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THE IMPACT OF THE INTERNATIONAL FOUNDATION FOR SCIENCE (IFS) FUNDING ON LATIN AMERICAN RESEARCH IN ANIMAL HEALTH AND PRODUCTION

C.S. Galina, J. Riveroll, P. Cardenas, M. Aguilar and J.M. Russell

SUMMARY

A three-part study was carried out to evaluate the characteristics and impact of the International Foundation for Science (IFS) funding in Latin America between 1975 and 1997. In the first part analysis of the grants awarded by the IFS showed that support peaked in 1990. Countries most frequently favored were Mexico and Argentina with animal diseases and nutrition being the research areas most commonly funded. A second part of the study in which present and ex-IFS grantees were asked to answer a questionnaire on their total research publications revealed that they published predominantly in peer reviewed journals from their home countries. A third approach involved a search in the international database Science Citation Index *to identify the grantee's publications published in the mainstream research literature. Few publications were retrieved suggesting a reduced international presence. These findings are discussed in relation to the objectives of the IFS program and the characteristics of scientific research in agricultural disciplines in Latin America.*

RESUMEN

Se efectuó un estudio de tres partes para evaluar las características y el impacto del financiamiento de la International Foundation for Science (IFS) en América Latina entre 1975 y 1997. En la primera parte el análisis de las subvenciones otorgadas por la IFS muestra un máximo de las mismas en 1990. Los países más frecuentemente favorecidos fueron México y Argentina, siendo las áreas más comúnmente financiadas las de enfermedades animales y nutrición. Una segunda parte del estudio, donde se les solicitó a los anteriores y actuales subvencionados contestar un cuestionario sobre el total de sus publicaciones, reveló que publicaron principalmente en revistas arbitradas por pares de sus países de origen. Un tercer enfoque consistió en buscar en la base de datos internacional del Science Citation Index para identificar cuáles de estas publicaciones aparecieron en la literatura de corriente principal (mainstream). Se encontraron muy pocas publicaciones, lo cual sugiere una discreta presencia internacional. Estos hallazgos se comparan con los objetivos de los programas de la IFS y las características de la investigación científica en disciplinas agrícolas en América Latina.

Introduction

In the context of science in the developing world there is a wide range of strategic areas where investment is needed to improve performance. In spite of the diversity of these needs (laboratories, equipment, easy access to information sources, etc) the acute shortage of human resources in every aspect of scientific activity has traditionally been considered to require the most urgent attention (Moravcsik, 1975). While injection of large sums of money may, for instance, facilitate the building within a few years of research laboratories, or the stocking of libraries, the development of manpower is a long-range proposition (Moravcsik, 1975). The training of scientists is a costly undertaking and an investment that will be realized only in the long run (Frame, 1979).

In many cases developing countries have recognized the

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RESUMO

Foi efetuado um estudo de três partes para avaliar as características e o impacto do financiamento da Internacional Foundation for Science (IFS) na América Latina entre 1975 e 1997. Na primeira parte em análise das subvenções outorgadas pela IFS mostra um máximo das mesmas em 1990. Os países mais freqüentemente favorecidos foram México e Argentina, sendo as áreas mais comuns de financiamento as doenças animais e nutrição. Uma segunda partes do estudo, onde foi solicitado aos anteriores e atuais subvencionados responder um questionário sobre o total de suas publicações, revelou que publicaram principalmente em revistas arbitradas por parte de seus países de origem. Um terceiro enfoque consistiu em buscar na base de dados internacional de Science Citation Index para identificar quais destas publicações apareceram na literatura de corrente principal (mainstream). Foram encontradas poucas publicações, o qual sugere uma discreta presença internacional. Estes descobrimentos são comparados aos objetivos dos programas da IFS e as características da pesquisa científica em disciplinas agrícolas na América Latina.

urgent need for increasing scientific manpower by implementing programs to encourage the postgraduate training of young scientists abroad and/or by promoting the availability of quality postgraduate studies nationally in areas where the respective countries have acquired expertise. In their 1998 report on science in LA and the Caribbean, Cetto and Vessuri mention that efforts are currently focused on expanding and strengthening postgraduate programs in those countries of the region where science has become more firmly established. This combined with limited funds available for postgraduate training abroad in many instances has led to an increasing number of students getting their postgraduate degrees within their home countries. This increasing availability of postgraduate programs in the region has detained to some extent the traditional brain drain to countries of the North. Nonetheless limited job opportunities continue to drive young scientists to look for job opportunities elsewhere (Cetto and Vessuri, 1998).

