

## **A COMPARATIVE STUDY OF UNIVERSITY OF MYSORE AND KARNATAK UNIVERSITY IN SCIENCE: RESEARCH OUTPUT AND CITATION IMPACT DURING 2002-16**

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The study makes a comparative assessments of scientific productivity of science faculties of the University of Mysore and the Karnatak University, using different bibliometric indicators, as reflected in publications covered in Web of Science database, during 2002-16.

### **INTRODUCTION**

The scientific productivity is customarily assessed considering the published output, since the data on the number of publications by the authors, institutions, journals can easily be collected and are generally reliable. However, the developments in the fields of mathematics, statistics, operations research, management science, economics and systems analysis have led to the identification and application of suitable quantitative measuring techniques for evaluating the effectiveness and efficiency of scientists, organizations and nations. This has led to the emergence of concepts like librametry, bibliometrics, informetrics, scientometrics and webometrics.

The University Grants Commission (UGC) identified fifteen potential universities in the country under the scheme of “University with Potential for Excellence” (UPE). In the state of Karnataka, the University of Mysore and the Karnatak University are identified and selected as the UPE status. Although a number of scientometrics studies have been carried in the past on the institutional research performance, but on few makes a comparative assessment. As a result, the present study makes a modest attempt to compare the research performance of two UPE-awarded universities within the Karnataka state. While recognizing the universities with potential for excellence, the UGC has set a criterion which predominantly includes universities’ research productivity.

## OBJECTIVES OF THE STUDY

The objectives of the study is to make a comparative study of the growth of scientific productivity of the University of Mysore and the Karnatak University. The specific objectives are to; (i) to identify the annual growth in the their publications output; (ii) to identify the local and global citation score of their publications; (iii) to identify the growth rate of quinquennial publications; (iv) to find out the relative growth rate and doubling time (Dt) of the publications; (v) to make the time series analysis for making future prediction of their publication output.

## METHODOLOGY

The present study extracts publication data of University of Mysore and Karnatak University during 2002-16 from the Web of Science database by Clarivate Analytics. The search staregy used for extracting data is given below. The data collected was fed into MS-Excel for further analysis. The Histcite software was used to calculate the scientific productivity of the two universities.

(OO=UNIV MYSORE AND PY= (2002-2016) and OO=(KARNATAK UNIV AND PY= (2002-2016)).

The scientific research output of the University of Mysore and the Karnatak University was measured to assess the performance of science faculty members as well as of overall universities in science disciplines during 2002 - 2016. The scientometric techniques were applied to analyze the research productivity of the University of Mysore and the Karnatak University. The total publications output of the science faculties of both the University of Mysore and

the Karnatak University were 3,316 and 1,912 respectively during the period under consideration.

## ANALYSIS AND RESULTS

### Year-wise Scientific productivity of the University of Mysore and Karnatak University

The University of Mysore has comparatively higher number of publications than Karnatak University. The growth trend of publications by science faculty members of the University of Mysore and the Karnatak University is displayed in Table 1. The publications of University of Mysore increased from 149 in 2002 to 211 in 2016, registering an annul average growth rate of 41.61%. Compared to this, the annual publications of Karnatak University increased from 93in 2002 to 135 in 2016, registering an annul average growth rate of 45.16%. Five –year cumulative publications od University of Mysore and Karnatak University registered 54.42% and 107.41% growth, increasing from 871and 583 publications during 2002-06 to 1345 and 728 publications during 2007-11. In contrast, University of Mysore and Karnatak University showed negative growth of -18.22% and -21.78%, showing decrease in publications output 1345 and 728 publications during 2007-11 to 2012-16 (Table 1).

### Citation Impact

In terms of Total Local Citation Score (TLCS) and Total Global Citation Score (TGCS), the following results were found. University Mysore accomplished higher total TLCS (3929) compared to Karnatak University (3146). In contrast, Karnatak University obtained higher total

**Table 1: Year-Wise Distribution of Scientific Productivity of University of Mysore and Karnatak University during 2002-16**

