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Analysis of information use in agricultural science PhD theses at Central University of Venezuela (1986-2002)

Analysis of
information use

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Abstract

Purpose To analyze information use in agricultural science PhD theses submitted between 1986 and 2002 in the Faculty of Agronomy, Central University of Venezuela (UCV).

Design/methodology/approach The source of information was the UCV Faculty of Agronomy, Library's database, "Tesis". The unidimensional production and use indicators analyzed included: scientific production, reference density, self citations, document contemporaneousness and type of documents cited, reference scattering and accessibility of the journals cited.

Findings The analysis of the data obtained from 4,646 bibliographic references in 42 agricultural science PhD theses provides insight into information use in a Venezuelan agricultural science community. The mean number of references per thesis found was 113 ± 21 . The number of women earning a PhD in agriculture was observed to grow. The percentage of self citations varied widely. The half life was 11 years and the Price's Index 22 per cent. According to the distribution by document type, most of the publications cited were articles in journals, while references to technical standards and internet publications were rare. UCV Faculty of Agronomy PhD students tended to seek information primarily in the Anglo Saxon literature. The Celestino Bonfanti Library periodicals section met a high proportion (92 per cent) of the demand for journals located in the first and second concentration scattering zones.

Originality/value This is the only paper on the evaluation of PhD theses in Venezuela. The findings will be useful for education planners in Venezuela and other developing countries.

Keywords Education, Information science, Theses, Venezuela

Paper type Research paper

Introduction

Interest in the analysis of scientific research in Venezuelan agricultural science has been growing in recent years. The result has been studies that review and compare academic production in terms, for instance, of publications in national journals (Texera, 1982; Arenas, 2001; Chaparro and Maldonado, 2004).

But the analysis of scientific research based on PhD theses is still a minority option world-wide and conditioned by the quality of the data available in nation-wide surveys (Pires, 1998; Nascimento, 2000; Moralejo, 2000; López, 2002; Pelzer and Wiese, 2003; Camps *et al.*, 2005; Hakan and Tayb, 2007; Haider and Mahmood, 2007). Most of the above papers focus primarily on the humanities and social sciences, the exceptions being the Walcott (1994) survey of biology and geology in the United States and two Spanish studies, on geotechnology and IT (Urbano, 2000a,b).



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User citations are a source for determining information use by a library's potential public and can be viewed as a simulation of user demands. The most direct alternative for studying information use by a university's researchers is the bibliometric mining of their publications (Martín and Sanz, 2001). In such cases several questions must be considered: what type of publications should be included, and how should they be identified? Depending on the answers to these questions, the source publications may vary widely in nature.

Any analysis of library users entails deciding whether to take account of all types of source documents (theses, journal articles, congress papers and so on) and in that case whether their use is to be stratified, or whether on the contrary priority is to be given only to the documents that best reflect research tasks.

Oliveira (cited by Urbano, 2001) compares several source publications: PhD theses, monographs and journals, finding that the references cited in PhD theses were the ones best represented in the university library's stacks. Zipp in turn (cited in Urbano, 2000a) sustains that PhD students' use of information is highly representative of information needs and use in university environments. Walcott (1994) observes that PhD students account for the most intensive use of periodicals in the State University of New York biology library.

The analysis of PhD theses may be an ideal source for obtaining data on information use by department researchers, in particular post-graduate students. This has been established by authors such as McCain, Zipp and Barry (cited by Urbano, 2000a) who, based either on statistical methods or sound argument, assert that PhD student use is highly representative of the information needs and use of research staffs as a whole in university environments. Moreover, several authors find the analysis of PhD theses to be an ideal source for obtaining data on information use by PhD students. Barry (cited in Urbano, 2001), for instance, uses statistical methods to maintain that PhD students' use is highly representative of the information needs and use of research staffs as a whole in university environments.

The analysis of PhD theses is justified in most of the papers reviewed, which focus on the determination of information use and needs among PhD students in a given institution (Urbano, 2001; Pérez, 2002). The objective pursued is generally an evaluation of library stacks from the standpoint of their use.

