MISJUDGEMENTS AND SHORTCOMINGS IN THE MEASUREMENTS OF SCIENTIFIC ACTIVITIES IN LESS DEVELOPED COUNTRIES

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ABSTRACT

The bibliographic database widely used for measurement of scientific production (counting of publications) either for developed or developing countries is Science

INTRODUCTION

The process of Science can be regarded as an input-output phenomenon, capable of being quantified. In general, input is much easier to measure than output, since all of its elements are tangible and input calculation does not require experience in science: manpower, financial resources, equipment, materials, buildings, etc. whereas the output of science consists of the knowledge generated during the research process, which is rather intangible and hence difficult to quantify directly.

It is very often assumed that the results of any research must have a close correlation with the investment made into the said research, and so input indicators have been used sometimes to estimate research results. However this

this period, authors from LDCs had their papers rejected more frecuently (57%) than authors from advanced countries (17%), not because their low scientific quality, but mainly for giving inadequate references to relevant literature, lack of clarity and excessive length of papers. This indicates the low level of awareness of current literature possessed by LDCs researchers, the lack of experience in

regarded as covering the most significant research papers in the world ("mainstream" of world research). Each core journal issue is indexed comprehensively (cover to cover), 2) Usually developing countries' journals are excluded from the SCI, which covers less than 2% of the all LDCs journals, 3) SCI is strongly biased in favour of Anglosaxon journals, mainly from the USA, neglecting a great number of relevant periodicals from other countries and non English languages, 4) A great number of these journals belong to the biomedical field, disregarding other important areas, i.e. applied science and technology, 5) The SCI based evaluations ignore the works that are not published by conventional and formal journal channels (reports, patents, workshops, notes etc), which may be heavily used in transmitting scientific research among scientists from LDCs, and could be significant in research, particularly in applied sciences.

2. CONTRIBUTION OF LDC's TO THE "MAINSTREAM" OF SCIENCE.

In any case, the use of SCI as a bibliometric indicator will only be suitable for evaluating the contribution of each country to the "mainstream" of world science, and not to find out the total scientific production of countries (8). As a matter of fact, the underdeveloped countries' contribution to the "mainstream" of science is almost negligible (9), as is shown in the following data.

According to Garfield (10) and Frame (11) in 1973 (data from SCI) 90% of the world "mainstream" scientific papers came from Europe, USA, USSR and Japan, whereas the Indian contribution was 2%, Argentina 0,4% and Brazil 0,23%. In 1978, the scientific production of Argentina, Mexico, Chile, and Venezuela, altogether represented only about 1% of all published articles in SCI (12), whereas the USA generates 40% of all international scientific literature, obtains 60% of all citations, and the 80% of the world scientific literature was written in English (10).

These figures, based on SCI data, have remained without significant variations. In a more recent study carried on by Schubert (13) in 1981-85 period, it is deduced that almost 85% of all world scientific production is generated in the USA, Europe, USSR and Japan. In the said period, the contribution of Brazil to the "mainstream" of world science was 0,36%, Argentina 0,28%, Mexico 0,17%, Venezuela 0,07, India 2,64%, Taiwan 0,13% and Singapore 0,05%.

In spite of the above points about awkwardness, shortcomings and lack of adequacy for evaluating Third World science, SCI is widely used even in the less developed countries as a bibliographic database for publication counting to quantify their own scientific production (4,8,14,15,16,17,18,19,20,21). This method when used without supplementary information derived from other sources, supplies mistaken and false results.

Many bibliometric studies based in SCI database indicate that papers from peripheral countries covered by SCI have certain characteristics in common, which are:

1) Much of the research in developing countries pertains to the biomedical area (4,17,22,23,24).

2) Almost all the papers done in LDCs and covered by SCI are written in English and published in periodicals in the Western World (often in low impact journals) (4,23,24).

3) Most foreign journals come from the USA, UK or Netherlands, except in the case of Cuba, where journals from GDR and USSR are highly used (6).

4) A great number of papers from LDCs are rarely cited even if many of them have appeared in journals having impact factors greater than one (4,24). However, papers published in UK and USA journals have better citation records than those publised elsewhere.

3. INCONSISTENCIES IN THE USE OF SCI AS AN EVALUATION SOURCE.

Some inconsistencies can been observed when using SCI as an evaluative resource. For instance: much of the work done in areas such as tropical medicine and agriculture, public health, parasitology, soils (fertilizing and microbiology), tropical fishes biology, etc. is underrepresented in SCI (17,25). However, when using the French bibliographic database Pascal to establish the world bibliographic production in tropical soil sciences during 1983 (22), a considerable percentage (65%) of the 2040 retrieved references corresponds to research made in peripheral countries, showing that scientists from those countries play an important role in Agricultural Sciences as a whole, and in Tropical Agriculture in particular.

The analysis of 258 papers published from Singapore institutions and covered in SCI (1979-1980) (4), indicates than most of the research made belongs to the Medical field (48%), whereas Engineering reports only 11%. That research output does not match the Singapore national priorities in view of the Goverment's investment promotion and Economic Planning Organization that has choosen 11 industrial fields for prioritary promotion, among them: automotive components, machine tools, computers, electronic instrumentation, optical equipment, etc. Also Singapore has the world third largest petroleum refining centre and the second largest oil rig construction. Other major industries include ship building also.

These kinds of scientific and technical priorities agree with data given by the National Development Research Centre from Canada (NDRC) about research in small countries (26), which reports that, in 1987, the 72% of Singapore government funding was assigned to Engineering and Technology, whereas the Medical Sciences funding was of 13% and Natural Sciences 10%. It seems that

the research made in Engineering and Technology does not reach international diffusion through SCI as it originates internal reports or is published in domestic sources or in international ones not covered by SCI.

