Scientific Output Indicators and Collaboration in Southern Brazil1

Rama Mohan Reddy Associate Professor M.Tech--MECH
Dr I V Prakash Associate Professor Ph.D ECE
B.Naresh,Assistant Professor
Pallavi engineering and technology, hyderabad

Abstract

It is impossible to create S&T indicators without first assessing the state of science and technology. This kind of review is particularly essential on a national and regional scale in the United States because of the country's diversity and the rapid increase of its scientific output in recent years. This paper will conduct a literature review of studies conducted in Rio Grande do Sulk and available in the Web of Science database between the years 2000 and 2010. These indicators have tracked the growth of research papers published in academic journals, fields of study, file formats, spoken languages, and international collaboration. With the exception of 2006, the statistics show a steady and exponentially adjusted growth rate, with output often exceeding Brazil's scientific output. Articles make up a large percentage of published work (71.71 percent), with the great majority of these pieces written in English (84.89%) and appearing mostly in a few of national periodicals. The sciences of health, biology, agriculture, and engineering are recognized as priorities for education in Rio Grande do sulk. It is largely on a national scale that institutions in Rio Grande do sulk and elsewhere in Brazil collaborate with one another. Among the world's most important allies are the United States, Germany, France, the United Kingdom, and Argentina.

Introductio

Science and technology (S&T) related organizations, government agencies, and development agencies in many nations regularly conduct assessments of scientific output. Such evaluations have proved crucial in the creation of S&T indicators, the allocation of investments, the creation of local and institutional plans, and the assessment of the outcomes of policies. Practices relating to S&T indicators have garnered extra attention in countries with rapidly increasing scientific output. It wasn't until the latter half of the 19th century that Brazil began to value scientific inquiry (The present..., 1883). According to the Web of Science (Woos) database, Brazil's output grew by 8% per year in 2006 (Glaze, Let, & This, 2006), making it the fastest-growing among Latin American nations. With more Brazilian journals now part of Woos, Brazil's scientific output rose to the thirteenth spot globally in 2008. (Packer, 2011). Brazil is now ranked 15th in SCOPUS' national productivity ranking2 and has maintained the same position in Woos. In spite of the questions raised by Brazil's rapidly increasing scientific output, the country is still timid when it comes to developing S&T indicators and lacks an information tool capable of characterizing and sizing the state systems of science, technology, and innovation (Rocha & Ferreira, 2004). Against this background, several unanswered concerns remain, like how the number of publications has been growing, where these papers are being published, and what kinds of collaborations are behind their publishing. We discover that the condition of scientific research and publishing in the United States is an even larger unknown than the dearth of studies pertaining to Brazil as a whole. Differences in scientific production across Brazilian states are mostly attributable to disparities in social and economic development. Researching Brazil's scientific production and its global share is crucial; such research must take into account the unique characteristics and priorities of the country's many regions, states, cities, and institutions (FAPESP, 2010). "The nation's continental and federative character needs a study of regional distinctions," Albuquerque, Sims, Bases, Cipolin, and Leandro (2002) write. "At the same time, said analysis exposes the possible role of developing local and state innovation systems in the country." (p. 230). Therefore, it is necessary to identify particular cases.

Methodology

The Web of Science database hosted by Thomson Reuters was mined for its information. In January 2012, Woos was scoured for as many articles as possible written by writers affiliated with Rio Grande do Sulk-based universities. For starters, we used the more specific "CU= (Brazil OR Brazil) AND PS=Rio Grande do Sulk" phrase to hunt for results relating to Brazil and Rio Grande do Sulk (RS OR RGS OR Rio Grande do Sulk). After that, a more targeted search strategy was implemented by employing specialized terms and the names of colleges and research centers in Rio Grande do Sulk, such as: OG= (name of all Rio Grande do Sulk research institutions and universities). The list of authorities from Brazilian institutions was compiled by the research group a few years ago, and it included the names of the research institutes and universities utilized in the search phrase in Rio Grande do Sulk (Moure, 2009; Vans, 2009). The scope of the search included any and all document types in any of the 45 languages included in the index. Specifically, we narrowed our results to papers published between 2000 and 2010 and picked the Science Citation Index, the Social Science Citation Index, and the Arts & Humanities Citation Index in the corresponding area. After eliminating duplicates, we located 29,560 publications from Rio Grande do Sulk institutions. Curculio Lattes is a platform built by Cap that provides the curriculum vitae of instructors, researchers, and students in a uniform manner. This was done because of namesakes and name variations. Lattes are a very trustworthy database for checking identities and institutional affiliations since the information is entered by researchers themselves.