The present study uses an analysis of the bibliographic references appearing in agricultural science PhD theses defended in the Faculty de Agronomy, Central University of Venezuela (UCV) from 1986 to 2002 to obtain an overview of information use by this community. The details discussed hereunder characterize the specialized use of information by a certain sector of Venezuelan agricultural science. The analysis of the citations in theses written in a university may carry a clear bias in favour of that university's library because, according to observations on referencing behaviour, the more accessible a source, the more likely it is to be cited.

The UCV, a higher education institution where a fair share of Venezuelan research work is conducted, consists in 11 faculties, one of which is the Faculty of Agronomy. The faculty's primary aims are to deliver agronomic training, and generate and transfer agronomics knowledge and technology through (under- and post-graduate) education, research and outreach; its ultimate mission is to contribute to the improvement of the quality of life of the people of Venezuela (UCV, 2002). The UCV's Faculty of Agronomy, the only institution in Venezuela offering a PhD in agricultural science, trains post-graduates in any area of agriculture. Instituted in 1983, its objective is to train professionals to lead the generation, planning and implementation of both

basic and applied research in agricultural science. PhD candidates must submit and successfully defend a thesis in a public exam pursuant to the provisions of Article 160 of the University Act.

An exhaustive review of the literature is requisite to the drafting of a PhD thesis. This is a strong argument in support of the suitability of studying PhD students as library researcher-users and sources of information. Be it said that the intention, with the choice of PhD theses, is not to deal with scientific research in general, which would include other types of papers besides theses. Rather, it is an acknowledgement that such theses constitute one of the avenues through which research is channelled in the university and therefore reflects the lines of academic interest at any given time. They are obviously a very valuable indicator of scientific production (Agudelo *et al.*, 2003a,b).

In light of the importance of PhD theses for agricultural science activities in Venezuela, the purpose of the present study is to analyze and quantify information use by the authors of such theses written at the UCV Faculty of Agronomy between 1986 and 2002, and describe the most prominent tendencies and characteristics. The choice of the Central UCV and the area of agricultural science for this survey is intended to contribute to the study of these two spheres, which are only scantily addressed in the literature analyzed.

Methodology

The main premises adopted in this study are: in Venezuela, the university is a relevant social institution for the world of science; in general the number of PhDs awarded in a discipline constitutes a measure of research development in that field; the inventory of references affords an indication of the bibliographic materials being used by researchers to reinforce their intellectual effort and may indirectly represent the use of the literature in a specific area.

Type of study

The study performed was both retrospective, referred to the years 1986-2002, and descriptive (Tamayo, 1997), covering the description, recording, analysis and interpretation of the present nature of information use by some of the researchers defending their PhDs in agricultural science at the Faculty of Agronomy de la UCV.

Data were collected on a spread sheet, used to synthesize the information. The data from all the PhDs in agricultural science read at the Faculty of Agronomy, UCV between 1986 and 2002, the period covering nearly the entire time doctorates in agriculture have been offered in Venezuela, were transferred on to these spread sheets; one of the parameters determining selection of the theses analyzed was the availability of the original version at the faculty's Celestino Bonfanti Library.

Sources of information

When choosing a source for surveys such as this one, the data must be expected to be sufficient, continuous, reliable and involve many aspects of bibliographic production. A source with sufficient data is one containing at least the data needed to identify each of the references cited. Continuous means that using the same method, the information is maintained for a sufficient length of time to perceive variations in output. By reliable is meant that data selection and presentation is rigorous, with a minimum of – in any event rectifiable – errors. Varied means that the data should cover other characteristics

of bibliographic production that can be analyzed and provide for the subsequent review of auxiliary aspects of cultural interest.

For the period in question, a source was identified that may be regarded to be essentially "ideal" in terms of meeting nearly all the above requirements. Indeed, the UCV Faculty of Agronomy Celestino Bonfanti Library's TESIS database is a source that meets most of these ideal characteristics: it covers the entire period in question with a uniform, fairly rigorous data format, and it includes all the PhD theses defended throughout the period. TESIS is the Celestino Bonfanti Library database for inventorying and publicizing the teaching and research staff's scientific activities. It contains bibliographic descriptions of undergraduate papers and graduate, master's and PhD theses, as well as professors' research for promotion. It is specialized in agricultural science and its coverage is local, for it deals solely with the results of research conducted in the UCV Faculty of Agronomy.

