INTERNATIONAL FOUNDATION FOR SCIENCE

MESIA
Impact Studies

Report No. 3



# IFS Impact in Mexico

## 25 years of support to scientists

*Jacques Gaillard*
*Jane M. Russell*
*Anna Furó Tullberg*
*Nora Narvaez-Berthelemot*
*Eren Zink*

# IFS

The International Foundation for Science, IFS, is an international, non-governmental organisation, founded in 1972. The mission of IFS is to contribute to strengthening the capacity of developing countries to conduct relevant and high quality research on the sustainable management of biological resources. This may involve the study of physical, chemical, and biological processes, as well as relevant social and economic aspects, important in the conservation, production, and renewable utilisation of the natural resources base.

The strategy to achieve this objective is to identify young, talented scientists who have the potential for becoming the future research leaders and lead scientists in their nations, and to effectively support them in their early careers.

The primary form of support, and the entry point to the "IFS system", is the small grant awarded in international competition. Once a grantee, the scientist can be supported in many other ways - invited to workshops, purchasing services, travel grants, training, scientific contacts, participation in networks, publishing reports, etc.

To date, more than 3,000 scientists in Africa, Asia and the Pacific, and Latin America and the Caribbean have been supported by IFS.


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# Preface

The mission of IFS is to strengthen scientific capacity in developing countries through the support of young scientists at the beginning of their careers. Research grants are awarded for projects to be carried out in a developing country on the sustainable use of biological natural resources.

Besides the research grant, IFS provides its grantees with a range of supporting services, including help in purchasing laboratory equipment and expendable supplies and access to literature databases. Travel grants provide opportunities for grantees to attend scientific meetings or to visit other research institutes or universities for training or collaboration. IFS organises training courses in developing countries to help potential applicants prepare a research grant application or write a scientific paper. All aspects of IFS support are intended to increase the chances for young scientists to become lead scientists and science leaders both in their home countries and internationally.

IFS aims at long-term associations with its grantees, which today number more than 3,000 in some 100 developing countries. At any one time, IFS supports around 1,000 research projects. Through the IFS database we try to keep track of the scientific careers of our grantees. The database is also a vital tool for the success of the IFS Monitoring and Evaluation System for Impact Assessment (MESIA), which is currently being developed to become a permanent component of the IFS.

MESIA Report 2 (Gaillard and Furó Tullberg, 2001) reported on a questionnaire study addressed to IFS grantees in Africa. The results provided important insights into the perceived needs and constraints experienced by young scientists in developing countries. These, in turn, will help IFS to better define its priorities and adapt its programme as well as its *modus operandi* in order to provide the best possible support to its grantees.

In addition to questionnaire studies, four country case studies have been initiated: Tanzania, Cameroon, Mexico, and Malaysia. Visits have been made to all four countries and selected grantees from each country have been interviewed. This report is the first of the country studies. It provides an overview of the Mexican science and technology system, which is important for understanding the situation of young Mexican scientists. It also describes in some detail the research environments in which the grantees work. An essential measure of success is publication output, and a bibliometric study shows that the grantees in general have a good record. Through personal interviews, it is also abundantly clear that the IFS grant and other supporting services have been of considerable importance for the early careers of the grantees. In-depth studies such as this one provide complementary insights to the questionnaire studies and will be essential for guiding the future development of the IFS programme.

This work could not have been carried out without the support of the IFS Mexican Member Organisation, Consejo Nacional de Ciencia y Tecnología (CONACYT). Three persons at CONACYT were particularly instrumental in its facilitation: Dr Efrain Aceves, Director of International Co-operation; Ms Clara Moran, Deputy Director of Multilateral Affairs; and Ms Rita Torres, Coordinator of Multilateral Affairs. CONACYT's active involvement was particularly useful in locating former IFS grantees thereby enabling a very satisfactory response rate of 76% to the questionnaire survey. I hope that the exemplary collaboration with CONACYT will serve as a model for other IFS Member Organisations in recipient countries to conduct national impact studies in their respective countries.

Finally, I would like to express our special appreciation to the French Institut de Recherche pour le Développement (IRD) for the secondment of Dr Jacques Gaillard to the IFS Secretariat. Without his insight and enthusiasm, MESIA could never have been developed.

Stockholm, December 2001
Thomas Rosswall
IFS Director

# 1. Introduction

The overall mission of the International Foundation for Science (IFS) is to support researchers from the developing world in their early research careers to conduct research on the management, use, and conservation of biological resources. During 1974-2000, IFS supported more than 3000 scientists in 99 developing countries, of which slightly less than one third were in Latin America and 145 in Mexico. Mexico is the second top recipient country in Latin America after Argentina and before Brazil (Figure 1).

The core of IFS support is financial, and comes in the form of research grants with a maximum value of USD 12,000 and renewable twice. The major budget items covered by a grant are equipment, literature, and supplies. In some cases, local travel costs connected with the research project, as well as salaries of research assistants and technical personnel can be covered. IFS provides opportunities for grantees to meet and interact with other scientists, and travel grants permit grantees to attend scientific meetings or to visit other research institutes or universities for training or collaboration. IFS organises its own workshops as well: to date 90 meetings related to the IFS Granting Programme have been held. IFS is also active in promoting and stimulating scientific networks at a regional and international level. Furthermore, IFS has an award scheme with a cash component that recognises grantees for noteworthy achievements associated with research projects supported by IFS. All of these efforts are intended to enhance grantees' credibility as scientists and to enable them to become established and recognised in national and international scientific circles.

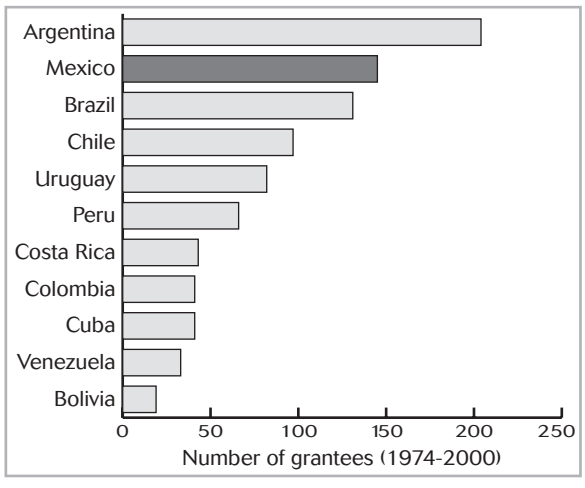


Figure 1
**Top recipient countries in Latin America (1974-2000)**

In Mexico, IFS research grants awarded during 1974-2000 had a total value of approximately USD 2.5 million. A workshop on "Dual Purpose Cattle Production" has also been organized by IFS in Mérida in 1992.

When IFS was established in 1972, the founders turned to the national academies of sciences that represented their colleagues worldwide. On May 25th, 1972, IFS was formally founded with fifteen Member Organisations. Today (2001), 125 Member Organisations in 82 countries constitute a unique contact network for IFS, providing important links to both donor and recipient countries. In Mexico, IFS has had a particularly productive relationship with the Consejo Nacional de Ciencia y Tecnología[1] (CONACYT), which became a Member Organisation of IFS in 1980. In addition to providing support for the present impact study, it also became a donor to the IFS budget in 1999 when it contributed the monetary equivalent of two IFS research grants in Mexico.

## 1.1 Measuring the impact of IFS activities

To better evaluate the impact of IFS activities, a Monitoring and Evaluation System for Impact Assessment (MESIA) is being established at the IFS Secretariat in Stockholm, Sweden. The main objectives of MESIA are to assess the achievements of the grantees and the effect that grants and other forms

1. National Council for Science and Technology.

of support provided by IFS have had on grantees' academic and institutional career. A number of complementary approaches are used to achieve this aim including interviews and questionnaire surveys intended primarily for IFS grantees, bibliometric studies on scientific output of IFS grantees and national impact studies such as the present one for Mexico. A conceptual framework and a standardized set of guidelines have been elaborated in order to allow international comparisons and to involve IFS staff and as many IFS Member Organisations as possible (MESIA Report No.1, 2000).