Year of Publication	University of Mysore				Karnatak University			
	Publications	%	Cumulative Publications	%	Publications	%	Cumulative Publications	%
2002	149	4.49	149	4.49	93	4.86	93	4.86
2003	109	3.29	258	7.78	99	5.18	192	10.04
2004	154	4.64	412	12.42	110	5.75	302	15.79
2005	198	5.97	610	18.40	109	5.70	411	21.50
2006	261	7.87	871	26.27	172	9.00	583	30.49
2007	304	9.17	1175	35.43	152	7.95	735	38.44
2008	196	5.91	1371	41.34	132	6.90	867	45.35
2009	263	7.93	1634	49.28	149	7.79	1016	53.14
2010	282	8.50	1916	57.78	152	7.95	1168	61.09
2011	300	9.05	2216	66.83	143	7.48	1311	68.57
2012	210	6.33	2426	73.16	113	5.91	1424	74.48
2013	211	6.36	2637	79.52	106	5.54	1530	80.02
2014	236	7.12	2873	86.64	122	6.38	1652	86.40
2015	232	7.00	3105	93.64	125	6.54	1777	92.94
2016	211	6.36	3316	100.0	135	7.06	1912	
2002-06	871				583			
2007-11	1345				728			
2012-16	1100				601			
Total	3316				1912			

**Table 2: Year-Wise Distribution of Local and Global Citation Score during 2002-16**

Year	University of Mysore					Karnatak University				
	Pub.	TLCS	%	TGCS	%	Pub.	TLCS	%	TGCS	%
2002	149	199	5.06	2126	8.98	93	367	11.67	1933	7.83
2003	109	172	4.38	984	4.15	99	309	9.82	1435	5.81
2004	154	286	7.28	1593	6.73	110	311	9.89	2763	11.19
2005	198	332	8.45	1651	6.97	109	298	9.47	2123	8.60
2006	261	552	14.05	3071	12.97	172	416	13.22	4012	16.25
2007	304	572	14.56	2894	12.22	152	289	9.19	3066	12.42
2008	196	206	5.24	1910	8.06	132	229	7.28	1826	7.39
2009	263	295	7.51	2095	8.85	149	258	8.20	2003	8.11
2010	282	269	6.85	1620	6.84	152	160	5.09	1845	7.47
2011	300	293	7.46	1612	6.81	143	131	4.16	1122	4.54
2012	210	155	3.95	916	3.87	113	96	3.05	840	3.40
2013	211	205	5.22	1208	5.10	106	86	2.73	498	2.02
2014	236	248	6.31	1107	4.67	122	148	4.70	748	3.03
2015	232	119	3.03	690	2.91	125	35	1.11	340	1.38
2016	211	26	0.66	208	0.88	135	13	0.41	141	0.57
<b>Total</b>	3,316	3929	100	23685	100	1,912	3146	100	24695	100

Annual publication output increase of UM – 41.61% and KU- 45.16%

Pub.= Publications; TLCS= Total Local Citation Score; TGCS=Total Global Citation Score

TGCS (24695) compared to the University of Mysore (23685). The University of Mysore ranked first with 572 TLCS and 3071 TGCS counts during 2007 and 2006 respectively, while Karnatak University obtained the first rank with 416 Local Citation Scores and 4012 Global Citations scores in the year 2006. Coincidentally, both the University of Mysore and Karnatak University received highest TGCS in the year 2006. The Karnatak University has got the highest TGCS with less publication count (172) compared to University of Mysore (261 publication counts). The results are presented in Table 2.

**Relative Growth Rate (RGR) and Doubling Time (Dt)**

This section studied the scientific productivity of the University of Mysore and the Karnatak University over a period of fifteen years (2002-2016) for analyzing their Relative Growth Rate (RGR) and the Doubling Time (Dt).

**Relative Growth Rate (RGR)** is the increase in number of articles per unit of time. The mean Relative Growth Rate (RGR) over the specific period of interval can be calculated from the following equation as given by Krishnamoorthy et al. (2009).

$$1 - 2^{\bar{R}} = \frac{\log_e W_2 - \log_e W_1}{2^T - 1^T} \dots\dots (1)$$

whereas,

$1 - 2^{\bar{R}}$  = mean relative growth rate over the specific period of interval

$\log_e W_1$  = log of initial number of articles

$\log_e W_2$  = log of final number of articles after a specific period of interval

$2^T - 1^T$  = the unit difference between the initial time and the final time

The year can be taken here as the unit of time. The RGR for articles is hereby calculated. Hence,  $1 - 2^{\bar{R}}$  (aa-1 year-1) can represent the mean relative growth rate per unit of articles per unit of year over specific period of interval.