The success or failure of a system to promote the training of researchers cannot therefore be measured solely by the number of postgraduate degrees awarded nationally or obtained by students in universities abroad. These young PhDs must be given the opportunity to prove productive in their home environments and eventually go on to establish their own research groups (Etzkowitz, 1992). In order to facilitate this, they must be given adequate conditions for carrying out research. Taking into consideration that research funding often favors more established scientists, an important factor in national and international science policy should be the provision of a stable research environment for scientists in developing countries at this early stage of their scientific careers (Galina and Russell, 1994).

Aware of this problem scientific bodies in LA have implemented programs to provide individual financial support for young scientists, such as that of Mexico´s CONACYT (Consejo Nacional de Ciencia y Tecnología) which provides modest initial financing for recently graduated PhDs from both foreign and national universities[1]. At the level of international funding agencies, the International Foundation for Science (IFS), a non-governmental organization, was founded in 1972 to assist in the building of scientific capacity in developing countries with respect to the management, conservation, and sustainable use of natural resources. This is achieved by identifying young, talented scientists with the potential to become the future scientific leaders and to effectively support them early on in their research careers thus filling an important gap in the research support to developing countries given by the network of international donor organizations. The importance of the IFS to science in the developing world is demonstrated by the fact that it was the leading European funding agency in the number of projects financed in the fields of agriculture in an analysis carried out between 1987 and 1991 (Arvanitis *et al.* 1995).

Gaillard agrees that what makes IFS unique with respect to other international funding bodies, is that it helps young graduates from developing countries to set up programs in the biological and agricultural sciences applied to the basic necessities of life, and in technology applied to rural problems (Gaillard, 1991). The primary form of support and the entry point to the "IFS system" is the small grant. Once a grantee, the developing country scientist is entitled to receive support for other activities such as travel, workshop attendance and publishing (IFS Annual Report, 1986).

As an example of the dimensions of IFS support between 1993 and 1998, 751 grants were funded world wide from a total of 3,549 applications. These were mainly in the fields of Animal Production (22.8%) and in Crop Science (22.2%)[2]. To date more than 3,000 scientists from these developing regions have received support from IFS.

With a view to analyzing the characteristics and impact of the IFS programs in LA, the present study has two main objectives. Firstly, to analyze trends in support given by the IFS to countries of the region in the field of Animal Health and Production between 1975 and 1997 and secondly, to evaluate the contribution made by the LA IFS grantees to both the national and international scientific literature up to 1997. A previous study of IFS grantees world-wide was carried out during 1985 as a basis for contributing to our understanding of how, by whom, and under what conditions research is carried out in developing countries (Gaillard, 1991).

Material and Methods

The study was undertaken in three parts. The first was a quantitative analysis of the grants given to LA scientists from 1975 to 1995. The database of the IFS was used to determine a) the number of grants given annually to LA b) the countries of the grantees, c) subject areas of the grants, d) whether the study was undertaken in an urban or a rural area, and e) the gender of the grantees.

In the second part of the study, a letter was sent out from IFS headquarters to 194 present and ex-IFS grantees from LA requesting them to indicate their scientific production to date. A total of 110 grantees replied giving a response rate of 57%. The survey was carried out between April and June 1997. Scientific production was divided into two categories: a) publication in peer reviewed journals, and b) other types of publication such as proceed-

ings, abstracts, thesis, chapter in books or publication in non-peer reviewed journals. The language of publication was also analyzed and the main journal titles noted. No attempt was made to distinguish between scientific production prior, during and after the period of the IFS grant. Our efforts were directed towards evaluating the scientific contributions of the IFS grantees in general.