A first questionnaire survey was designed for IFS grantees and beneficiaries of the INCO-DEV programme of the European Commission in Africa. The results of this survey, highlighting the conditions and the constraints for scientists in Africa today, have now been analysed and published (MESIA Report No.2, 2001). Another questionnaire has also been circulated to IFS grantees in Africa to study in more detail two primary constraints in the working environment of African scientists: the availability, access, maintenance and repair of scientific equipment, and access to E-mail communication, the Internet and bibliographic databases. A third questionnaire combining the two first ones is being sent to IFS grantees in Asia and in Latin America. Four country case studies have also been conducted or initiated: two in Africa (Tanzania and Cameroon), one in Asia (Malaysia) and one in Latin America (Mexico).

In Mexico, the collaboration with CONACYT was exemplary, and we hope that it can serve as a model to conduct additional national impact studies. A number of conditions were necessary to make it possible and successful:

- CONACYT understood from the beginning the mutual shared interest of the MESIA project both for IFS and CONACYT in Mexico, and agreed to also share the costs.
- Two local collaborators, Dr Jane M. Russell and Dr Nora Narvaez-Berthelemot, were recruited to take part in the study of scientific outputs of IFS grantees, the interviews of IFS grantees and in gathering information on the Mexican science and technology (S&T) system.
- One staff member at CONACYT, Ms Rita Torres, was identified as a resource person. She circulated the questionnaire and sent reminders to the grantees. Thanks to her efforts, a response rate of 76% was reached.
- CONACYT and IFS were able to combine forces and networks to identify intermediaries (often former IFS grantees) at the different institutions involved in the study. They were very helpful in organising local programmes and schedules for interviews.

| Institutions | No. of grantees |
|---|---|
| Universidad Autónoma de Yucatán (UADY) | 26 |
| Universidad Nacional Autónoma de México (UNAM)* | 21 |
| Centro de Investigación y de Estudios Avanzados (CINVESTAV) del IPN* | 14 |
| Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias (INIFAP)* | 9 |
| Universidad Autónoma Metropolitana (UAM)* | 8 |
| Universidad Autónoma de Nuevo León (UANL)* | 6 |
| Colegio de Postgraduados en Ciencia Agrícolas (CP) | 6 |
| Centro de Investigaciones Biológicas del Noroeste (CIBNOR) | 6 |
| Centro de Investigación Científica de Yucatán, (CICY) | 5 |

* centres in several cities

Table 1
**Top recipient institutions in Mexico (1974-1999)**

## 1.2 The components of the MESIA study in Mexico

The MESIA study in Mexico co-ordinated by Dr Jacques Gaillard and Dr Russell was initiated in early 2000. The time period covered is 1974-1999 and the total number of grantees is 138, out of which 69 were still benefiting from IFS support at the time of the study. While these grantees are working in 36 research institutes and universities throughout the country, half of them are found in the top four recipient institutions (see Table 1). The study comprises five main components: an overview of S&T activities in Mexico, a retrospective statistical analysis of IFS applications, applicants and grantees, a questionnaire survey addressed to the 138 IFS grantees in Mexico, a bibliometric study of their scientific production, and finally 48 interviews of Mexican grantees. These five components are briefly presented below.

### *1.2.1 Overview of S&T activities in Mexico*

The main objective of the overview, prepared by Dr Russell and presented in Chapter 2, is to describe the Mexican S&T environment. The topics covered include the diversity of the Mexican institutional landscape, the conditions under which scientists work in Mexico, the variety of funding mechanisms supporting S&T activities, and IFS grantees' roles in the Mexican S&T system. Organisations and individuals interested in working in Mexico on strengthening science capacity will find it to be an informative and detailed introduction that can be used independently of the rest of the report.

The history of academic institutions in Mexico is nearly as old as it is in Europe. It dates back to the middle of the 16th century when the Universidad Nacional Autónoma de México (UNAM), by far the largest Mexican institution for higher education and one of the oldest and most prestigious in Latin America, was established. Scientific research in Mexico is also highly centralized within the federal district of Mexico. Not surprisingly, IFS grantees are also partly concentrated in the capital city and in particular at the UNAM, but to a much lesser extent. As shown in Table 1, the second, even more important pole of concentration is to be found in Yucatan at the Autonomous University of Yucatan (UADY). The rest of the grantees are distributed throughout 22 of the 30 remaining states. This study addresses the question of whether this distribution is satisfactory, and whether there is a difference in the relative impact of IFS support at strong and established institutions, such as the UNAM, compared to institutions with more modest resources in other states (see Chapter 6 and Chapter 10)?

To support S&T activities a variety of funding programmes are administered by CONACYT including the Sistema Nacional de Investigadores[2] (SNI). SNI entitles selected researchers to a monthly tax-free payment on top of that received as institutional salary, a programme for funding scientific research projects, a programme for funding the research projects of young scientists, and a programme for the support of the decentralisation of scientific and technological activities. In this study it is asked whether IFS support has a different impact on the careers of SNI members than on the careers of other scientists?

### *1.2.2 Statistical analysis of applications, applicants and IFS grantees*

This central component of the study, for which Dr Anna Furó Tullberg is the kingpin, took much more time than originally anticipated. A large amount of information was not readily available in the IFS database and a lot of time was spent digging out data from the grantees' files and updating and upgrading the IFS database. It includes statistics on applicants and grantees (including success rates and overall distribution; duration of projects and quality of submitted reports), and academic and institutional promotion of grantees. Most of the data on IFS applications, applicants and grantees are presented and discussed in chapter 3.

### *1.2.3 Questionnaire survey*

The questionnaire designed by Dr Gaillard for the survey of African scientists was adapted for use in Mexico (see Appendix 1). During the latter part of 1999, Ms Rita Torres from CONACYT wrote to the main recipient institutions in Mexico to initiate the tracer study of IFS grantees in Mexico. In particular, e-mail addresses of IFS grantees were checked and updated. The questionnaire was sent as an e-mail attachment to the Mexican IFS grantees in January 2000 and a reminder in April 2000. The 48 interviews of IFS grantees conducted during March-September 2001 also provided a good opportunity to remind them and their colleagues to return the questionnaires, duly filled in, to CONACYT.

2. National System of Researchers.

As a result, 105 questionnaires were returned to CONACYT. Present grantees being supported by IFS and having received their grant over the last ten years or so tended to respond more often (91.3%) than the former grantees no longer supported by IFS (60.9%). Otherwise no important bias is found in the response rates and the overall response rate of 76% should be considered excellent (see Appendix 2). The transfer of the data from the questionnaires into a database provided by IFS was carried out by CONACYT. Data analysis was done at IFS by Mr Eren Zink and Dr Gaillard. The results of the questionnaire survey are presented in different chapters of the report, and in particular in chapters 4, 5, 7, 8 and 9.

### *1.2.4 Bibliometric study on scientific production*

A bibliometric study was also carried out to determine the effect of IFS support on trends in the nature and volume of the scientific output of IFS grantees. From 138 grantees, 105 complete publication lists containing a total of 4,234 publications (all document types) were gathered by Dr Nora Narvaez-Berthelemot. Many of the publication lists were received via CONACYT as an annex to the completed questionnaires. Grantees who are members of the SNI programme were more likely to send their publication lists. Except for the Animal Production Research Area, in which fewer grantees sent their publication lists, no important bias was found in the response rates. The response rate of 76% should be considered very satisfactory (see chapter 6)[3]. Dr Narvaez-Berthelemot also recorded the data in a database that was designed by IFS following a new procedure for entering references created by Dr Gaillard and Dr Furó Tullberg. A first analysis of the data made by Dr Narvaez-Berthelemot and Dr Russell in Mexico was enlarged and completed by Mr Zink and Dr Gaillard at IFS. The results of the bibliometric study are presented in chapter 6.

### *1.2.5 Interviews*

A sample of Mexican grantees was selected to be interviewed. When selecting the grantees to be interviewed, particular care was taken to ensure a satisfactory balance between characteristics such as IFS research areas, number of grants obtained, year of obtaining the first grant, universities and research institutions, gender, member of the SNI programme, etc. A standardised interview grid was used to conduct the interviews (MESIA Report No.1, 2000: 25-29) which usually took place in the grantees' institution. In total, 48 interviews were conducted in Mexico during March-September 2000 by Dr Russell, Dr Anne Marie Gaillard and Dr Jacques Gaillard (see Appendix 3). This represents more than one-third (34,8%) of all IFS grantees in Mexico. With the permission of the grantees, 15 representative cases of interviews out of the 48 have been selected to be inserted in the appendix of this report (Appendix 4). Qualitative information and quotes from the interviews have been used throughout the report. Interviews have also been summarised in boxes and inserted into the body of the report to illustrate the impact of IFS support on the grantees' working environment and career.