The criteria, on which the decision to use the TESIS database was based, were: total coverage of all the PhD theses defended at the UCV Faculty of Agronomy; representative of the area constituting the object of the survey; existence of selection criteria for the sources indexed; highly standardized fields; and data updating on a regular basis. The primary problem encountered in the use of databases is securing the original papers to analyze the references cited. On this occasion, a copy of the theses was requested from the university library's collection of publications. This photocopied material was manually reviewed to calculate the various bibliometric indicators for each of the PhD theses on agricultural science read from 1986 to 2002.

Unit of analysis

The analysis of the bibliographic references in PhD students' theses provides insight into the use of the UCV Faculty of Agronomy library stacks and is a method to be considered for the study of researchers as library users; the weak point of this methodology is the difficulty in automating references for processing.

The present study analyzes the references in user publications. This is an indirect method for determining information use and ascertaining these users' habits as information consumers. The aim of studying references in the analysis of scientific information use is to ascertain the impact of research output on a given scientific community (López and Terrada, 1992a). Studies of bibliographic references constitute an ideal means of retrieving information, for they are the material link between the research reported and the research that preceded it.

Indicators

A wide variety of indicators were used to evaluate user habits and information needs and use, most prominently bibliometric indicators (González and Moya, 1997) determined via indirect methods, inasmuch as they were inferred from papers published by agricultural science PhD students enrolled at the UCV's Faculty of Agronomy.

Bibliometric indicators, according to López and Terrada (1992b), are numeric data on social phenomena associated with the generation, transfer and use of information inherent in scientific activity in any given community, and are valid where publications are an essential result of research. Consequently, they are most useful in basic research, where scientific publication plays a predominant role, and much less so in technology or applied science (Granda, 2003). López and Terrada (1992b) defines essentially five basic types of bibliometric indicators: quality, circulation, scattering, information use

and impact. The unidimensional indicators considered in this study were production and use, as described below.

Production

Scientific output is generally measured as the number of publications produced by an author, institution or country. In the present study, the number of PhD theses in agriculture defended at the UCV Faculty of Agronomy was tallied for each year analyzed. Thesis production per year was found for the entire period studied (1986-2002).

Gender

The relationship between women and science/technology was addressed in the study from a number of perspectives (Vesuri and Canino, 2001; Licea *et al.*, 2003). Ever since these concerns first began to be expressed, one of the questions has revolved around the presence of women in a country's scientific-technological systems. The number of PhD theses was broken down by sex for each year in the period (1986-2002).

Reference density

The references appearing in each PhD thesis in agriculture read at the UCV Faculty of Agronomy were quantified. The reference density was found for each year analyzed as the mean number of bibliographic references per thesis.

Self-citations

Two levels should be distinguished: self-citation in journals and self-citation by authors. Journal or organization self-citation is said to exist when the citing and the cited papers both appear in the same journal or are generated in the same organization, even though they share no author (Spinak, 1996). The clearest case of self-citation is when primary author A cites a previous paper of his or her own authorship. In this paper, the rate of author self-citation was calculated from authors' citations of their own papers in the references (Sanz and Martín, 1997).

Contemporaneousness

This characteristic refers to the tendency for items in a library collection to decline in use as they age and is evaluated by half-life and Price's index, which measure the contemporaneousness of the papers cited (Sanz and Martín, 1997). Reference half-life: in scientific literature it is defined as the time needed for one half of the literature circulating about a given subject to become obsolete (Massó *et al.*, 2001). Sanz and Martín (1997) define half-life as the time during which half of the active literature circulating on a given subject was published, interpreting active literature to mean research cited by other authors or requested from a documentation centre. Half-life can be understood to mean the speed at which papers become obsolete, in other words, when their impact and scientific dissemination wane. It is consequently measured in terms of the year of publication of the literature cited. This indicator estimates the contemporaneousness of the references used by scientists (Sen, 1999).