In the third part of the study a search was made in April 1997 on the *Science Citation Index* (SCI) database on CD-ROM to determine the production visible in the mainstream scientific literature of the 194 IFS grantees. The names of the grantees were searched in the author index. Results were individually checked to make sure that the countries of origin and the institutions of the authors matched with those of the IFS grantees. Where the data matched, we assigned the publications to the IFS grantees.

Results

Figure 1 shows the distribution of the IFS grants given to scientists in LA countries since 1975 in Animal Health and Production. There was a marked increase in the number of grants given to LA from 1987 to 1990 followed by a gradual decline in later years. However, the number of grants given to LA in 1997 is several times that assigned in 1975.

When looking at the total of grants given to scientists in LA countries from 1975-1995, Mexico and Argentina were found to be the countries that were most successful in obtaining grants in this period (Figure 2). Several small LA countries such as Uruguay and Costa Rica have been favored by IFS funding while Brazil, the leader in LA scientific research, received relatively few grants.

Table I shows the main topics of research in the two areas related to Animal Health and Production from 1975-1995. The most common fields of study are Animal Diseases with respect to Animal Health, and Nutrition related to Animal Production. When breaking down the main fields of study into more specific topics, the use of natural resources for animal feed supplementation is the dominant topic in nutritional studies, whereas in Reproduction several topics seem to be equally important. Studies in Genetics and Diseases are centered on vaccine control and diagnostic procedures.

A marked contrast was found between countries with respect to the number of grants given to scientists working in the capital cities as compared to those working in the provinces (Table II). Whereas in Uruguay and Peru IFS grantees were working predominantly in urban areas, grants assigned to Mexico were mainly given to scientists in the provinces. Argentina, the other main recipient with Mexico of IFS grants, showed a more balanced distribution between urban and rural areas

Twenty-eight percent of the grants were given to a total of 50 female scientists, the grants being almost equally divided between the urban and rural areas of the countries concerned (28 and 22, respectively). The 129 male recipients of IFS support were working predominantly in the provinces (58 grants in the capital cities and 71 in the provinces).

With regard to the distribution of studies according to species, 24% (n=74) of the grants were assigned to research on bovines with studies on sheep and pigs being second and third priority (29 and 24 grants respectively). The number of grants for other species were: poultry with 17, goats 11, camelids 8, rodents 7, bees 4, dogs 3 and horses with one study.

Figure 3 shows that the results from the questionnaire survey demonstrate that total production of papers by grantees has gradually increased particularly during the nineties (The figures for 1997 are only partial). Publication is predominantly in peer-reviewed journals.

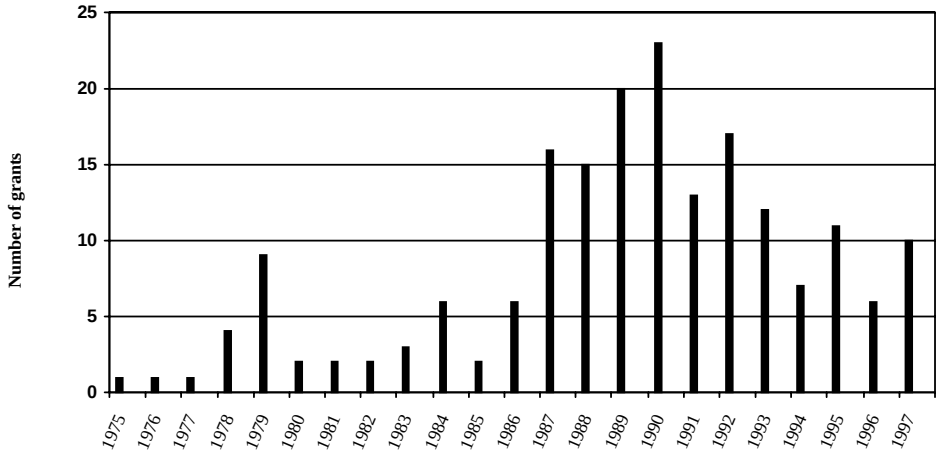

Figure 1. Annual total of IFS grants to Latin America in Animal Health and Production