## 1.3 The content of the report

The report is organized in ten chapters including this introduction and the conclusion with cross-references between the chapters. Although an effort has been made to organise the chapters in a logical order, they can be read separately and/or in a different order. The conclusion summarises the main findings of the study and makes recommendations for the future.

## 1.4 Acknowledgements

In addition to the people mentioned above, Mr Brian Porter designed the cover and did the layout of the report. A number of people at CONACYT were very instrumental in the facilitation of our work, in particular Dr Efrain Aceves, Director of International Co-operation, Ms Clara Moran, Deputy Director of Multilateral Affairs and Ms Rita Torres, Coordinator of Multilateral Affairs. We are also grateful for the constructive comments on Chapter 6 that we received from Dr Ingrid Leemans, Dr Jeremy Elston and Dr Carlos Galina. Last but not least, the backbone of this report comes from the Mexican scientists themselves. Without their answers to the questionnaire, and the many enlightening discussions during the interviews, this report could not have been written. Their contribution is gratefully acknowledged.

3.. The overlap of the population submitting publication lists with the population submitting filled in questionnaires is not complete.

# 2. Overview of National Science and Technology Activities

Mexico has been an independent country since 1810. The Constitution (1917) defines it as a Federal Republic with three equal but separate bodies: Executive, Legislative and Judicial. The contemporary political scene is characterised by intense electoral competition between registered parties. In July 2000 an increasingly democratic climate saw for the first time in the history of the country the election of a president from one of the opposition parties.

Mexico is the 14th largest country in the world with almost 2 million $km^2$ of territory and over 11,000 km of coastline. It has a diversity of climates ranging from deserts to tropical jungle. Natural resources abound, and the production of oil accounts for an important share of export revenues. The total population in 1998 was 96.3 million with a projected figure for 2000 of close to 100 million inhabitants. At present over one third of the Mexican population is under 15 years of age.

World Bank figures for 1998 showed Mexico to be the 13th largest economy in the world in terms of its GNP, comparable in size to The Netherlands. However, given the size of its population, its GNP per capita (USD 3,970) ranked 76th the same year, below the average for upper middle income countries (World Bank, 2000). As a consequence, Mexican scientists remain eligible for IFS support[4].

## 2.1 S&T national co-ordinating bodies

Diverse government organisations participate in the Mexican S&T system, with the Secretaría de Educación Pública[5] (SEP) and the Consejo Nacional de Ciencia y Tecnología[6] (CONACYT) taking a central role. CONACYT is a Member Organisation of IFS since 1980. Various consulting bodies advise the Mexican President and the nation's Congress on matters concerned with S&T. The universities and government research centres are important players in the country's R&D activities not only carrying out original research but also providing services for industry.

The Mexican Federal Constitution sets the overall legal framework for education and S&T policies. Accordingly, the Federal Congress has the authority to legislate in these matters. It also has the power to decree on foreign investment, technology transfer and technological knowledge necessary for national development. The National Council for Science and Technology Act, originally published in 1970 and revised in 1999, defines CONACYT as a decentralised public agency responsible for assisting the Federal Government in the development, execution, analysis and evaluation of S&T policy. The main activities of CONACYT are to:

- advise the Executive branch, local governments, individuals and corporations in all matters related to S&T,
- channel public and other resources to academic institutions and research centres,
- design and operate a national programme of scholarships for graduate studies,
- promote international co-operation and academic exchange,
- design the National Programme for Science and Technology,
- design and manage a National S&T Information System.

4. In 1995, the IFS Board of Trustees agreed to a procedure by which countries, which for a period of three consecutive years, have had a GNP/capita above a certain level (defined as the average GNP for so-called Upper Middle Income countries in the annually issued World Bank Development Report) are "phased out" from eligibility for grant support from IFS core funds. So far, only Argentina and Uruguay have been phased out.
5. Ministry for Education.
6. National Council for Science and Technology.

CONACYT also has important mandates in other areas such as the co-ordination of the SEP/ CONACYT network of research centres and the Sistema Nacional de Investigadores (SNI) . These two systems are considered in detail later in this chapter. CONACYT is currently under the umbrella of the SEP, making this Ministry responsible for its supervision and evaluation as well as for its agenda and budgetary decisions. The SEP has overall responsibility for S&T policy and for co-ordinating the promotion of S&T activities in the country. Other ministries also engage in S&T activities, while Congress through ***ad hoc*** committee intervenes in regulation and budgeting.

## 2.2 S&T Resources

According to CONACYT, a total of 4,299,400 people were working in activities related to S&T in Mexico in 1998, 2,477,700 (57.6%) of which were male and 1,821,700 (42.4%) were female. Those with postgraduate studies made up 263,900 of the total population in this sector. Of this population of scientists, 6,742 were members of the SNI, 72.0% of which were male and 28.0% female (See below for a description of the SNI). The most recent figures for Mexico published by the RICYT (Red Interamericana de Indicadores de Ciencia y Tecnología) indicate a total population of 26,479 researchers in 1995, 62.5% of which worked in institutions of higher education, 26.5% in government institutions, 9.7% in the private sector and the remaining 1.3% in non-profit private institutions.

Scientific research is highly centralised within the federal district of Mexico City (which also houses the world's largest urban population). It is the main location of the country's principal research institutions, namely the UNAM, the Instituto Politécnico Nacional (IPN), and the Universidad Autónoma Metropolitana (UAM). Scientific research thus follows the country's generalised model of geographic and political centralism. There is also a concentration of IFS grantees in the federal district of Mexico City.

Mexican research and development institutes can be divided into two broad groups: the institutes of higher education, and the government research institutes.

### *2.2.1 Institutes of Higher Education (Universities, Polytechnics and Technological)*

Data from the early 1990s indicate that 46% of scientific and technical personnel in institutes of higher education were dedicated to research and development (R&D). Furthermore, 53% of the members of the SNI work in the higher education institutes of Mexico. The principle institutions in this sector, plus others that have received IFS support, are the following:

#### *2.2.1.1 Universidad Nacional Autónoma de México (UNAM)*

The Universidad Nacional Autónoma de México (UNAM) is the largest Mexican institution for higher education and one of the oldest and most prestigious in Latin America; its origins date back to the middle of the 16th century. With a total student population of around 150,000, the UNAM employs approximately 27,000 teachers, researchers and other academic staff. Figures for the early 1990s indicate that 15% of scientific and technical personnel dedicated to R&D and 26% of the membership of the SNI were assigned to this institution. By 1999, the UNAM's percentage of SNI members had increased to over 30%. Its share of the federal S&T budget assigned to the educational sector grew from 22.3% in the period 1990-1994 to 24.0% in the period 1995-1999.

Box 1
**Research Institutes and Centres of the UNAM**

The UNAM has research institutes or centres (year of creation in parentheses) in the following scientific fields: astronomy (1929); biology (1929); geology (1929); geography (1938); physics (1938); chemistry (1941); mathematics (1942); biomedical research (1945); geophysics (1945); engineering (1956); applied mathematics and systems (1958); materials research (1967); nuclear sciences (1967); instrumentation (1971); marine sciences and limnology (1973); atmospheric sciences (1977); cellular physiology (1979); nitrogen fixation (1980); genetic engineering and biotechnology (1982); ecology (1988); neurobiology (1993); energy (1995). More recent are centres in the areas of physical sciences, and solid state research.

Research is carried out mainly within the 39 research institutes and centres, of which 24 are in the area of S&T (see Box 1). Almost a quarter of the total institutional budget is assigned to research activities. Research is also carried out within the teaching faculties and through special interdisciplinary programmes. In recent years, a policy of decentralisation of research activities and collaboration with the state universities has increased the presence of the UNAM in locations outside the Federal District. Furthermore, experimental stations are scattered around the country in strategic areas where the local environment provides important conditions for research. Approximately 25 observatories, laboratories and other types of experimental stations belonging to the UNAM are situated outside Mexico City.