Reference half-life is calculated by finding the median of the distribution of the years of publication of references or their age, or the number of years between the present and the year after which half of the references were published (Sen, 1999; Massó *et al.*, 2001). If the data are ranked in descending order of magnitude, the median year is the

one in position $(N + 1)/2$. If there is an even number of elements, the median is the arithmetic mean between the two central values (Spinak, 1996).

Price's index, in turn, measures the percentage of papers referenced that were published within the last five years (Sanz and Martín, 1997). Calculated as the difference between the year of publication of the reference and the year in which it is cited, it entails counting the number of references that are five years old or less (taking the year of publication of the citing paper as year zero), and finding the percentage with respect to the total number of references. The result therefore reflects the larger or smaller percentage of recent papers consulted by the library user to generate new knowledge.

Type of documents cited

This is a way of classifying publications that disseminate knowledge. It is important to know the type of documents used and consulted by users, for these data can be applied to determine their information needs. The typology indicator provides insight into the type of papers most commonly consulted by users when divulging the results of their research or to obtain the information needed (Sanz and Martín, 1997, 1998).

The value of this indicator was computed from the frequencies found for the various types of sources in the references cited in the research papers analyzed, year by year. The following document types were analyzed: (1) journal articles, (2) books, (3) theses, including PhD, masters' and graduate theses, (4) Internet papers, (5) congress proceedings, reports, official publications, press articles, (6) technical standards and (7) other genres.

Reference scattering

The analysis of journal scattering in production and use of literature both is important in that, firstly, it identifies the number of journals accounting for a certain percentage of papers on a given discipline or subject. Secondly, the study of publication scattering provides an indication of research trends in different branches of science.

This indicator shows which journals are cited. Journal names are compiled from the respective references, their percentage is computed and they are ranked in descending order. A study of reference scattering was conducted following Bradford's law of scattering. This distribution identifies the most relevant publications in a given area of knowledge. Following the Bradford scheme, the journals constituting the main source of information are clustered in the so-called core zone (many references in a short number of journals); several outwardly concentric zones are then defined, all with approximately the same number of references as the core zone but each with a larger number of journals than the preceding zone.

Spinak (1996) and Gorbea (1996) offered a clear enunciation of Bradford's law as follows: if scientific journals are ranked in decreasing order of number of articles on a given theme, they can be divided into a core of journals devoted specifically to that theme and several groups or zones containing the same number of articles as the core, but in which the number of journals grows exponentially, with the relationship between the successive zones being: $1: n: n^2: \dots$ this is a theoretical formulation of Bradford's law. The constant n , known as the Bradford multiplier, is a property of the periodicals in question.

Bradford divides the list of journals ranked by descending frequency in clusters or zones, each with a similar number of articles, and relates each zone numerically via a multiplier, which he himself notes is not exactly constant. The number of zones is

arbitrary, for different authors divide the list into anywhere from three to ten zones. The larger the number of zones, the smaller and less constant is the multiplier (Brooks, cited by Spinak, 1996).

Journal accessibility

The availability of all the periodicals located in the first and second concentration-scattering zones in Bradford's mathematical model was explored to determine the ease with which agriculture PhD students could obtain the articles in question. Availability was analyzed by reviewing the Celestino Bonfanti Library's collective catalogue of periodicals, which can be accessed on line at www.ucv.ve.

Statistical analysis of the data

A univariate descriptive analysis was run on the various indicators subjected to evaluation. The mean, minimum and maximum values are given for some of the indicators.

Results and discussion

The analysis of the data obtained from 4,646 bibliographic references in 42 agricultural science PhD theses read between 1986 and 2002 at the Central UCV's Faculty of Agronomy yielded the results set out below.

Scientific production

Forty two, or 43.7 per cent, of the total 96 PhD theses defended at UCV's Faculty of Agronomy were on agricultural science (Table I). The first PhD in agricultural science was read in 1986, three years after the formal initiation of this doctorate in the UCV's Faculty of Agronomy (Table II). At least one thesis was defended per year thereafter, with a maximum of six in 2001.