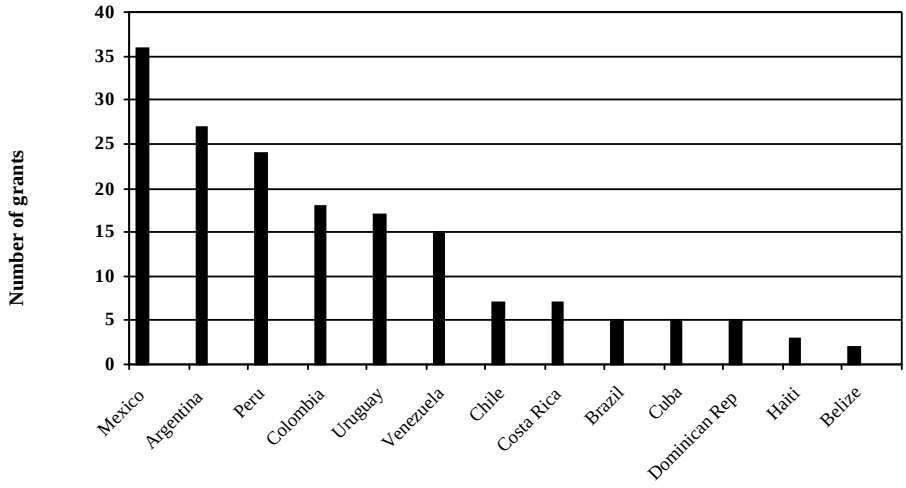

Figure 2. Distribution of IFS grants between the Latin American countries 1975-1995

TABLE I
SUBJECTS AREAS OF THE 1974-1995 IFS GRANTS TO LATIN AMERICA

Subject	Number of grants
Animal Health	
Animal diseases	58
Viral diseases	26
Parasitic diseases	22
Bacterial diseases	14
Total	**120**
Animal Production	
Nutrition	58
Genetics	26
Reproduction	14
Total	**98**

TABLE II
DISTRIBUTION OF 1974-1995 IFS GRANTS BETWEEN THE CAPITAL CITIES AND PROVINCES BY COUNTRY

Country	Capital	Province
Argentina	11	18
Belize	1	0
Brazil	0	5
Chile	4	4
Colombia	2	17
Costa Rica	4	4
Cuba	3	2
Dominican Republic	4	1
Haiti	3	0
Mexico	9	29
Peru	22	4
Uruguay	16	1
Venezuela	7	8

Figure 4 denotes the journals where IFS grantees most frequently published. As expected the two most frequent journals are published in Argentina and Mexico respectively.

Table III divides the total production of 2,489 contributions into language and document type. Results showed that almost 78% of the total production was produced either as articles in peer reviewed journals or as congress proceedings. Their production of book chapters is also noteworthy. As expected Spanish was by far the most common language with 60% of the documents published in this language. Almost half were proceedings, notwithstanding journal articles also constituted an important publication medium in Spanish accounting for more than 35% of publications.

Table IV correlates the number of grants given to each country (A, B and C) with their scientific production (A, B, C, and D). As expected there is marked contrast between countries, although countries such as Argentina and Mexico received a large number of the grants, their scientific production is also quite important. Small countries such as Costa Rica have a large production in spite of receiving fewer grants, contrasting with others such as Dominican Republic or Nicaragua where production is negligible.

Table V shows the most frequent journals chosen in some of the countries of the study. As anticipated most of the scientists prefer to publish in their local scientific journals.

The *Science Citation Index* search results on the names of 194 grantees produced a total of 3255 mainstream papers which were screened to match the criteria described in the Material and Methods section. Only 140 were found to meet our requirements of which 135 were published in English and 110 in peer reviewed contributions. The journal titles with the highest numbers of papers published are seen in Figure 5. This approach produced a much poorer result than that based on the production reported by the grantees themselves (Figure 3).