*2.2.1.2 Instituto Politécnico Nacional (IPN)*

The Instituto Politécnico Nacional (IPN), an institution of the SEP founded in 1936, is the most important higher education establishment in technological education in the country. In the early 1990s it employed 4% of all personnel in R&D and 2% of all SNI members. In 1999 its share of SNI members had increased to 3.3%. During the five years from 1990 to 1994, the IPN received 3.7% of the federal budget in S&T assigned to the educational sector, and for 1995-1999 it received only 2.2%.

The Escuela Nacional de Ciencias Biológicas[7] (ENCB) in Mexico City and the Centro Interdisciplinario de Investigación para el Desarrollo Integral Regional[8] (CIIDIR) in the State of Morelos are two IPN institutions. The autonomous research institute, Centro de Investigación y de Estudios Avanzados[9] (CINVESTAV), is also part of the IPN but because of its status as one of the country's most important research establishments, it is usually considered separately from the IPN in any discussion of Mexican S&T activities and statistics (see section 2.2.3.1).

*2.2.1.3 Universidad Autónoma Metropolitana (UAM)*

Founded in 1973, R&D activities in the UAM are carried out in three different units, each with three disciplinary divisions, situated on three campuses in separate locations within Mexico City:

- Azcapotzalco: basic sciences and engineering; social sciences and humanities; sciences and arts for design.
- Iztapalapa: basic sciences and engineering; biological sciences and health; social sciences and humanities.
- Xochimilco: biological sciences and health; social sciences and humanities; sciences and arts for design.

At the beginning of the 1990s, the UAM employed 8% of the nation's R&D personnel and 5% of SNI members. By 1999 this institution had 6% of all SNI members. For the period 1990-1994, 5.6% of the federal budget in S&T assigned to the educational sector went to the UAM and for the period 1995-1999, this had increased to 6.8%.

*2.2.1.4 State Universities*

Another group of higher education establishments with important activities in scientific and technological research is the more than 30 public universities situated in different states of the Mexican Republic under the auspices of their respective state governments (see Box 2 on the following page). This group had 1,355 SNI members in 1999 making up 18.7% of the total. Most of these universities can trace their origins back to colleges established when Mexico was a Spanish colony.

### *2.2.2 Technological Institutes*

Another group with significant R&D activity in the country are the 70 or more technological, agricultural and marine sciences institutes scattered throughout the country. These institutes are coordinated by the Underministry of Techological Education and Research of the SEP.

Notable examples are:

- Instituto Tecnológico Agropecuario (Acapulco)
- Instituto Tecnológico Agropecuario (Aguascalientes)
- Instituto Tecnológico de Celaya
- Instituto Tecnológico Agropecuario (Mérida)

7. National School of Biological Sciences.
8. Interdisciplinary Research Centre for Integrated Regional Development.
9. Centre for Research and Advanced Studies of the IPN

Box 2
**Mexican State Universities with IFS Grantees**

- **Benemérita Universidad Autónoma de Puebla**
  Granted university status in 1937.
- **Universidad Autónoma Agraria "Antonio Narro"**
  Located in the north of Mexico in Saltillo, State of Coahuila.
  Founded in 1923 as the Regional School of Agriculture "Antonio Narro".
- **Universidad Autónoma de Aguascalientes (UAAC)**
  Founded in 1871.
- **Universidad Autónoma de Baja California Sur (UABCS)**
  Located in the city of La Paz.
  University status since 1975.
- **Universidad Autónoma del Estado de Morelos**
  Located in Cuernavaca, capital of the State of Morelos.
  Founded in 1938.
- **Universidad Autónoma de Nuevo León (UANL)**
  Located in the northern industrial city of Monterrey.
  University status since 1933.
  Teacher population of approximately 6,500.
- **Universidad Autónoma de Querétaro**
  Founded as an autonomous university in 1951.
- **Universidad Autónoma de San Luis Potosí**
  Granted university status in 1923.
- **Universidad Autónoma de Yucatán (UADY)**
  Granted university status in 1938 and granted autonomy in 1984.
- **Universidad de Colima**
  Granted university status in 1940 and granted autonomy in 1962.
- **Universidad de Guanajuato**
  Granted university status in 1945.
  1,497 teachers at undergraduate level of which 454 are full-time.
  268 teachers at postgraduate level of which 54 are full-time.
  78 teachers are members of the SNI.
- **Universidad Juárez del Estado de Durango**
  Granted university status in 1957.
- **Universidad Michoacana de San Nicolas de Hidalgo**
  Located in Morelia, capital city of the State of Michoacán.
  Granted university status in 1917.

*2.2.2.1 Colegio de Postgraduados (COLPOS)*

Founded in 1959, the Colegio de Postgraduados (COLPOS)[10] is an institution for postgraduate teaching, research and services in agricultural sciences. It is organised into four institutes:

- Institute of Phytopathology
- Institute of Genetic Resources and Productivity
- Institute of Natural Resources
- Institute of Socioeconomics, Statistics, and Information Technology

The main campus is situated about 25 km to the northeast of Mexico City. Other campuses are in the states of Veracruz, Tabasco (formerly the Advanced College for Tropical Agriculture - El Colegio Superior de Agricultura Tropical), San Luis Potosí, and in Puebla.

COLPOS employed 2% of all SNI members in 1999 (144 members). Its percentage of the federal budget for S&T activities in agriculture increased from 11.5% in the period from 1990-1994 to 19.1% from 1995-1999.

*2.2.2.2 Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM)*

The ITESM is the principal private Mexican higher education institute carrying out R&D activities. Main areas of research are in chemistry, agriculture, marine sciences, food technology, and different fields of engineering. Originally founded in 1943 by a group of Mexican businessmen in the industrial city of Monterrey in Northern Mexico, the ITESM has grown to over 30 campuses in the major cities of the Republic. It has a student enrolment of over 80,000 and a faculty of over 6,000. Graduate students number almost 9,000. Engineering, computer science, and business administration are the majors with the greatest number of students. Research and extension activities are focused on Mexico's sustainable development in areas such as: development planning; increased competitiveness of companies and institutions; environmen-

10. Postgraduate College

tal improvement and protection; and improving education in Mexico and Latin America. Student participation in research and development projects is actively encouraged, especially at the graduate level. Yet, in spite of the fact that the ITESM web page describes one of their two missions (the other is obviously education) as "to carry out research and extension relevant to Mexico's sustainable development", they do not seem to have a large research base. Also, like other private universities in Mexico, they are geared towards producing professionals (in business, law, commerce, etc.) and not towards training teachers or researchers.

In general, private universities had 220 SNI members in 1999 accounting for 3.0% of total membership.

### 2.2.3 Government Research Institutes

*2.2.3.1 Centro de Investigación y de Estudios Avanzados (CINVESTAV) del IPN*

The Centro de Investigación y de Estudios Avanzados (CINVESTAV) del IPN[11], founded in 1961, is an autonomous, decentralised, public institution located principally in Mexico City. Research and teaching is carried out in the following main areas: physics, chemistry, mathematics, cell biology, biochemistry, pharmacology, toxicology, bioelectronics, physiology, biotechnology, bioengineering, computing, communications, automation, solid state electronics, metrology, ocean resources, human ecology, and non-ferrous metallurgy.

The Unit for Biotechnology and Plant Genetic Engineering in Irapuato is committed to the formation of specialised researchers through graduate programmes (MSc and PhD) providing expertise in the biotechnology of plants of importance in Mexican agriculture. The Unit is divided into two departments: plant genetic engineering, and biotechnology and biochemistry.

Other units are situated in Guadalajara, Tlaxcala (Laboratory for Animal Reproduction), Mérida, Querétaro and Saltillo.

The CINVESTAV received 5.5% of the federal S&T budget assigned to the education sector between 1990 and 1994 and 6.8% of that assigned from 1995 to 1999. The CINVESTAV had 472 SNI members in 1999 representing 6.5% of total membership.