Gender

Women authored 45.2 per cent of the PhD theses in agricultural science; the number of women earning their doctorate in agricultural science grew between 1986 and 2002 (Table III). This increase would not appear to be significant, however, nor in keeping with other areas of education. In Spain, women accounted for 21.8 per cent of the PhD students in 1972, 42.1 per cent in 1982 and 40.6 per cent in 1991. The distribution by area of such post-graduates, both in 1982 and 1991, was roughly the same as the figures for undergraduate studies, with some notable exceptions such as in the experimental and health sciences (Pérez, 2003).

Reference density

A mean of 113 ± 21 references per thesis was found for the agricultural science PhD theses defended at the UCV's Faculty of Agronomy. This figure was higher than the one reported by Dulle *et al.* (2004) in a study on the use of citation analysis to select agricultural journals in a library in Tanzania, and by García and Román (2006), who analyzed the references in three Spanish geology journals, finding a mean of 26 references per article. Unlike journal articles, theses allow authors a good deal of freedom for including a significant number and wide variety of references. The fact that a large fraction of the scientific literature remains uncited in the journals included in citation indices does not necessarily mean that it is not read. Rather, due to the

| LR | Year | Agricultural science | Soil science | PhD theses Entomology | Agricultural zoology | Agronomy |
|---|-------|----------------------|--------------|--------------------------|----------------------|----------|
| 57,2 | 1974 | | | | | 1 |
| | 1975 | | | | | 1 |
| | 1976 | | | | | 2 |
| | 1977 | | | | | |
| 130 | 1978 | | | | | |
| | 1979 | | | | | 1 |
| | 1980 | | | | | |
| | 1981 | | 1 | | | |
| | 1982 | | | 1 | | |
| | 1983 | | 1 | | | |
| | 1984 | | | 2 | | |
| | 1985 | | 1 | | | |
| | 1986 | 1 | 1 | 2 | | |
| | 1987 | 1 | | | | |
| | 1988 | 3 | 2 | 2 | | |
| | 1989 | 1 | 3 | | | |
| | 1990 | 2 | | 2 | | |
| | 1991 | 1 | | | | |
| | 1992 | 3 | | 2 | | |
| | 1993 | 2 | 2 | 2 | | |
| | 1994 | 4 | | 1 | | |
| | 1995 | 1 | 2 | | | |
| | 1996 | 4 | | 1 | | |
| | 1997 | 2 | 2 | 3 | | |
| | 1998 | 3 | 1 | | | |
| | 1999 | 2 | | 1 | | |
| | 2000 | 2 | 3 | 1 | 2 | |
| | 2001 | 6 | 3 | 1 | 1 | |
| | 2002 | 4 | 1 | 1 | 1 | |
| Table I. PhD theses read at the faculty of Agronomy, Central UCV, (1979 2002) | Total | 42 | 23 | 22 | 4 | 5 |
| | % | 43.7 | 23.9 | 22.9 | 4.2 | 5.2 |

limitations imposed by scientific journals on total number of pages and references, many articles consulted can simply not be cited.

Self-citations

Self-citation is a common practice whose rates vary widely (Table IV). It may indicate, among others, an author's ongoing engagement in a line of research, or that the field addressed is new or highly specialized. According to Tagliacozzo, cited by Spinak (1996), in over 50 per cent of self-citations the interval between the dates of the citing and the cited articles cited is very short. The percentage of self-citations does not seem to be directly related to the length of the reference section or the author's productivity. Rather, the practice would seem to be a characteristic of scientific behaviour and writing style. In principle, it should be an indication of constancy in a line of research. Nonetheless, a high rate of self-citation seems to go hand-in-hand with a high degree of social isolation, along with scant outside recognition and low visibility and scientific impact.

| Year | PhD theses in agricultural science | |
|-------|------------------------------------|------|
| | Frequency | % |
| 1986 | 1 | 2.4 |
| 1987 | 1 | 2.4 |
| 1988 | 3 | 7.1 |
| 1989 | 1 | 2.4 |
| 1990 | 2 | 4.8 |
| 1991 | 1 | 2.4 |
| 1992 | 3 | 7.1 |
| 1993 | 2 | 4.8 |
| 1994 | 4 | 9.5 |
| 1995 | 1 | 2.4 |
| 1996 | 4 | 9.5 |
| 1997 | 2 | 4.8 |
| 1998 | 3 | 7.1 |
| 1999 | 2 | 4.8 |
| 2000 | 2 | 4.8 |
| 2001 | 6 | 14.2 |
| 2002 | 4 | 9.5 |
| Total | 42 | 100 |