Results

Between 2000 and 2010, the RS scientific output increased, as measured by the annual total of published documents (n=29,560). However, the rate of expansion seems to be unstable, slowing between 2004 and 2006 then picking up speed between 2006 and 2009. Chart 1 contrasts the rate of increase of the RS's scientific output in Woos with that of Brazil's, showing that both countries have followed an exponential development pattern (R2 0.9718 and R2 0.924, respectively).
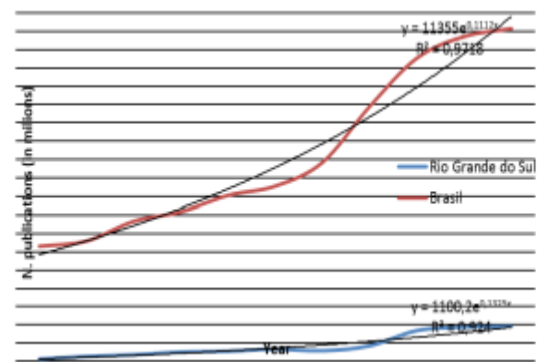

Chart 1 shows the increase in the level of scientific research published in the World of Science between 2000 and 2010 in Brazil and the RS.

Information gleaned via studies. Table 1 displays the sum of RS and Brazilian scientific production over the last decade, demonstrating both countries' rising prominence in the field. The percentage increase in indexed papers for RS scientific output ranges from 2.05% in 2009 and 2010 to 61.60% in 2007. When compared to 2005, 2006's growth was negative (-7.44%). The increase of RS output remained consistent and greater than the growth of Brazilian scientific production over the period, with the exception of 2006, when production fell. Its growth has outpaced Brazil's in various years (2001, 2003, 2005, 2008, and 2009, for example). Table 1 displays the percentage of total national scientific output that each state contributes. From 2000 to 2009, we can observe that the value remains stable from 9.17% to 12.9%. These increases seem to be associated with the recent boom in Brazilian graduate and postgraduate education. In 1998, for instance, there were 1,259 Master's and Doctoral programs. To put it another way, the figure increased to 2,718 in 2009. (Oliveira & Almeida, 2011). The large growth in the number of Brazilian journals indexed by Thomson Reuters is also tied to the rise in Brazilian and state

scientific output indexed in Woos. That's an increase of around 700% in a single decade! (Packer, 2011). In particular, the state of Rio Grande do Sulk had its scientific production rise by 61.60 percent between 2007 and 2008. In 1977, just eight Brazilian periodicals were included in the index (Morel & Morel, 1977). Within the next decade, in 1998, 17 Brazilian titles were added to the index (Torino & Garcia, 2000). After another ten years, in 2008, the number had increased to 120 works (Packer, 2011). When we look at the search results connected to the examination of the journals' language, it becomes clear that Brazil established itself in 2010 with 132 journals indexed in Woos (Test, 2011), many of which are published monthly and in Portuguese.

The study of journal titles with higher publishing frequency (Table 2) shows that Agriculture journals take up the top ranks, contradicting the assumption formed by the prominence of engineering areas. This disparity may be attributed to the fact that most agricultural research is only published in a small number of publications, most of which are of a national or regional scope. When compared to these disciplines, which tend to publish in national publications, the publishing outlets for Health and Biological Sciences and Engineering are more dispersed.

Scientific topics from RS that were indexed in Woos from 2000-2010 (Table 3).

Fields	RS	%
Clinical and Experimental Medicine II	5982	13.78
Engineering	5768	13.28
Biology (organism and supra-organism levels)	4773	10.99
Agriculture	4022	9.26
Chemistry	3620	8.34
Biosciences	3210	7.39
Clinical and Experimental Medicine I	3179	7.32
Biomedical Research	3123	7.19
Physics	3057	7.04
Neurosciences and Behavior	2532	5.83
Geosciences and Space Sciences	1877	4.32
Multidisciplinary Sciences	860	1.98
Social Sciences I and II	635	1.46
Mathematics	486	1.12
Arts and Humanities	299	0.69
Total	43423	100

Source: Research data.