*2.2.3.2 Centres SEP/CONACYT*

The SEP/CONACYT system of research centres was set up in 1992 to decentralise S&T activities in the country, to improve and extend the formation of highly qualified researchers, to link national scientific activities to international trends, to contribute to a greater understanding of the reality of national problems in different research areas, and to advance and support the technical capabilities of private producers in order to satisfy the demands of the population for improved well-being. Twenty-seven research centres are integrated in this system. They are equally divided between the Exact and Natural Sciences (see Box 3), the Humanities and Social Sciences, and Engineering and Technology, and are located in 14 states and 42 cities.

The SEP/CONACYT system of research institutes has a large number of highly qualified scientists and a significant research infrastructure. In 1999

Box 3

**Exact and Natural Science Research Centres of the SEP/CONACYT**

The nine centres making up the area of the Exact and Natural Sciences are the following:

| | |
|---|---|
| **CIAD** | Centro de Investigación en Alimentación y Desarrollo |
| **CIBNOR** | Centro de Investigaciones Biológicas del Noroeste |
| **CICESE** | Centro de Investigación Científica y de Educación Superior de Ensenada |
| **CICY** | Centro de Investigación Científica de Yucatán |
| **CIMAT** | Centro de Investigación en Matemáticas |
| **CIMAV** | Centro de Investigación en Materiales Avanzados |
| **CIO** | Centro de Investigaciones en Optica |
| **INECOL** | Instituto de Ecología |
| **INAOE** | Instituto Nacional de Astrofísica, Optica y Electrónica |

These institutes and centres vary in age between 14 and 21 years and carry out basic and applied research in the following areas: nutrition, food science and technology, aquaculture, regional development, ecology, biotechnology, sustainable development, marine ecophysiology, agroecology, physical oceanography, seismology, astronomy, applied geophysics, geology, electronics and telecommunications, optics and computer sciences, basic mathematics, probability and material sciences, among other topics.

11. Centre for Research and Advanced Studies

it had 861 SNI members representing 11.9% of total membership. At the present time approximately 40% of researchers working in the SEP/CONACYT system are members of the SNI. Half of the total research personnel have PhDs, 34% Master's degrees and 16% Bachelor's degrees. In 1999 each researcher had an average of two thesis students and published 1.3 articles.

The SEP/CONACYT network of research institutes received 15.1% of the federal S&T budget assigned to the education sector between 1990 and 1994 and 21% of that assigned from 1995 to 1999.

Of the nine technological development centers, only the Centro de Investigación y Asistencia en Tecnología y Diseño del Estado de Jalisco (CIATEJ) has had an IFS grantee.

*2.2.3.3 Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias (INIFAP)*

Emerging in 1985 from the fusion of three separate government research institutes, the Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias[12] (INIFAP) is the most important centre for research in these areas. INIFAP is a decentralised body of the Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación[13] (SAGARPA). INIFAP has six national centres for disciplinary research in the following areas: veterinary parasitology; veterinary microbiology; physiology and animal improvement; sustainable production; conservation and improvement of forestry ecosystems; and the relationship between water, soil, plant and atmosphere. In addition it has 81 experimental stations and eight centres for regional research scattered throughout the country.

In spite of its central role in agricultural research, INIFAP's share of the federal budget for S&T activities in the agricultural sector was reduced considerably during the ten year period from 1990-1999, both in real terms and as a percentage of the total budget assigned to this sector. In the first five-year period (1990-1994) the INIFAP received 72% of the budget (4,855 million Mexican Pesos, or USD 511 million), and in the second it received 61% of the budget (3,423 million Mexican Pesos, or USD 360 million). In 1999 the institute had 112 employees that were members of the SNI (1.5% of all SNI members). Very few applications from INIFAP scientists have been submitted to IFS, and only two grants have been awarded. One reason for the lack of applications from INIFAP may be that INIFAP does not have, as do many other institutes, a programme to promote the training of postgraduate students.

## 2.3 Education and human resources: student population, graduate courses and student loans

The Mexican government gives priority to basic education (the first nine years of schooling). In 1998, 5.2% of the GDP was allocated to education. The proportion of students in higher education has increased since the 1970s while graduate enrolments have shown a more recent growth.

The number of doctoral programmes increased from 117 in 1990 to 446 in 1999. The greatest percentage (23.5%) of these in 1999 was in the area of the exact and natural sciences, followed by 22.2% in social sciences and administration, 18.8% in engineering and technology, 14.2% in education and the humanities, 11% in the health sciences, and 10.3% in the agricultural sciences. The average number of students graduated annually per programme from 1990-1999 varied considerably. While in the exact and natural sciences, in the social sciences and administration, and in the health sciences this figure was 14, in education and the humanities this dropped to 11, and to 7 in the agricultural sciences, and in engineering and technology.

The total number of doctoral degrees awarded from 1990-1999 was in the order of 5,200. The average increase per year during this period was 17.3%. The number of students graduated per million inhabitants increased from 2.5 in 1990 to 8.6 in 1999, growing 9.3 times faster than the total population from 1995-1999. In spite of this growth the number of doctoral degrees awarded in Mexico was well below that of other OECD countries. For example, France graduated 180 doctoral students per one million inhabitants and Brazil graduated 18 doctoral students per one million inhabitants.

The number of student loans[14] given by CONACYT over the 30 years from 1971 to 2000 amounted to more than 100,000, increasing from 580 in 1971

12. National Institute for Forestry, Agriculture and Livestock Research.

13. Ministry for Agriculture, Livestock, Rural Development, Fisheries and Food.

14. These loans are termed "becas-crédito"(credit scholarships) in Spanish. Rather than repay the value of the loan, loans may also be forgiven if the scientist returns to the institute of higher education or public sector and works for a time period that equals the duration of the loan.

to 6,800 in 2000. It was not until the 1990s that the support of doctoral programmes was given priority, and as a result two-thirds of all awards have been given to Master's students. Seventy-five percent of the loans were awarded for postgraduate studies within the country, and the rest supported studies abroad. It was more common for CONACYT to support education abroad at the PhD and Postdoc level than at the Master's level. Forty-five percent of all loans for doctoral training and 63% of all postdoctoral scholarships were for study abroad. While in the period from 1971 to 1979 only 44% of all grantees completed their studies, this figure rose dramatically to 91% for the period 1990-1997.

One of every two scholarships awarded for training abroad was for study in the USA. France and the United Kingdom also received an important number of Mexican scholars, followed by Spain. While in the period from 1971 to 1973 more than 50% of the scholarships were for study abroad, from 1998 to 2000 more than 80% went to support national programmes. This is due, firstly, to the increasing number and quality of postgraduate courses available in the country and, secondly, to the negative effects of the financial crisis of the 1980s.

Estimated figures suggest that only 5% of those receiving student loans sought employment abroad, principally in the USA (64%), Spain (8%) and England (7%). Half of the grant holders not returning home were Master's students and the other half were doctoral students. At least one quarter of a sample[15] of 2,000 ex-grantees had been offered employment abroad upon completing their studies while only a minority accepted the offer. Two-thirds of these had studied abroad and one third in national institutions.

For every 100 scholarships awarded, 28 were in the field of engineering, 23 in the basic and natural sciences, 19 in the social sciences and administration, 14 in applied biology, 10 in the humanities and in the behavioural sciences, and 6 in the health sciences. Up until 1989, the percentage of scholarships awarded to residents of Mexico City was greater than 40%, while from 1995 to 2000 this decreased to 35%. The average age of the scholars was 28 years with 41% in the range of 25-29 years.

As of 2000, only 3% of former grantees were unemployed, and 65% required three months or less to find employment upon completing their studies. Approximately four of every five worked in the public sector, the majority in education.

Nearly one third of former grantees are female, but for recent years this figure has increased. While in 1985 25% of grantees were female, in 1997 the number of grantees that are women had risen to 41% of all grantees.

## 2.4 Sistema Nacional de Investigadores (SNI)

As a response to declining salaries of researchers due to the economic crisis, in 1984 the Mexican government created the SNI in order to advance scientific research and to prevent the possible disintegration of the Mexican scientific community. Membership of the SNI is open to researchers from all fields working full-time in recognised Mexican institutes of scientific research, following an evaluation of their productivity and contribution to the formation of new researchers. Membership entitles the scientists to a monthly tax-free payment over and above that received as institutional salary.