Table VI denotes the type of publication per country. It is quite noticeable the lack of review articles which are a powerful instrument for the dissemination of information particularly when the original publications are not in English.

Discussion

From the trends in the number of grants given to LA scientists from 1975 onwards it is possible to see the progressive development of the IFS as an important funding body for the region. Up to the middle of the 1980s only a handful of grants were given annually, and by 1990 these had increased up to tenfold. The questionnaire survey answered in the mid-80s by 489 IFS grantees, past and present, from all developing regions supported by IFS, showed that only 17.6% were from LA. This was explained at the time by IFS policy of avoiding the publicizing of its program in the more scientifically advanced developing countries, such as Argentina, Brazil and Mexico, and concentrating its resources on other regions such as Africa, considered to be more deserving of its support. In addition, IFS had only two official languages, French and English, which limited the participation of scientists whose native language was either Spanish or Portuguese (Gaillard, 1991). Present results suggest that IFS policy towards LA has changed over the last decade and that increasing support has been given to young scientists within this region even

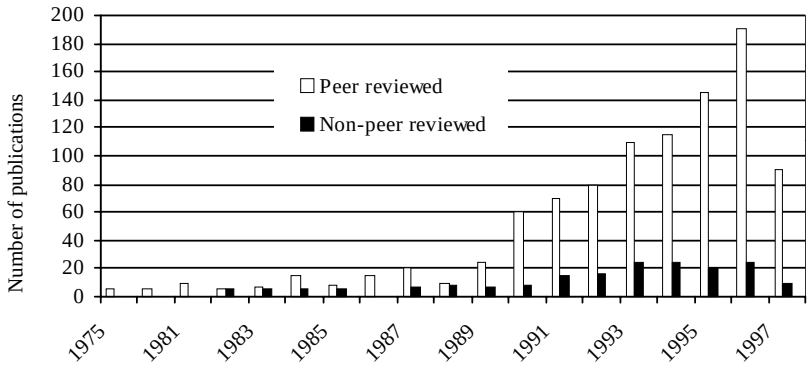

Figure 3. Annual production of Latin American IFS grantees in peer reviewed and non-peer reviewed journals

from the scientifically more advanced countries of Mexico and Argentina. Few grants were assigned to Brazilian scientists perhaps partly due to the availability of alternative sources of financing within Brazilian university agricultural science, particularly from federal government research agencies (Velho, 1990).

There were, however, some notable gaps with respect to the LA countries that received IFS grants. Countries such as Ecuador, Guatemala, Honduras and Paraguay which depend heavily upon local agriculture and animal production to support their economies, were absent from the list of grant recipients. Considerable differences were found between countries with respect to the balance of grants given to institutes located in or away from the capital cities. A tendency was apparent for the larger scientific countries to have a greater number of IFS grantees working outside the capital cities. This could be due to these more advanced countries having better research infrastructure outside their capitals than the less developed ones, particularly with respect to animal health and production. Notwithstanding, scientific research in LA countries such as Mexico, is highly centralized in and around the densely populated, capital cities (Jiménez *et al.* 1991).

The distribution of the funded grants among the different priority areas of IFS could be related to a number of factors, such as preference being given to fashionable topics for research or those of particular concern to developing countries. Animal reproduction, for instance, is known to be a research area where LA shows particular strength (Mirandé *et al.* 1987). Nonetheless, in the present study projects concerned with animal diseases were far more frequently funded than those related to animal reproduction. Previous studies have also shown that cattle are the most frequently studied species in animal reproduction both in LA and world-wide (Mirandé *et al*. 1987; Mier and Terán, Galina *et al*. 1994). The presence of a significant number of LA projects in camelids is not surprising due to their importance for the economic survival of rural communities in countries such as Peru (Urquieta and Rojas, 1990).