Table II.
PhD theses in
agricultural science read
at the Faculty of
Agronomy, Central UCV
(1986 2002)

| Year 1986 2002 | Total theses | PhD theses in agricultural science | |
|-------------------|--------------|------------------------------------|-------|
| | | Men | Women |
| | 42 | 23 | 19 |
| % | 100 | 54.8 | 45.2 |

Table III.
Gender distribution of
agricultural science PhD
thesis authors (1986
2002)

| Year | Number of theses in agricultural science | Number of references | Number of self citations | % self citations |
|------|---|-------------------------|-----------------------------|---------------------|
| 1986 | 1 | 197 | 0 | 0 |
| 1987 | 1 | 85 | 0 | 0 |
| 1988 | 3 | 201 | 18 | 8.9 |
| 1989 | 1 | 82 | 0 | 0 |
| 1990 | 2 | 194 | 7 | 3.6 |
| 1991 | 1 | 28 | 2 | 7.1 |
| 1992 | 3 | 325 | 10 | 3.1 |
| 1993 | 2 | 138 | 1 | 0.7 |
| 1994 | 4 | 681 | 23 | 3.4 |
| 1995 | 1 | 46 | 1 | 2.2 |
| 1996 | 4 | 394 | 7 | 1.7 |
| 1997 | 2 | 244 | 6 | 2.4 |
| 1998 | 3 | 314 | 6 | 1.9 |
| 1999 | 2 | 229 | 4 | 1.7 |
| 2000 | 2 | 437 | 15 | 3.4 |
| 2001 | 6 | 690 | 3 | 0.4 |
| 2002 | 4 | 493 | 2 | 0.4 |

Table IV.
Presence of self citations
in agricultural science
PhD theses read at the
Faculty of Agronomy,
UCV (1986 2002)

Contemporaneousness

The half-life of the references in agricultural science PhD theses is eleven years, while the Price's index comes to 22 per cent (Table V). Spinak (1996) maintains that different areas of research have different half-lives: in biology, citations are more immediate whereas in mathematics and social science they are incorporated more slowly and reach obsolescence later.

Type of documents cited

According to the distribution by document type (Table VI), most of the publications cited were articles in journals; the number of references to other kinds of texts such as books, congress proceedings, reports, official publications and press articles represented a small percentage of the publications used to draft and defend theses; references to other theses and Internet documents were rare. This predominance of references (56.8 per cent) to journal articles in agricultural science PhD theses confirms that the pattern followed is consistent with that of other experimental sciences, where information is transmitted primarily via journal articles, with percentages of over 50 per cent (Dulle *et al.*, 2004).

Reference scatter

Tables VII, VIII, and IX show the journals cited in descending order of frequency of citation in the period studied. The journals were divided into four zones, each containing approximately the same number of references, the division most consistent

Table V.
Reference age in
agricultural science PhD
theses (1986 2002)

| Year | Frequency | | | Total |
|-------|-----------|------------|-----------|-------|
| | ≤5 years | 6 10 years | ≥11 years | |
| Total | 1,206 | 1,437 | 2,754 | 5,397 |
| % | 22 | 27 | 51 | 100 |

Table VI.
Type of documents cited
in agricultural science
PhD theses read at the
Faculty of Agronomy,
UCV (1986 2002)

| Year | Books | Journal articles | Theses | Congresses | Technical standards | Internet papers | Other |
|----------|-------|---------------------|--------|------------|------------------------|-----------------|-------|
| Mean (%) | 23.4 | 56.8 | 3.22 | 2.2 | 1.2 | 2.3 | 10.9 |
| Minimum | 16 | 50 | 1 | 0 | 0 | 0 | 0 |
| Maximum | 30 | 72 | 5 | 3.4 | 2.3 | 3 | 14.5 |

Table VII.
Distribution of cited
journals by Bradford
zones

| Zone | Number of references | Number of journals | Cumulative total |
|--------|----------------------|--------------------|------------------|
| Zona 1 | 658 | 8 | 658 |
| Zona 2 | 677 | 19 | 1,335 |
| Zona 3 | 682 | 44 | 2,017 |
| Zona 4 | 644 | 260 | 2,661 |

with the Bradford model (Gorbea, 1996); in other words, there is one first or core zone and three additional zones.