Each year, a call for applications for SNI membership at the following levels is made:

- Candidate - must be < 40 years of age and have a doctoral degree. In exceptional cases a significant, quality scientific output can compensate for the absence of a PhD.
- Level I - must hold a doctoral degree[16] and be actively carrying out original high quality research as shown by publication in prestigious journals with international peer review and impact, or in books published by renowned publishing houses. In addition the researcher must be taking part in teaching and supervision of theses at the undergraduate or postgraduate level.
- Level II - Apart from the requirements for Level I, the applicant must have established an important trajectory in original research either as an individual researcher or as part of a group and have participated in activities directed towards a greater public understanding of science.

15. This was a "representative sample"of former grantees taking into consideration ten-year periods, and the different subject fields. Level of confidence was 95% and the error margin 3%.

16. Applicants with an excellent research trajectory can be exempted from the requirement of a doctoral degree.

| | MEXICO CITY | | MEXICAN STATES | |
|---|---|---|---|---|
| | Mexican Pesos | USD* | Mexican Pesos | USD* |
| Candidate | $3,100.50 | $326 | $4,134.00 | $435 |
| Member Level I | $6,201.00 | $653 | $7,234.50 | $762 |
| Member Level II | $8,268.00 | $870 | $9,301.50 | $980 |
| Member Level III | $14,469.00 | $1,523 | $15,502.50 | $1,632 |

* Approximate value in US dollars at 9.5 Mexican pesos per US dollar

Table 2
**Monthly stipend for SNI Members in 2000**

- Level III - Apart from the requirements for Level II the applicant must demonstrate an outstanding contribution to new knowledge and/or its application and first-rate leadership qualities within the scientific or technological community. In addition, the applicant must enjoy national and international recognition, and have an exceptional history of training teachers and independent researchers.

The duration of membership is three years for candidates with the option of a fourth year. At Levels I and II memberships are for three years and at Level III for four years. Membership at Levels I - III is renewable following evaluation. In certain circumstances specified in the SNI regulations the duration of the awards can be extended.

The monthly stipend is based on the minimum wage for an unskilled worker in Mexico City. It varies with the level of membership assigned and geographic location of the member (see Table 2). Government (CONACYT) policy is to decentralize research that is highly concentrated in and around Mexico City. One of the ways is to encourage researchers to move to institutions outside Mexico with incentives such as offering more money from the SNI.

In addition to the SNI levels discussed above, the supplementary level of Emeritus Researcher was created in 1991. Conditions for eligibility are to have reached 60 years of age, to have an exceptional career in research and teaching, to be awarded membership at Level III in three consecutive periods and to be proposed by at least three members at this same level. The distinction is a life annuity equivalent to membership at Level III. In the period 1991-1999, this honour was bestowed on 94 scientists.

The SNI had 7,252 members in 1999; 1,318, were candidates, 4,191 were at level I, 1,159 were at level II, and 584 were at level III. From 1990 to 1999 the membership of the SNI grew on average 2.7% annually from a total of 5,704 members in 1990. The rate of growth was greatest at level III (10.4%), followed by level II (8.4%) and level I with (8.0%), while the number of candidates decreased on average by 7.3% annually from 1990-1994 and by 4.1% annually from 1995-1999. The primary explanation for this drop is that in 1993 the entry requirements for candidacy were changed, making it obligatory for applicants to have completed or to be near completing a doctoral degree. In 1999, 90% of members of the SNI Levels I-III had a doctoral degree, and 59% of candidates.

In 1999, 22.4% of SNI members were in Area 1, Physical Sciences, Mathematics and Earth Sciences; 19.8% were in Area 2, Biology and Chemistry; 9.9% were in Area 3, Medicine and Health Sciences; 17.5% were in Area 4, Humanities and the Behavioural Sciences; 10.2% were in Area 5, Social Sciences; 8.8% were in Area 6, Biotechnology and Agricultural Sciences; and 11.4% were in Area 7, Engineering. The average age of candidates was 36 years, members of Level I were 45 years, Level II members were on average 52 years, and Level III members averaged 59 years old. Women accounted for 28.4% of SNI[17] membership. The highest percentage of women was in the candidate category (35%) and the lowest at Level III (15.2%). The ratio of men to women was greatest in Area 7 and least in Area 4.

17. The percentage of women members of the Mexican Academy of Sciences (Academia Mexicana de Ciencias) is 24%. Notwithstanding there is only one female member out of the total of 40 of the prestigious National College (Colegio Nacional) of Mexican intellectuals.

Almost one-third of SNI members in 1999 were from the UNAM. 18.7% from public universities outside Mexico City, 11.9% from the SEP/CONACYT network of research institutes, 6.5% from the CINVESTAV, and 6.2% from the National Health Institutes. The only category in which the UNAM did not occupy first place was with respect to candidates, where those from the public universities outside Mexico City outnumbered those from the UNAM (333 and 287, respectively). At Level III the UNAM had 54% of members and at Level II, 42%.

In 1999, SNI members were distributed throughout the different states of the Mexican Republic in the following manner:

- Group A (more than 100 SNI members): State of Mexico, Morelos, Puebla, Jalisco, Guanajuato, Baja California, Nuevo León, Querétaro, Michoacán, Veracruz, Yucatán and Sonora.
- Group B (20-100 SNI members): Baja California Sur, Coahuila, San Luis Potosí, Chiapas, Sinaloa, Chihuahua, Colima, Zacatecas, Oaxaca, Tamaulipas, Aguascalientes, Hidalgo, and Quintana Roo.
- Group C (less than 20) members: Durango, Tlaxcala, Guerrero, Campeche, Nayarit and Tabasco.

Of the 7,252 SNI members in 1999, 52.4% were located in Mexico City, 38.1% were located in Group A, 8.6% in Group B, and 0.9% in Group C.

## 2.5 Salary Structure

In many cases only a small part of the income that scientists in Mexican higher education and research institutes receive is related to the basic salary structure of the post that they hold. As a result of dwindling academic salaries from the mid 1970s onwards, mechanisms were introduced to compensate for the drop in earnings based on productivity. These programmes have had an enormous impact, not only in clearly differentiating the salaries received by individual academics, but also in prioritising different work activities and in the relationships between staff and institutions. Some experts maintain that these initiatives have mainly benefited a small group of highly productive scientists.

The evaluation/remuneration model was first introduced into the Mexican higher education institutions at the end of the 1980s and the beginning of the 1990s to address the problem of low academic salaries. Programmes based on this model are designed to reward dedication and productivity as well as to stimulate competition within institutions and between institutions. This type of mechanism had previously been implemented with the establishment of the SNI in 1984 to give financial reward to the most productive scientists nationwide. During the early 1990s the grants given by the SNI were increased both in amount and in number.

The conditions, requirements and rewards of the different incentive programmes vary considerably between institutions. The UAM, for instance, has a series of these programmes that take into consideration different aspects of academic performance such as annual productivity, productivity over a period of years, outstanding productivity, teaching abilities, and degrees obtained.

As an example of two different institutional salary and reward structures to which a young scientist might have access, the specific situations of the UNAM and the UADY are considered.

### *2.5.1 Universidad Nacional Autónoma de Mexico - UNAM*

A young PhD graduate with at least one international publication can aspire to the highest category of research associate position ("Investigador Asociado C") in one of the research institutes or centres of the UNAM. Along with this, he/she can expect to be accepted as a candidate in the SNI within one year. The researcher will also be eligible after one year's full-time employment to submit papers to the UNAM's productivity bonus programme. Levels awarded range from level A giving the scientists an extra 45% of his/her salary, level B, an extra 65%, level C, an extra 85% and the highest level, D, with an extra 105%.

A young scientist with a level "C" research associate post plus the candidate level in the SNI plus level B in the institutional productivity programme will earn a monthly salary of approximately 17,500 Mexican Pesos (≈ USD 1,850) if working within Mexico City and 18,500 Mexican Pesos (≈ USD 1,950) if working outside the capital city. The annual salary will be more than 12 times the monthly amount due to certain benefits such as

holiday pay, and a Christmas bonus of 40 days extra pay.