The number of female grantees in the present study (28%) was significantly higher than that found in Gaillard's survey where only 17% were female (Gaillard, 1991). This suggests that either a greater proportion of grants are given to women in LA than in other regions supported by IFS or there has been an increase in the number of IFS grants

TABLE III
NUMBER AND PERCENTAGE (IN PARENTHESIS) OF PUBLICATIONS ACCORDING TO LANGUAGE AND DOCUMENT TYPE

Language	Document type				
	Journal articles	Proceedings	Abstracts	Book Chapters	Theses
German	3(0.2)	3(0.3)		2(2.7)	2(2.4)
Spanish	526(46.3)	717(73.3)	134(62.3)	34(45.3)	65(78.3)
French	12(1.1)	2(0.2)			
Italian		2(0.2)			
Portuguese	21(1.9)	46(4.7)	19(8.8)	6(8)	9(10.8)
English	575(50.5)	211(21.5)		33(44)	7(8.4)
Total	1135	981	215	75	83

TABLE IV
NUMBER OF GRANTS PER COUNTRY AND SCIENTIFIC PRODUCTION

Country	Grant	Production
Argentina Mexico	A	A
Colombia Peru Uruguay Venezuela	B	B
Costa Rica	C	A
Brazil Chile	C	B
Cuba Haiti	C	C
Dominican Rep. Nicaragua	C	D

Number of Grants
A= High (>30)
B= Medium (10-30)
C= Low (<10)

Production
A= High Production (>90)
B= Medium Production (31-90)
C= Low Production (1-30)
D= No Production (0)

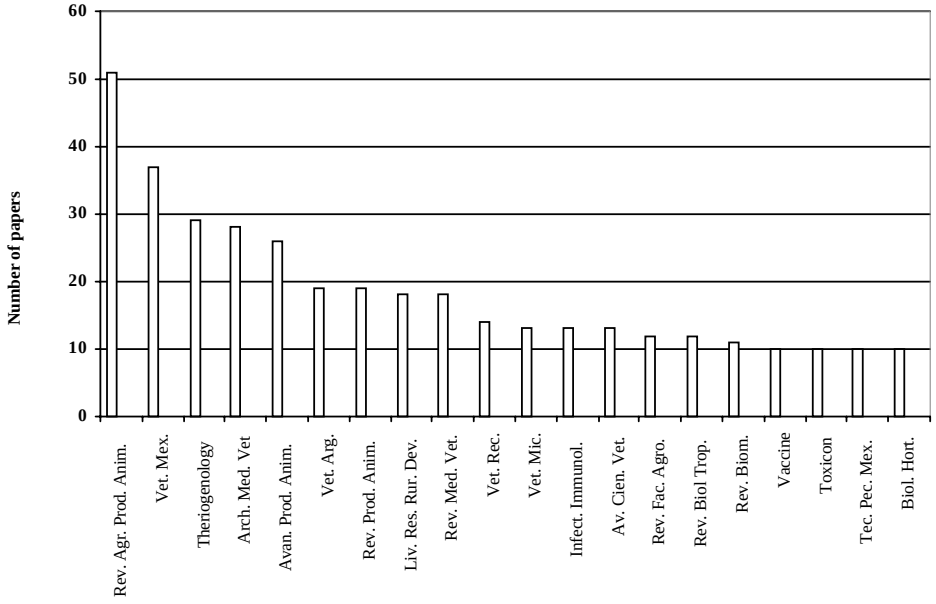

Figure 4. Journals where Latin American IFS grantees most frequently publish

given to female scientists in recent years.

Results with respect to the publication formats and languages of the grantees' output suggest an important participation in regional meetings as well as certain visibility in the international literature. Arvanitis and Chatelin in their study on communication in tropical soil sciences suggested that results should be presented orally at international meetings while publication should be through local journals. This strategy was based on the premise that publication is determined by the two external factors of language access and publication opportunities. Both of these obstacles are less important in informal communication hence their emphasis on meetings (Arvanitis and Chatelin, 1988). In the present study articles were almost equally divided between journals published in Spanish and in English. However, participation in international proceedings was much less than those published in the regional languages of Spanish and Portuguese.