Increases in the number of Brazilian journals indexed by Woos may explain why there were so many articles published in agriculture-focused publications in this analysis (9.26%). In the city of Pelotas in Rio Grande do Sulk, back in the day when Brazil was still mostly an agricultural empire, was founded the Imperial Escola de Medicine Veterinarian e de Agriculture Practice (Imperial School of Veterinary Medicine and Practical Agriculture) (Capdeville, 1991). Since 1969, the institution has been affiliated with Universidad Federal de Pelotas. There are now 29 graduate-level agricultural programs in the state, and four EMBRAPA units are located there. The findings somewhat validate those reported by Albuquerque et al. (2002), who identified Health and Agricultural Sciences as the top scientific sub-fields in RS. Analysis of 29560 documents released by the State of Rio Grande do Sulk revealed the involvement of 45535 writers. The state's total production throughout the time (n=29,560) was 24.98

percent higher thanks to the work of 49 writers who each produced more than 100 pieces. Biochemistry, memory, and genetics are just some of the topics covered by some of the most prolific authors, including Wagner, M (325 documents), Rocha, JBT (299 documents), Giugliani, R (292 documents), Souza, DO (265 documents), Kapczinski, FP (249 documents), Nigeria CW (234 documents), Wyse, ATS (232 documents), and Inquired, I (207 documents). Scientists affiliated with UFSM only contributed 27.37 percent of the total number of publications (7366), while those affiliated with UFRGS made up 58.25 percent. Numbers show that both federal universities are well regarded in Rio Grande do Sulk, however researchers from Pontifical Universidad Catholic do Rio Grande do Sulk (PUCRS), Universidad Federal de Pelotas (Fuel), and Universidad Caxias do Sulk (UCS) are also included.

Regarding institutional partnerships, the state averages 2.19 and the median is 2, both quite close to the national average of 2.4 institutions per publication (Vans & Stump, 2012). While both the mean and the median suggest inter-institutional cooperation, the fact that 43.51 percent of publications had just one institutional affiliation suggests that this is not yet the norm in the state. Table 5 shows that when the totals for the following positions are summed together, cooperation between two, three, and four institutions accounts for 51.06 percent of the scientific research in the RS. Cooperation's with a larger number of organizations are unimportant.

Institutional affiliations of RS authors in World of Science articles published between 2000 and 2010 (Table 5).

No. institutions	No. publications	%
1 institution	12830	43.51
2 nstitution	8744	29.65
3 institution	4537	15.38
4 institution	1777	6.03
5 institution	663	2.25
6 institution	312	1.06
7 institution	151	0.51
8 institution	91	0.31
9 institution	80	0.27
10 institution	57	0.19
11 institution	38	0.13
12 institution	29	0.10
13 institution	24	0.08
14 institution	20	0.07
15 or more institution	137	0
No institutional connection	70	--
Total	29490	100.00

Source: Research data.

Consistent with the descriptive studies, the cluster analysis of the cooperation among the top 100 institutions in the ranking does not reveal the establishment of tightly related work groups. It is clear from the map that the RS institutions are not working together, and there are no visible signs of coordinated activities that can be studied. Since UFRGS is already well-established in the RS scene, it may feel obligated to seek relationships beyond the state and, potentially, outside Brazil, which may explain why it seems isolated at the center. Partnerships between UFRGS and other national institutions in the agricultural and biotechnology domains have been noted by previous research (Costa, Pedro & Macedo, 2013). All three of these universities are located in Rio Grande do Sulk, not far from UFRGS. Both the Federal University of Rio Grande do Sulk (FURG) and the Federal University of Pelotas (UFPEL) may be seen in close proximity to one another, despite the fact that they are not part of the same cluster. UFPEL, EMBRAPA, and UNIPAMPA are all in the same cluster as UFSM.

The Institute de Cardiologic, the University of So Paulo School of Medicine (UFCSPA), the Hospital Me de Deus, and the Hospital Moinhos de Vento are all affiliated medical research organizations located at the top of the map. UFRJ, UNICAMP, UFSC, USP, UFPR, UNIFESP, and UNESP are all in adjacent states that are near to Rio Grande do Sulk. These states are Santa Catharina, Paraná, So Paulo, and Rio de Janeiro. Previous research has indicated that the universities of USP, Unicamp, Unsex, and UFRJ work together in the area of biotechnology (Moura & Caregnato, 2010). Given that health sciences constitute the primary subject of study in Rio Grande do Sulk, it is not surprising that USP is working as a partner with the state. USP is responsible for roughly 30% of Brazil's scientific output relating to health sciences (Let, Pereira, & Chaimovich, 2005). We also find a distinct grouping of international institutions that operate independently from their RS counterparts.