**Doubling Time (Dt)** has been calculated using the formula;

$$\text{Doubling time (Dt)} = \frac{0.693}{\bar{R}} \dots\dots\dots (2)$$

Where,  $\bar{R}$  is the Relative Growth Rate

Based on data given in Table 5 for **University of Mysore**, Relative Growth

$$\text{Rate} = \log_e W_2 = 258,$$

$$\log_e W_1 = 149, T_2 = 2003, T_1 = 2002$$

Using equation (1) above  $(5.55 - 5.00) / 1 = 0.55$

$$\text{Doubling time Dt} = 0.693 / \bar{R} (2)$$

Based on data given in Table 5.6 for **University of Mysore**,  $R = 0.55$

$$\text{Using equation (2) above } 0.693 / 0.55 = 1.26$$

The relative growth rate in publications output of University of Mysore decreased gradually from 0.55 to 0.07. Correspondingly, the doubling time increased from 1.26 to 9.90, with the decrease during 2009 (3.85). The mean relative growth rate and doubling time for the University of Mysore is 0.21 and 4.60 respectively. The The relative growth rate in publications output of Karnatak University also decreased gradually from 0.73 to 0.08. The doubling time, correspondingly, increased from

**Table 3: Relative Growth Rate and Doubling Time of Scientific Publications of University of Mysore and Karnatak University during 2002-16**

Year	University of Mysore				Karnatak University			
	Publications	Cum. Pub.	RGR	Dt	Publications	Cum. Pub.	RGR	Dt
2002	149	149	-	-	93	93	-	-
2003	109	258	0.55	1.26	99	192	0.73	0.95
2004	154	412	0.47	1.47	110	302	0.45	1.54
2005	198	610	0.39	1.78	109	411	0.31	2.24
2006	261	871	0.36	1.93	172	583	0.35	1.98
2007	304	1175	0.3	2.31	152	735	0.23	3.01
2008	196	1371	0.15	4.62	132	867	0.17	4.08
2009	263	1634	0.18	3.85	149	1016	0.15	4.62
2010	282	1916	0.16	4.33	152	1168	0.14	4.95
2011	300	2216	0.14	4.95	143	1311	0.12	5.78
2012	210	2426	0.09	7.70	113	1424	0.08	8.66
2013	211	2637	0.09	7.70	106	1530	0.07	9.90
2014	236	2873	0.08	8.66	122	1652	0.08	8.66
2015	232	3105	0.08	8.66	125	1777	0.07	9.90
2016	211	3316	0.07	9.90	135	1912	0.08	8.66
Mean			0.21	4.60			0.20	5.00

Cum. Pub. = Cumulative Publications; RGR= Relative Growth Rate; Dt= Doubling time

0.95 to 8.66, with a decrease during 2006 (1.98). The average relative growth rate and doubling time for Karnatak University is 0.20 and 5.00. During 2014, the relative growth rate and doubling time is the same for both the University of Mysore and Karnatak University.

There is an exponential growth in the research output of the University of Mysore ( $R^2 = 0.19615$ ). Compared to the Karnatak University, Dharwad ( $R^2 = 0.0509$ ). The Figure 1 and 2 provide the publications trend in scientific research output of the University of Mysore and the Karnatak University. This may be because, being the oldest universities of the Karnataka state, both the universities are setting the same trend in the scientific productivity. From the Table 5, it is evident that the Relative Growth Rate (RGR) and Doubling Time (Dt.) are directly proportional in both the universities.

Fig 1.  $R^2$  Value of Research output of the University of Karnatak University

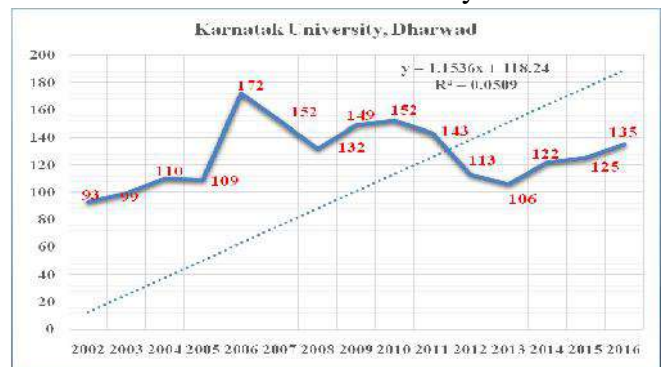
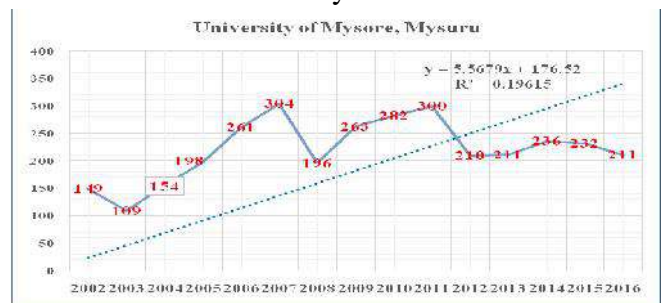