The same can be said about Agricultural Science, which as Engineering and Technology, does not fit in the concept of mainstream proposed by SCI, being a subject of more local than international interest. According to SCI none of the 25 journals of higher impact factor belong to Agriculture and none of the most cited papers from LDCs authors deal with Agriculture (25). That agrees with Velho (27) who shows that 85% of all Brazilian papers in Agriculture are published in local journals, and with our previous paper about Cuban productivity (6), where we demonstrate that the great majority of Agricultural subject papers are written in domestic journals.

A bibliometric analysis of papers published over a two year period (1979-1980) from the five ASEAN countries (Indonesia, Malaysia, Philippines, Singapore and Thailand), and covered by SCI (24), reveal than those countries have the largest number of papers published in medical journals. In Philippines, Medicine comes on second place very close to Agriculture. Taking into account that the International Rice Research Institute (IRRI) is located in Manila, it seems quite probable that the number of agricultural research publications were greater than those supplied by SCI. It would be useful to verify this feature in local or specialized databases.

In a study by Schubert (13), data from 45 different developed and underdeveloped countries having at least 50 papers published in SCI in five major fields (Life Sciences, Chemistry, Physics, Engineering and Mathematics) during 1981-1985 period were presented. It was revealed that the scientific effort

4.SCIENTIFIC EVALUATION USING DIFFERENT DATABASES: COMPARISON OF RESULTS

A large percentage of LDCs research results are published in relevant

multidisciplinary databases. Those results will achieve international visibility.

With the aim of obtaining information about the possible differences in scientific productivity of each country by counting retrieved references from SCI in comparison with other databases, searches in SCI, Chemical Abstracts (CA), BIOSIS, INSPEC, CAB and EXCERPTA MEDICA during the period 1985-1989 were made, in order to find the scientific productivity of a total of 8 countries, chosen at random between those considered as less developed (Table 1).

In spite of its specific subject area, CA gives much more bibliographic information than SCI at least for Cuba, and quite similar for Taiwan. BIOSIS gives more information in the case of Malaysia and Cuba, and quite similar in the case of Singapore, Nigeria and Peru. CAB provides more references in the case of Malaysia and Cuba and similar number in case of Nigeria. EXCERPTA offers more documents in the case of Cuba.

In a bibliometric study promoted to establish the worldwide scientific productivity in the field of sugar cane by products, (1983-87) (7), it was proved that Cuba is the world leader according to number of scientific publications in that subject (128 papers), followed by Brazil (115 papers) and US (93 papers). The results agree with those mentioned by Ubell (28): "In some applied areas; for example, sugar cane by products research, Cuba has jumped to world leadership". To obtain these figures eight international databases had to be used, due to the multidisciplinarity of the subject (CA, BIOSIS, PASCAL, COMPENDEX, FSTA, AGRIS and SCI) as shown in Table 2. 1) CA, BIOSIS and AGRIS, give more information than SCI; 2) all databases other than SCI

deal of data and features of the field that could not be possibly obtained by using SCI as a unique data source, as it is presented in the following examples related to Chemical Abstracts database.

According to the Cuban Chemical literature it is shown (6) that the Cuban papers retrieved in CA, 33% correspond to Biochemistry sections, followed by Macromolecular Chemistry (23%), Physical Chemistry (20%) and Applied Chemistry (19%). The limited extent of Cuban research published in Organic Chemistry (4,5%) is also to be noted.

In another bibliometric study (29), Cuban research in Chemistry through Chemical Abstracts database, during 1985-87, was reported. 737 references were retrieved. It was shown that Cuba is making its research effort in the subjects related to the following CA sections: Industrial Carbohydrates (sect. 44), Cellulose, Lignin, Paper and other Wood products (sect. 43) and Food and Animal Nutrition (Sect. 17 and 18). The percentage of Cuban papers covered by CA in said sections is very much higher than the world average. So Cuban Activity Indexes are: in Industrial Carbohydrates subfield 147,5; in Cellulose, Lignin and Paper subfield 13,3 and in Animal and Human Food 3,9. (Table 3).

Table 3. Cuban scientific production in CA (1985-1987)
Most studied CA subjects

CA Section	N. Papers	% Cuba (85-87)	% World (85)	AI*
Industrial Carbohydrates	132	17,7	0,12	14,5
Cellulose Lignin, Paper	60	8,0	0,6	13,3
Animal & Human Food	76	10,2	2,6	3,9
Industrial Biochemistry	35	4,7	2,7	1,7

* Activity Index = The given field's share in the publication output/ The given share in world publication output

6. SCIENTIFIC EVALUATION USING LOCAL DATABASES

In the case of Cuba its own database, a multidisciplinary publication (Revista de Información Científica y Técnica Cubana, RICTC), which encloses the most relevant Cuban journals, has been taken into consideration with the purpose of detecting the Cuban scientific production published in national journals. 9319 papers were retrieved (Table 4). None of those papers could be retrieved by SCI, since no Cuban journal is included as source journal in the said repertory,

however, most of those papers are able to be retrieved from CA, BIOSIS, INSPEC, etc. since some Cuban journals are included in said databases. As seen in Table IV, 60% of all Cuban papers published in local journals corresponds to Medicine and Agriculture .

Table 4. Subject and chronological distribution of Cuban papers retrieved from RICTC

On the other hand, total overlapping is produced between SCI and CA and BIOSIS (no more than 74 and 123, of course), some is produced between CA and RICTC and Biosis and RICTC, and no overlapping at all is produced between RICTC and SCI since no Cuban journal is covered by SCI.

Table 5. Cuban scientific production (1985-1989) Number of references retrieved

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