The United States of America appears in 21.86 percent of all RS production, followed by European nations such as Germany (8.17 percent), France (7.37 percent), the United Kingdom (6.66 percent), Spain (5.31 percent), and Italy (3.91%). When compared to other Latin American nations, Argentina's 6.35 percent publication share makes it stand out. Collaboration with the nation bordering Rio Grande do Sulk State is far more than the 3.8% that Brazil maintains with that country (Vans & Stump, 2012).

Countries that contributed to the work of Rio Grande do Sulk from 2000 to 2010 are listed in Table 6.

Country	No. publications	%
USA	2397	21.86
Germany	896	8.17
France	808	7.37
UK	730	6.66
Argentina	696	6.35
Spain	582	5.31
Canada	512	4.67
Italy	429	3.91
Australia	371	3.38
Portugal	314	2.86
Chile	228	2.08
Japan	183	1.67
Uruguay	178	1.62
Netherlands	162	1.48
Switzerland	160	1.46
Belgium	132	1.20
Mexico	129	1.18
Peoples R China	128	1.17
Sweden	126	1.15
Another 101 countries	1804	16.45
Total	10965	100

The focus on cooperation with the United States in the fields of health, the environment, and energy; and the focus on cooperation with the European Union in fields such as health, biotechnology, nanotechnology, agriculture, energy, and the environment are among the bases for the Brazilian scientific collaboration, as stated by Costa et al. (2013). These are the fields in which RS has had the most success, a finding that may be connected to the nations with whom the state has established cooperative relationships.

Final Considerations

The scientific output of RS as reflected in the Woos base increased at a rate that was both exponential and constant, until in 2006, when it declined. When comparing percentage statistics relating to certain of the years examined, such as 2001, 2003, 2005, 2008, and 2009, this rise is greater than the increase in

Brazilian scientific output. Articles account for a majority of the published material (71.71%), and English is the language of publication (84.89%). The results are published in a wide range of periodicals, although those from Brazil are notably well-represented in the Agricultural Sciences. Because this is not the most prolific sector in terms of publications in the state, we suppose that more successful disciplines, such as clinical medicine, engineering, and the biological sciences, exhibit less endogenous behavior and publish in foreign, more diversified journals. Documents published in agricultural-related publications seem to reflect a bias toward domestic publication. According to the examination of writers, those affiliated with UFRGS, UFSM, UFPEL, UCS, and PUCRS produce the most works. The institutional productivity study confirms these findings, revealing that universities account for a majority (20) of the top 30 most productive RS institutions. Porto Alegre, the capital city, and Santa Maria, a city in the country's center region, are where the majority of the country's scientific output is made. Results from the analysis indicate that the writers worked together. However, just one university accounts for 43.51 percent of all publications, indicating that cooperation across universities is still in its infancy. There is international cooperation in 23.22 percent of Rio Grande do Sul's publications. The United States, Germany, France, the United Kingdom, and Argentina are the primary partners. Because of its proximity to Argentina, cooperation with that nation is stronger than with Brazil. The conclusions reported here may be improved upon by more research into the cooperation between RS and the other Brazilian states and between RS and other nations. The scientific output of the RS is certainly bigger than the projections reported in this research, which focus only on the papers indexed in Woos. The goal is to encourage conversation; hence the research is neither comprehensive nor definitive. We think it's crucial for society and development organizations to be aware of the research efforts in Rio Grande do sulk, thus we did this study.

References

1. Albuquerque, E. M., Samos, R., Bases, A., Cipolin, B., & Leandro, L. (2002). A distribuição especial ad produces scientific e technological Brasilia: puma descrição de statistics de produce local de patents e Artigas científicos. Revisit Brasilia de Inovação, 1(2), 225-250.

2. Berta, L. C., Oliveira, D. L., Souza, D. O., & Woodchuck, S. T. (2010). Produce scientific e Formica de recourses humans an area de bioquímica me instituições federals do Rio Grande do Sulk: foment stadia. Química Nova, 33(3), 765-771.

3. Bramble, S. D. S., & Stump, I. R. C. (2012). Artigas ad UFRGS representations an Web of Science: so mains citados e seus citantes. Em Questão, 18(3), 179-197.

4. Capdeville, G. O. (1991). Ensino superior agrícola no Brasil. Revista Brasileira de Pedagogia, 72(172), 229-261. 5. Costa, B. M. G., Pedro, E. S., & Macedo, G. R. (2013). Scientific collaboration in biotechnology: the case of the northeast region in Brasil. Scientometrics, 95(2), 571-592.

6. Fundação de Amparo à Pesquisa do Estado de São Paulo. (2004). Indicadores de Ciência, Tecnologia e Inovação em São Paulo. Retrieved from http://www.indicadores.fapesp.br/