics (1.27), geology (1.13), and Statistics (0.50).

Of the total publications of four universities, 72.35% papers from Karnatak University, 64.55% from University of Mysore, 68.48% from Mangalore and 63.11% from Bangalore University have received one or more citations for all their publications during 1999-08.

Among the top 100 citation papers of Karnatak University, 17 involve international collaboration (13 bilateral and 4 multilateral) and 26 national collaboration. Of the 100 high-cited papers, 84 were from chemistry department, 4 each from botany and zoology departments, 3 from physics department, 2 each from anthropology and mathematics departments and 1 from biochemistry department. The 100 high cited papers were published in 43 journals, of which 18 papers in *Journal of Applied Polymer Science*, 10 in *Journal of Chemical & Engineering Data*, 9 papers each in *Journal of Controlled Release* and *Journal of Membrane Science*, etc

The total publications of Karnatak University during 1999-08 were published in 238 Indian and foreign journals and the cumulative output of these top 20 most productive journals consists of 179 papers during 1999-03, 3001 papers during 2004-08 and 480 papers during 1999-08, accounting for 38.66%, 39.81% and 39.38% of the total university output

The top 20 authors from Karnatak University has together contributed 998 papers during 1999-08, accounting for 81.87% of the total university output. The average output per author was 49.9. Only four out of 20 authors have published than the average output per author. Similarly average citation per paper recorded by all 20 authors was 3.78. Only five out of 20 authors have recorded the average citation per paper more than the average value. The average h-index of these 20 authors during 1999-08 was 5.85. Only four authors have scored the h-index value more than the average value of all authors.

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