Results from the survey carried out by Gaillard showed that a little more than half of the total scientific production was published or available locally. Although grantees from all regions published predominantly in their native languages, English was an important alternative for publication with respect to all non-English speaking countries. In the case of the mainly Spanish-speaking LA scientists, for instance, more than one third of their output was in English, a figure which is comparable with the percentage of publications in English found in the present study (Gaillard 1991). This suggests and continuing interest in LA grantees to publish their findings in English.

The search carried out on the names of the grantees in the SCI indicated a reduced presence of their scientific production in the mainstream literature. Nonetheless, the problems associated with carrying

TABLE V
MOST FREQUENT JOURNAL TITLES ACCORDING TO COUNTRY OF GRANTEE

Country of grantee and Journal title *	Country of publication	% of total papers
Argentina		
Revista Argentina de Producción Animal	ARG	12.4%
Brazil		
Arquivo Brasileiro de Medicina Veterinaria e Zootecnia	BRA	22.2%
Arquivos da Faculdade de Veterinária da UFRGS	BRA	16.6%
Pesquisa Veterinaria Brasileira	BRA	16.6%
Brazilian Journal of Genetics	BRA	11.1%
Chile		
Avances en Producción Animal	CHL	26.8%
Archivos de Medicina Veterinaria	CHL	22.7%
Colombia		
Livestock Research for Rural Development	COL	44.7%
Revista ACOVEZ	COL	10.5%
Costa Rica		
Revista de Biología Tropical	CRI	11.8%
Cuba		
Revista de Producción Animal	CUB	70.4%
Haiti		
Recherche et Développement Rural	HTI	75.0%
Mexico		
Veterinaria-México	MEX	23.4%
Peru		
Revista de Investigaciones Pecuarias	PER	12.2%
Uruguay		
Journal of Parasitology	USA	14.8%
Venezuela		
Zootecnia Tropical	VEN	11.5%

*Titles with >10% of the respective country's papers

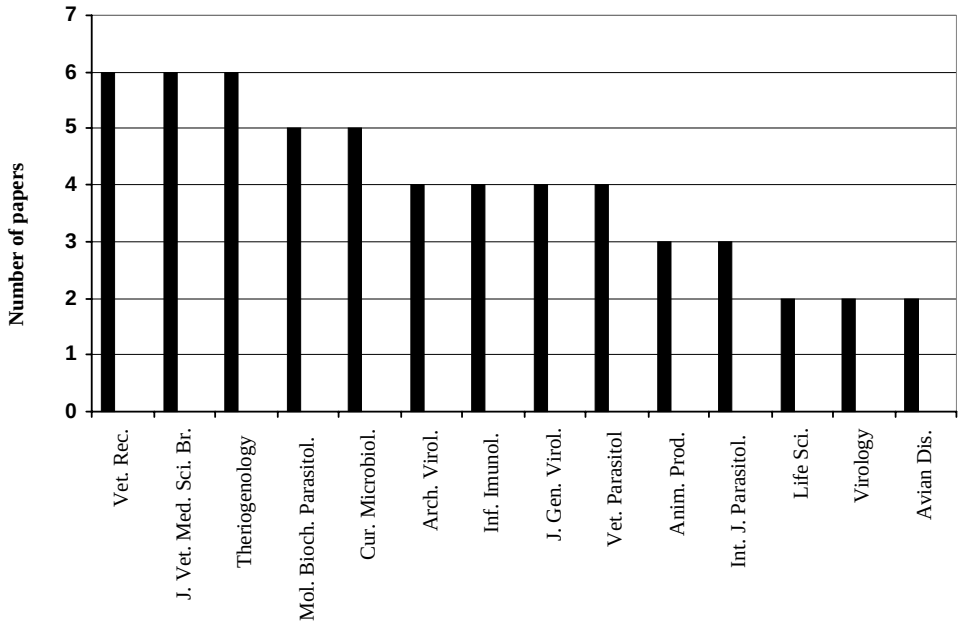

Figure 5. Journals registered in *Science Citation Index* where Latin American IFS grantees most frequently publish

out author searches for LA scientists in international indexes are well known and are due principally to the custom in Spanish and Portuguese-speaking nations of using both paternal and maternal surnames. The duplication of author names is apparent from the initial recovery of 3,255 records which were reduced to just 140 following screening for institutional affiliations. The search strategy also assumed that the grantees remained within one institution. The fact that, for instance, more articles in the mainstream journal *Theriogenology* were reported by the grantees than were found in the SCI search suggests methodological limitations in this part of the study.