A senior scientist at the top of the salary scale ("Investigador Titular C") and receiving the highest productivity bonus (level D) and awarded the highest membership level of the SNI (level III) will receive a monthly salary of 43,100 Mexican Pesos (≈ USD 4,540) when working in the capital city and 44,100 Mexican Pesos (≈ USD 4,640) outside. A senior scientist is likely to receive more benefits than a junior scientist such as extra money for the number of years of service given to the institution. In addition a member of the SNI level III giving classes at undergraduate level in a recognised institution of higher education is eligible to receive two extra minimum wages per month (1,600 Mexican Pesos or USD 170).

### *2.5.2 Universidad Autónoma de Yucatán - UADY*

At the UADY a researcher/teacher with a level "C" associate post receives a basic monthly salary of 10,235 Mexican Pesos (≈ USD 1,077) plus other "bonuses" (including medical insurance benefits) equaling a total salary of 20,470 Mexican Pesos (≈ USD 2,155). Assuming that the researcher also qualifies for the candidate level in the SNI, the total monthly salary would be 24,604 Mexican Pesos (≈ USD 2,600). As is the case at the UNAM, the yearly salary also includes holiday pay and a Christmas bonus, making a total yearly income for an associate researcher level "C" at the UADY of 276,248 Mexican Pesos (≈ USD 29,000), not including other possible income from SNI membership or other sources.

A researcher/teacher at the top of the salary scale (senior professor level "C") would receive a basic monthly income of 16,159 Mexican Pesos (≈ USD 1,700) plus the other "bonuses" for an equivalent amount, making a total salary of 32,318 Mexican Pesos (≈ USD 3,400). Membership in the SNI at level III would give an additional 15,502 Mexican Pesos (≈ USD 1,632) for a total monthly income of 47,820 Mexican Pesos (≈ USD 5,033). The annual income according to the UADY salary scale (including holiday pay, Christmas bonus, etc.) would be 435,985 Mexican Pesos (≈ USD 45,900 US) not including other possible income from SNI membership or other sources.

## 2.6 Research funding

The federal government is the principal funding body for scientific research, as well as the principal executor of S&T activities in the country. In the years from 1990 to 1994 the average percent of GDP assigned to science and technology was 0.34%, a figure that increased to 0.40% for the period 1995-1999. Mexico has yet to reach levels of investment comparable to those of other OECD countries that spent, on average in 1997, 2.21% of their GDP on R&D. Mexico also invests less than other Latin American countries such as Chile and Colombia that spent 0.65% and 0.41%, respectively, of their GDP in 1997 on R&D. Nonetheless, government support of S&T activities increased by 97.1% in real terms from 1990 to 1999. The sum assigned in 1999 was 9.678 million Mexican Pesos (approximately USD 1.020 million).

In 1999 the budget allocated to CONACYT represented 14.5% of the federal S&T expenditure, 40.1% of which went to the scholarship programme, 27.1% to promote scientific research and 19.7% to support the SNI programme.

The resources assigned to the energy sector increased from 19.2% of the total federal S&T budget in the years 1990-1994 to 25.5% from 1995-1999 while that of the agriculture, livestock and rural development sector decreased from 10.4% to 6.6%. The percentage allocated to the educational sector was reduced from 62.1% during the first five years of the 1990s to 59.9% during the second half of the decade.

## 2.7 Programmes of CONACYT

The mission of CONACYT is to increase the country's capacity in scientific research and technological development, to support advanced training, to stimulate the application of knowledge, to support innovation among enterprises, and to facilitate the participation of Mexican scientists and engineers in global scientific advancement through international co-operation. The undertakings of the Council are divided into ten main areas:

- Scientific research
- Technological modernisation
- Scientific research and regional development
- SEP/CONACYT Centres

- Science and technology policy
- International affairs and scholarships
- Administration and finance
- Strategic research
- Legal
- Communication in science and technology

To achieve these aims, a variety of funding programmes are administered by CONACYT, the following of which have special relevance to the present report.

### *2.7.1 Programme to Fund Scientific Research Projects*

From 1992 to 1997, the Programme to Fund Mexican Research (PACIME) fostered research activities in the country. This was replaced in 1998 by the Programme of Knowledge and Innovation (PCI) with a budget of USD 500 million to be allocated to S&T activities during the period 1999-2003. The World Bank provides 60% of the total, the rest comes from the federal government via CONACYT. Research proposals can be submitted to the programme in five different categories: individual projects, group projects, database development, proposals for setting up research, and for young researchers.

Special consideration is given to the needs of young scientists starting on a research career as these researchers are traditionally at a disadvantage compared to more established scientists when applying for research funding. Two funding modalities for young scientists are currently offered: research projects of young scientists, and the setting-up of research projects. The latter option together with the category for individual research projects, had the highest number of projects approved in 1999 accounting for 19.6% and 69.6%, and respectively, of the total number of projects funded in all categories and absorbing 77% of the total budget. The two funding modalities for young researchers are described in more detail further on in the text.

In the period between 1995 and 1999, the average number of total research projects funded was 966 compared to 509 during the previous five years. In 1998 the programme to fund scientific research projects started to operate in accordance with the guidelines and framework of the PCI. In 1999, 1,044 projects were financed to a total sum of 639.1 million Mexican pesos (USD 67 million). Of these 727 were individual projects (479.3 million Mexican pesos ≈ USD 50.5 million), 20 group projects (70.7 million Mexican pesos ≈ USD 7.5 million), and 74 projects approved for young scientists (59.5 million Mexican pesos ≈ USD 6.3 million). Other awards given as part of this budget were to create databases (23 projects approved totalling 15.8 million Mexican pesos ≈ USD 1.7 million) and to support the programme for setting up research projects (200 awards for a total sum of 13.8 million Mexican pesos ≈ USD 1.45 million).

State supported universities in the provinces had the greatest total number of projects approved (n=258), followed by the UNAM (n=256) and the SEP/CONACYT research centres (n=142). Almost 20% were given in the exact sciences, 14.1% in applied biology, 13.8% in the natural sciences, and 9.9% in applied engineering. Projects in the health sciences represented the greatest average cost per project, being 1.5 times more than mathematics, which had the lowest average cost per project.

Between 1994 and 1999 the number of projects awarded to institutions outside Mexico City increased by 64% from 377 to 618. In the same period, the number of projects awarded to institutes within the capital city increased by 44%. In 1999 the states of Morelos, Puebla and Mexico (three large states surrounding Mexico City) received the largest number of projects awarded outside the Federal District (18.5% of the total). This can be explained by the fact that these states have the highest number of members of the SNI (after Mexico City) and a solid research infrastructure.

#### *2.7.1.1 Research Projects of Young Scientists*

This new modality was created in 1998 when the PCI was implemented. Although these projects have similar characteristics to those funded under the general category of individual projects with respect to duration of funding (up to 3 years), budgetary items considered, general application requirements, etc., sums available are up to 15% more. Maximum funding available in the general category of individual projects for 2000 was $800,000 pesos ($84,000 US) for a 2- year project and 1,400,000 ($150,000 US) for 3 years. The objective of the programme is to provide young scientists with the minimal infrastructure necessary for them to carry out independent research work. Applicants must be less than 35 years of age and have completed their doctoral studies no more than three years

previous to the application. The demand and quality of applications for this type of support is so high that 56 projects were approved in 1998, even though only 30 were originally scheduled for funding. In 1999 the number of successful projects increased to 74.

*2.7.1.2 Setting-up Research Projects*

Created in 1997 this modality provides "seed" money for scientists employed in research and higher education. Potential applicants must comply with one of the following two requirements: a) acceptance into the Programme for the Repatriation and Retention of Mexican Researchers or b) recently graduated with a PhD[18]. Proposals are accepted only from individual scientists and only from researchers who have not received previous support as project leaders from the programme for funding research projects. Taking into consideration that this category is designed to help recent PhD graduates get started on research in their affiliated institute, the research proposal should estimate completion of the research within a period of 12 months and be approved by the director of the applicant's institution.

Awards given in 2000 were for a maximum of 130,000 Mexican Pesos, just under USD 14,000, for one year, up to 70% forthcoming from CONACYT and at least 30% from institutional funds. Money can be assigned, according to the requirements specified in the proposal, to the purchase of equipment and materials, and/or to running expenses. Where proposals are deemed of equal worth, preference is given to applicants from outside Mexico City. Successful candidates are not allowed to apply for other CONACYT funding during the period of the award. At the end of the funding period, scientists should be in a position to apply for further funding from one of CONACYT's other research funding programmes.