Fig 2.  $R^2$  Value of Research output of the University of Mysore



**Annual Growth Rate (AGR) and Compound Annual Growth Rate (CAGR)**

**Annual Growth Rate (AGR)**

The Annual Growth Rate (Gracio, et. al. 2013; Castanha and Gracio, 2015) is obtained by the differences between the current year’s publications and the previous year’s divided by the previous year’s total publications. Therefore, the Annual Growth Rate is calculated based on the following formula;

$$T_c(X_t) = \frac{X_t - X_{t-1}}{X_{t-1}} * 100$$

where Tc (Xt) is its scientific production growth rate in the year t, Xt is the scientific production in the year t, Xt-1 is the scientific production in the year t-1, i.e., in the previous year.

**Compound Annual Growth Rate**

The year-over-year growth rate of articles published over a specified period of time is known as Compound Annual Growth Rate (CAGR). The compound annual growth rate is calculated by taking the (n-1)<sup>th</sup> root of the total percentage growth rate, where n is the number of years in the period being considered.

This can be written as follows:

$$CAGR = \left( \frac{\text{Ending Value}}{\text{Beginning Value}} \right)^{1/n-1}$$

The annual growth rate of scientific productivity of the University of Mysore and the Karnatak University has shown in Table 6 during 2002- 2016. The data revealed that the annual growth rate of the University of Mysore was maximum in the year 2004 (41.28%) and minimum in the year 2008 (-35.52%). Similarly, the Karnatak University’s annual growth rate was maximum in the year 2006 (57.79%) and minimum during 2012

**Table 4: Annual Growth Rate of Publications of University of Mysore and Karnatak University during 2002-16**

Year	University of Mysore		Karnatak University	
	Publications	Annual Growth Rate	Publications	Annual Growth Rate
2002	149		93	
2003	109	-26.85	99	6.45
2004	154	41.28	110	11.11
2005	198	28.57	109	-0.90
2006	261	31.81	172	57.79
2007	304	16.47	152	-11.62
2008	196	-35.52	132	-13.16
2009	263	34.18	149	12.87
2010	282	7.22	152	2.01
2011	300	6.38	143	-5.92
2012	210	-30.00	113	-20.97
2013	211	0.47	106	-6.19
2014	236	11.84	122	15.09
2015	232	-1.69	125	2.46
2016	211	-9.05	135	8
Total	3,316		1,912	
<b>CAGR</b>	<b>2.35%</b>		<b>2.52%</b>	

\*CAGR = Compound Annual Growth Rate

(-20.97). It is observed from the table that during 2003, 2008, 2012, 2015 and 2016, University of Mysore witnessed for negative growth rate and like-wise during 2005, 2007, 2008, 2011, 2012 and 2013 Karnatak University perceived negative growth rate. The negative growth rate clearly indicates the shrinking trend in the scientific productivity of both the universities. The Compound annual growth rate (CAGR) of both the universities is 2.35% for University of Mysore and 2.52% for Karnatak University. The Compound annual growth rate compares the growth rate over a specified duration of time. It could be noticed that CAGR of both the University of Mysore and the Karnatak University is below 5.0% growth rate. The data highlights that both the University of Mysore and the Karnatak University

are showing fluctuation in growth rate of scientific productivity during the fifteen years of study.

**Time Series Analysis**

Understanding the mechanisms of a time series allows a mathematical model to be developed that explains the data in such a way that prediction, monitoring or control can occur. Monitoring of ambient conditions or of an input is common in science and industry. It is assumed that a time series data has at least one systematic pattern. The most common patterns are trends and seasonality. Trends are generally linear and quadratic. To find trends, moving averages or regression analysis is often used (Prasanna Kumari et. al. 2012).

Straight line equation is applied to arrive at projections for future growth of University of Mysore and Karnatak University under Time Series Analysis.

