South Africa's Scientific Productivity: Growth, Development, and Research Collaborations from 1995 to 2004

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Introduction

Publication profile is an indicator of the scientific activity of a country. Many important observations can be made by studying scientific publications through their bibliographic features (Garge, 2001). The quantitative analysis of the publication data, therefore, can be used in the identification of emerging research areas and in the evaluation of the research performance of individual scientists, research groups or organizations (Amudhavalli, & Florence, 2001). International scientific collaboration has been of increasing interest in recent years due to the higher quality of collaborative papers as shown by higher average impacts when compared to solely national publications (Van Raan, 1998) and the benefit gained by peripheral countries from international collaboration for integrating their national publications onto the international scientific network (Russell, 1995).

Objectives

The purpose of this paper is to explore the main scientific output that can picture the extend of scientific development in South Africa. The specific objectives of the paper are:

- to identify the productive institutions in South Africa during the period 1995-2004.
- to investigate the growth and development of south African scientific publications, 1995-2004
- to evaluate the percentage of international collaborations with South African scientists

Methodology

The data is collected using CD-ROM and Web versions of the Science Citation Index (SCI), and South African studies databases. All papers recorded in the annual volumes of the Science Citation Index and in the South African studies databases, as article, note, or review were taken into consideration for the period of 1995-2004.

The following South African institutions were found to be the most productive: Universities of Pretoria (UP), Cape town (UCT), Natal (NATAL), Stellenbosch (STELL) and Witwatersrand (WITS). The 7 main disciplinary fields are Clinical Medicine (CLIN), Plant & Animal Science (PLT&ANM), Biology & Biochemistry (BIO&BICH), Engineering (ENG), Environment & Ecology (ENV&ECO), Chemistry (CHEM) and Physics (PHY).

The performance of 5 institutions were compared based on the following qualitative and quantitative indicators:

1. Amount of scientific activity measured by volume of production during the period of study,
2. Each institutional fields of specializations using specialization index (SI) formula,
3. Publication activity
4. The collaboration of scientific activity measured by co-authorship.

Records were analysed using SPSS to identify the distribution of production throughout the period of study, distribution of publications by field and institution, and distribution by type of document. In order to study and compare the specialization of various institutions in specific fields, the specialization index (SI) formula has been used (Godin, Robitaille, & Côté, 2001) and it is calculated as share (%) of publications of institution X in field Y divided by the share (%) of publications of all institutions in field Y.

The study is also analytical in nature with the application of suitable statistical tools to strengthen the empirical validity. Non-parametric Chi-square test was applied in the analysis of differences of co-authorship among institutions and t-test was used to justify differences in co-authorship rate. A further ANOVA analysis was conducted to reveal if significant inter-institutional variation in their total publication out put among mainstream existed.

Findings

The result of the study showed that there were a total of 19399 articles from 7 fields of study among 5 institutions during the period 1995-2004 of which University of Cape Town (UCT) accounts for the

largest share of South African publications which is 26.80%, followed by UP (19.84%). The Universities of WITS and STELL have a publication share in the range of 18-19%. The University of Natal with 16.28% share accounts the least. A further statistical analysis has been employed to indicate if there was a significant level of inter-institutional differences identified on the total out put publications. However, the result of statistical analysis at p-value >0.10 does not reveal significant inter-institutional variation in their total publication out put.

The majority of South African Scientific Publications came from the field of Clinical Medicine (29.51%). Plant and animal science 20.85%, Physics 13.88% and Engineering 13.00% for the period. The other disciplinary fields, in order of percentage contribution were, Environmental science and Ecology (9.00%), Chemistry (8.94%), and Biology and Biochemistry (4.82%). Field of specialization varies greatly among institutions. UP, UCT and Natal have a higher relative publication activity in Plant & Animal science (SI=1.80), BIO&BICH (SI=1.72) and CHEM (SI=1.15) respectively. Whereas, STELL and WITS are more active in ENGIN (IS=1.58) and CLNIC (IS=1.50) respectively.

There was a marked increase in the publication output from 1995 to 2003. The Universities of Natal, UP and STELL showed highest percentage increase in 2003 with 84.10%, 108.10% and 105.10% respectively. However, their percentage increase declined in 2004 to 5.60%, 9.83% and 76.19% respectively. The annual output of scientific publications of UCT, on the other hand, declined from 1995 to 1996 by 57.0% and increased by 81.80% in 1997. It has further declined by 59.20% in 1998.

The analysis of the data distribution of national and international collaborations indicated that the share of South African national co-authorship is 26.01% and 73.99% for international collaborations. Given international collaboration, SA authors' affiliation with USA and UK ranked first and second with 45% and 13% respectively. Other countries in order of ranking were: France (8.05%), Germany (7.80%), Netherlands (7.60%), Australia (3.40%) and Belgium (3.20%). However, the affiliation with other countries were very minute; such as Sweden (2.90%), Japan (2.70%), Canada (2.50%) and African countries (3.20%). Each institutions' international percentage of collaboration vis-à-vis national collaboration showed that STELL (91.25%), UCT (83.33%), WTS (78.22%) and Natal (68.84%), while the corresponding share in UP was 44.87%.

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