The preference for LA and other developing country scientists to publish predominantly in national journals, especially in the agricultural and other applied sciences, is well documented (Velho and Krige, 1984; Russell and Galina, 1987; Russell *et al.* 1994). In the present study grantees were found to publish predominantly in peer reviewed journals, the main ones corresponding to national titles. A marked contrast was seen between countries such as Brazil where production was divided between several national titles and that of Uruguay where production was channelled through a single international journal. These differences are a reflection of the relative scientific strengths of these two countries. Brazil, for example, has some 1,000 journals registered in Ulrich's International Periodicals Directory while Uruguay has only 186 (Cetto and Alonso-Gamboa, 1998). Some countries such as Cuba and Haiti concentrated their production of papers in one national journal.

The increase in the number of publications, particularly notable in peer reviewed journals, could be the result of the accumulation of publications due to the gradual incorporation of new grantees during the period analyzed. Nevertheless, the increase does indicate that the IFS goal of contributing to the development of LA science is being achieved regardless of whether this is happening through increased individual or collective output. In the earlier survey IFS grantees were found to represent the most highly qualified scientists of their countries (Gaillard, 1991). Another finding of this survey was that grantees currently receiving support tended to respond more readily to the questionnaire than those whose grants had terminated.

As far as value for money is concerned, analysis of the relationship between the levels of grant assignation and scientific production would suggest that IFS invested wisely with respect to the funding given to Costa Rica, Brazil and Chile. In the case of other countries, output was consistent with input. Nevertheless, scientific productivity although important should not be used as the sole indicator for measuring funding impact. Aware of this, IFS is presently developing a system for monitoring and assessing the impact of their program using additional parameters such as the career development of its grantees, and the quality and impact of their work, especially in the post-grant period. Another important consideration is the impact of the IFS program on the wider issue of strengthening the research and scientific capacity of the developing countries it supports. Specific parameters to be considered are the possible multiplier effects of the IFS grants with respect to benefits obtained by other scientists from the grantees' institutions from actions such as workshops and equipment supply [3].

TABLE VI
TYPES OF MAINSTREAM PUBLICATION ACCORDING TO COUNTRY

Country	Article	%	Rev	%	Note	%	Abst	%	Edit	%	Total
Argentina	52	*80*	4	*6.1*	6	*9.2*	4	*6.1*	*	*	65
Brazil	1	*50*	*	*	1	*50*	*	*	*	*	2
Costa Rica	7	*87.5*	*	*	1	*12.5*	*	*	*	*	8
Cuba	1	*100*	*	*	*	*	*	*	*	*	1
Chile	11	*68.7*	*	*	4	*25*	1	*6.25*	*	*	16
Mexico	10	*83.3*	*	*	2	*16.6*	*	*	*	*	12
Peru	14	*77.7*	*	*	4	*22.2*	*	*	*	*	18
Uruguay	3	*50*	*	*	2	*33.3*	*	*	1	*16.6*	6
Venezuela	11	*100*	*	*	*	*	*	*	*	*	11
Total	110	*78.5*	4	*2.8*	20	*14.2*	5	*3.5*	1	*0.71*	140

Notes

[1] SEP-Conacyt: Apoyo a Proyectos de Instalación. Convocatoria 1999. [http: //www.conacyt.mx/conacyt/convocatorias/convproyins.html] April 1999

[2] Information received from IFS in May 1998

[3] J. Gaillard: Monitoring and evaluation system for impact assessment (MESIA). Inception Report. International Foundation for Science, Stockholm, 25 May 1999

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