The first zone contains eight journals that published 658 articles; this is the most productive zone or core of the Bradford distribution (Figure 1). This means that in the period studied, these eight journals were the ones most intensely consulted by students writing their PhDs. One of these journals, *Agronomia Tropical*, stands out in particular as the only one in the core published in Spanish, followed by other more general, multi-disciplinary journals, such as the *Journal of Agricultural Science*. This zone should contain the Venezuelan journals devoted to the subject studied. Nonetheless, since the Bradford law fails to take account of certain variables such as ambiguity in the definition of the field studied, frequency of journal publication or journal size, it would identify the most productive journals but not necessarily the ones most highly

| | Order | Journal | Number of references | Cumulative total |
|------------------|-------|--|----------------------|------------------|
| Core | 1 | <i>Phytopathology</i> | 154 | 154 |
| | 2 | <i>Agronomia Tropical</i> | 102 | 256 |
| | 3 | <i>Biométrica</i> | 83 | 339 |
| | 4 | <i>Acta Horticulturae</i> | 79 | 418 |
| | 5 | <i>Plant Disease</i> | 72 | 490 |
| | 6 | <i>Plant Physiology</i> | 62 | 552 |
| | 7 | <i>Journal of Dairy Science</i> | 54 | 606 |
| | 8 | <i>Journal of Agricultural Science</i> | 52 | 658 |
| Total journals | 8 | | | |
| Total references | | | | 658 |

Table VIII.
Main journals, in descending order, used by authors in writing their agricultural science PhDs core

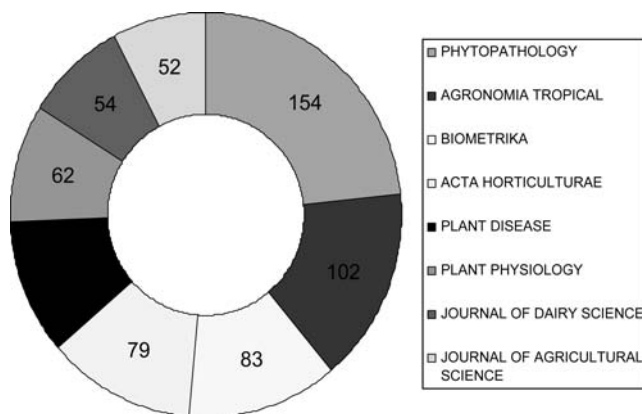
| Order | Journal | Number of references | Cumulative total |
|------------------|--|----------------------|------------------|
| 9 | <i>Agronomy Journal</i> | 48 | 48 |
| 10 | <i>Journal of Animal Science</i> | 46 | 94 |
| 11 | <i>Annual Review of Phytopathology</i> | 46 | 140 |
| 12 | <i>Plant Cell Report</i> | 44 | 184 |
| 13 | <i>Thecnometrics</i> | 43 | 227 |
| 14 | <i>Journal of Food Science</i> | 42 | 269 |
| 15 | <i>Crop Science</i> | 42 | 311 |
| 16 | <i>Revista de la Facultad de Agronomía UCV Maracay</i> | 39 | 350 |
| 17 | <i>Plant and Soil</i> | 36 | 386 |
| 18 | <i>Nature</i> | 35 | 421 |
| 19 | <i>The Plant Cell</i> | 34 | 455 |
| 20 | <i>Hortscience</i> | 31 | 486 |
| 21 | <i>Canadian Journal of Botany</i> | 31 | 517 |
| 22 | <i>Theoretical and Applied Genetics</i> | 29 | 546 |
| 23 | <i>Journal of the American Society for Horticultural Science</i> | 28 | 574 |
| 24 | <i>Cafe Cacao, The</i> | 28 | 602 |
| 25 | <i>Plant Science</i> | 25 | 627 |
| 26 | <i>Plant and Cell Physiopathology</i> | 25 | 652 |
| 27 | <i>Bioscience</i> | 25 | 677 |
| Total journals | 19 | | |
| Total references | | | 677 |