Straight Line equation  $Y_c = a + bX$

**Application of straight line equation to the University of Mysore**

Since  $\Sigma x = 0$

$$a = \Sigma Y/N = 3316/15 = 221.06$$

$$b = \Sigma XY/\Sigma x^2 = 1559/280 = 5.57$$

Estimated literature in 2031 is, when

$$X = 2031 - 2009 = 22 = 221.06 + 5.57 *$$

$$22 = 221.06 + 122.54 = \mathbf{343.6}$$

**Application of straight line equation to the Karnatak University, Dharwad**

Since  $\Sigma x = 0$

$$a = \Sigma Y/N = 1912/15 = 127.46$$

$$b = \Sigma XY/\Sigma x^2 = 323/280 = 1.15$$

Estimated literature in 2031 is, when

$$X = 2031 - 2009 = 22$$

$$= 127.46 + 1.15 * 22 = 127.46 + 25.3 = \mathbf{152.76}$$

Table 5 presents a Time Series Analysis of both universities during 2002-16. Time Series Analysis is implemented to forecast the scientific research output of the universities in the future years. The time series equation is applied for next fifteen years that is 2031 because the doubling

**Table 5: Time Series Analysis of Publications of University of Mysore and Karnatak University during 2002-16**

Year	University of Mysore				Karnatak University			
	Count (Y)	X	X <sup>2</sup>	XY	Count (Y)	X	X <sup>2</sup>	XY
2002	149	-7	49	-1043	93	-7	49	-651
2003	109	-6	36	-654	99	-6	36	-594
2004	154	-5	25	-770	110	-5	25	-550
2005	198	-4	16	-792	109	-4	16	-436
2006	261	-3	9	-783	172	-3	9	-516
2007	304	-2	4	-608	152	-2	4	-304
2008	196	-1	1	-196	132	-1	1	-132
2009	263	0	0	0	149	0	0	0
2010	282	1	1	282	152	1	1	152
2011	300	2	4	600	143	2	4	286
2012	210	3	9	630	113	3	9	339
2013	211	4	16	844	106	4	16	424
2014	236	5	25	1180	122	5	25	610
2015	232	6	36	1392	125	6	36	750
2016	211	7	49	1477	135	7	49	945
	3,316		280	1,559	1,912		280	323

time of scientific literature is usually 10 to 15 years (Price, 1965). From the above analysis, it is can be deduced that in comparison, the University of Mysore is showing the highest publication growth rate compared to Karnatak University, Dharwad.

### SUMMARY AND CONCLUSION

The Karnatak University, Dharwad and the University of Mysore, Mysuru published the highest number of publications in the year 2006 (172) and 2007 (304) respectively. In the year 2006, the University of Mysore, Mysuru and the Karnatak University, Dharwad received the highest citations for their publications i.e. 3071 and 4012 respectively. The University of Mysore, Mysuru and the Karnatak University, Dharwad have published the highest number of publications of 1343 and 728 respectively during quinquennial period of 2007-2011. The Relative Growth Rate and Doubling Time of 2015 is same (0.08) in both the universities. Mean values of Relative Growth Rate, Doubling Time and Compound Annual Growth Rate are almost similar in both the universities for fifteen years' research output [RGR (0.21, 0.20), Doubling Time [4.60, 5.0], CAGR [2.35%, 2.52%]. It can be deduced from the above analysis University of Mysore scientific performance is better in terms of quantitative publication output in contrast to Karnatak University publications showing comparative better results in terms of citation quality and impact.

For increasing the research output and for improving the impact of research, it is suggested that faculties and researchers of both the

universities need to actively collaborate with the scholars working in R&D and industrial sector establishments in India and abroad. For this purpose, they may sign MoUs with R&D organizations and industries. In addition, there is a lack of infrastructure in terms of library, computing and equipment requirements and proper environment to encourage creativity in the two universities. Besides, course contents needs to be updated and research scholars needs to be encouraged to take part in training programs and in national and international seminars and conferences.

Excellence in research in higher education may be promoted by supporting research programs of the universities in various disciplines. The Universities Grants Commission has clearly mentioned that, "although the Government has a network of science and technology laboratories for research and development, the major base of researchers in science and technology remains with the universities. Therefore, the university faculties need to be supported to meet this requirement. Hence, it is suggested to the UGC and other major funding agencies to extend liberal grants to undertake Minor and Major research projects and it should be the outcome-based funding. Setting up Incubation Centres with Seed Money to do innovative research and provide incentives for faculty and research scholars for publishing research articles with high impact factor journals is also needed.

The University of Mysore, Mysore and the Karnatak University, Dharwad research publications are gradually increasing year by year. Despite this growth rate, these two universities



need to increase their output and need to improve the quality of its research efforts. This can be done by investing more in Research and Development, deploying more qualified manpower, increasing international collaboration and by modernizing and strengthen its existing research infrastructure facilities of the both the universities.

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