Table IX.
Main journals, in descending order, used by authors in writing their agricultural science PhDs Zone 2

LR
57,2

134

Figure 1.
Zone 1 or core



specialized in a given subject (Urbizagástegui and Cortès, 1998). The second zone, with 19 journals, produced 677 articles. The third, with 44 periodicals, contained 682 referenced articles and the 260 journals in the final zone accounted for 644 references (Table VII).

Different disciplines have different referencing traditions. Interdisciplinary journals are cited more often than those more narrowly focused. Spinak (1996) proposes that Bradford's law can be applied to rationalize a library's collection as follows: – Identify the titles that comprise the core journals for a subject, defined in terms of the number of articles published, not their quality. – Determine the number of journal titles needed to cover a given fraction of all the literature on the subject.

Access to the cited scientific journals

Of the main journals (core and zone 2) cited by agricultural science PhD thesis authors, 93 per cent are available in the UCV, Faculty of Agronomy Celestino Bonfanti Library collection, while 7 per cent constitute demands not met by the library. Sanz and Martín (1997) postulate that 50 per cent of the journals in the first and second concentration-scatter zones should exist in the library's collection; in this case, then, the Celestino Bonfanti Library complies with that criterion.

Conclusions

The present study is an approach to the analysis of information use by the Venezuelan scientific community on the basis of the PhD theses defended in the Faculty of Agronomy at the Central UCV from 1986 to 2002. The results provide useful insight into the information base of Venezuelan scientific production in this area. The growth in the production of PhD theses is discussed, along with the sources of information used by the Venezuelan researchers defending PhD theses in agricultural science between 1986 and 2002. A total of 91 PhD theses were read in the Central UCV's Faculty of Agronomy in those years (Table I): 42 in agricultural science, the first ranking area. The 42 agricultural science PhDs contain 4,646 bibliographic references, for a mean of 113 ± 21 references per thesis.

The number of women earning their doctorate in agricultural science was observed to grow, accounting for 45.2 per cent of PhD theses awarded in that discipline by the Faculty of Agronomy, UCV.

The percentage of self-citations varies widely. It may indicate, among others, an author's ongoing engagement in a line of research, or that the field is highly specialized.

The half-life of the citations in agricultural science PhD theses is 11 years, while the Price's index comes to 22 per cent. While this half-life is low compared to other journals, it is typical of agricultural disciplines, where the literature ages quickly. A fairly high Price's index was found, indicating that a high proportion of the literature consulted for theses is recent.

According to the distribution by document type (Table VIII), most of the publications cited are articles in journals; the number of references to other kinds of documents such as books, congress proceedings, reports, official publications and press articles is small; and references to other theses and Internet documents are rare. The high percentage of citations of journal articles confirms the important role played by scientific journals in the dissemination of agricultural science in Venezuela. The paucity of citations of other types of documents such as theses, Internet papers and reports may be due both to the difficulty in accessing such literature and to the fact that as these are areas only recently developed in Venezuela, the number of such documents is small.

The two journals most intensely cited by agricultural science PhD thesis authors were *Phytopathology* and *Agronomía Tropical*. PhD students show a preference for Anglo Saxon literature, which reflects the use of information contained primarily in periodicals written in English (Tables VIII and IX). Moreover, a large share of the information is found in a short number of journals, essentially those with greatest international impact in the field.

The Celestino Bonfanti Library periodicals section meets a high proportion of the demand for journals located in the first and second concentration-scattering zones.

The methodology used in the study of PhD theses can be extrapolated to a greater or lesser extent to other academic papers of similar importance for students. Hence, when considering the academic studies requisite to earning a university degree, account must be taken of the fact that doctorates are not the only degrees that entail original research. Many other degrees in Venezuela require some manner of project or paper in addition to normal course work, such as certain post-graduate and masters' degrees.

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