During 1999, 200 of these awards were given for a total sum of 13.8 million Mexican Pesos (≈ USD 1.45 million) most averaging around 70,000 Mexican Pesos (USD 7,400). In 2000 a similar number of awards were given the great majority of which were between 70,000 and 90,000 Mexican Pesos (USD 7,400-9,500).

### *2.7.2 Programme for the Repatriation and Retention of Mexican Researchers*

The objective of this programme created in 1991 is to promote the integration of Mexican researchers into national institutions of research and higher education, as well as to offer adequate employment conditions for encouraging Mexican scientists working or completing studies abroad to return home. It is also designed to prevent the migration of researchers to other countries or to employment outside the research and education sector, as well as to further the decentralisation of Mexican research by offering applicants favourable conditions for moving to institutions outside the metropolitan area.

CONACYT provides funding to the local institution to finance the research position (when this cannot be provided by the institution) and pays the scientist an amount equivalent to the SNI stipend. The research category and the level of the "SNI" support are decided by the hiring institutions in accordance with the specific qualifications of the scientists in question. Successful applicants can also benefit from institutional productivity bonus schemes. CONACYT support is for one year only, after which time the institution is expected to provide the research position and the scientist to qualify for SNI support. Researchers who apply to this programme can also, if eligible, ask for support from CONACYT for establishing research projects.

From 1990 to 1994, 799 researchers were repatriated representing a yearly average of 160. This figure increased to 212 in the following five years from 1995 to 1999. In 1999 a total of 238 scientists benefited from this programme, 40.3% returning from the USA, 15.5% from France, 13.9% from Spain and 13% from the UK. Approximately 40% were given employment in provincial state-supported universities. SEP/CONACYT centres received 13.9%, the UNAM, 13%, private universities, 5.9% and CINVESTAV, 3.8%. Of these 238 scientists, 45% worked in the applied sciences, 15.5% in the exact sciences, 13% in the natural sciences, and 13% in the social sciences. The number of repatriated researchers in the applied sciences increased by 81.3% between 1995 and 1999.

18. Applicants who submitted their papers on/by August 15, 2000 must have received their doctorate after the 1st of November 1999.

Box 4

**The nine regions of the Programme for the Support of the Decentralisation of Scientific and Technological Activities:**

- North-West - Sistema de Investigación del Mar de Cortés (SIMAC)
- South - Sistema de Investigación Benito Juárez (SIBEJ)
- South-West - Sistema de Investigación Justo Sierra (SISIERRA)
- North-East - Sistema de Investigación Alfonso Reyes (SIREYES)
- South-Central - Sistema de Investigación Ignacio Zaragoza (SIZA)
- East - Sistema de Investigación del Golfo de México (SIGOLFO)
- West - Sistema de Investigación José María Morelos (SIMORELOS)
- North-Central - Sistema de Investigación Francisco Villa (SIVILLA)
- Central - Sistema de Investigación Miguel Hidalgo (SIHGO)

### *2.7.3 Other funding programmes*

The Scientific Research area of CONACYT also administers other programmes to finance and support research and teaching activities:

- Programme for the Identification and Selection of New, Emerging or Deferred Fields
- Programme to support Sabbatical and Postdoctoral visits to National and Foreign Institutes Visiting Lectureships
- Evaluation of Mexican Scientific Journals

In addition, the Technological Modernisation area of CONACYT offers a series of credits and incentives to industry to update technology, thereby stimulating and promoting increased productivity and competitiveness in the global market place. Likewise, the area of CONACYT responsible for Regional Development runs a series of programmes designed to promote S&T research outside the country's capital city. Support for research activities is also possible as a result of the agreements signed by CONACYT through the Council's programmes for international scientific co-operation. These latter two programmes are detailed below.

*2.7.3.1 Programme for the Support of the Decentralisation of Scientific and Technological Activities*

Nine regional research systems (see Box 4) were created in 1994, grouping together Mexican states with shared borders and problems under the auspices of the Programme for the Support of the Decentralisation of Scientific and Technological Activities. The intention of the scheme is to promote the sharing of human and material resources between states for the solution of common problems. As illustrated in the interviews, several IFS grantees have benefited from these programmes.

Funding is given for projects in the following areas: Foodstuffs; Health; Social and Humanities Development; Urban Development and Housing; Industrial Development, and Natural Resources and Environment. The following federal ministries participate with the local state governments and with CONACYT, in running the programme: Agriculture, Livestock and Rural Development; Commerce and Industrial Development; Environment, Natural Resources and Fisheries; Social Development; and Education. Financing of the nine regional research systems is handled through a trust fund with contributions from the state governments and from CONACYT. Additional funding is provided both by the public and privates sectors, as well as higher education institutes interested in the results of the funded research.

As of the year 1999, 2,465 (39%) out of a total of 6,260 projects submitted were considered quality proposals, and funding was awarded to 1,930 (30%) projects. Of the projects funded from 1995-2000, 30.1% were in the area of natural resources and environment, and 21% were in foodstuffs. In this same period SIBEJ had the greatest number of projects funded, 436, and SIMORELOS was assigned the largest sum of money. A total of 1,069 million Mexican Pesos (approximately USD 112.5 million) were assigned to the nine regional research systems from 1995 to 2000, of which 57% was provided by the trust fund and the rest by clients. Over 40% (987) of the funded projects were from the public state universities, followed by 18.4% (437) from the research institutes and centres of the SAGARPA and 13% (307) from the SEP/CONACYT system of research institutes.

*2.7.3.2 Programmes for International Co-operation in Science and Technology*

CONACYT has a series of international co-operation agreements both with similar bodies in other countries as well as with international S&T organisations. Support given under these agreements to the scientific and technological community permits its members to a) take advantage of research opportunities abroad to reduce costs, b) link national scientific activities to those carried out internationally, c) facilitate access to scientifically advanced laboratories and infrastructure in other countries, as well as to provide the opportunity for the training of Mexican students and scholars in specialised areas of importance for national development in cases where the required programmes and infrastructure are not available locally. The International Programme for Co-operation in Science and Technology is run jointly by CONACYT and the Secretaría de Relaciones Internacionales[19].

The bilateral programmes have four main divisions: a) joint research projects, b) exchange of specialists, c) exchange of information, and d) organisation of academic meetings, seminars and workshops. Between 1995 and 2000, 38 agreements with 25 countries were in operation with 1,544 research projects and 73 workshops approved involving the movement of 2,525 Mexican scientists abroad and 2,082 foreign scientists to Mexico. Thirty-two agreements are currently in force, 17 with European countries, 4 with Asian countries and 11 with the US and other nations of the American continent.

CONACYT also has multilateral co-operation agreements with 20 international organisations. Programmes with the Organisation of American States (OAS), International Foundation for Science (IFS), Third World Academy of Sciences (TWAS) and the International Centre for Genetic Engineering and Biotechnology (ICGEB) have, during 1995-2000, given support to 132 projects for a total sum of 2,798,149 Mexican Pesos (≈ USD 294,542).

## 2.8 Scientific Production

The international scientific visibility of Mexican researchers grew considerably over the last decade. Mexican publications registered by the Institute for Scientific Information (ISI) in all fields of knowledge increased from 1,486 in 1990 to 4,477 in 1999, from 0.27% of the world share in 1990 to 0.57% in 1999. The largest contribution was made by researchers in the basic sciences, especially in physics where production grew from 213 publications in 1990 to 951 publications in 1999. This represents a change in the share of all ISI publications in Mexico from 14.3% to 21.2%. Part of this increase is associated with the coverage of the *Revista Mexicana de Física*[20] by ISI from 1992 onwards. In spite of the increased international presence of Mexican authors, their participation in world science is still small compared to other nations, only 0.53% of global production from 1995 to 1999. Notwithstanding it is slightly higher in absolute terms than other Latin American countries such as Argentina with 0.48% (with a total population of about one third of that of Mexico),Chile with 0.22% (with a total population less than one sixth that of Mexico) but inferior to Brazil with 1.02% (with a total population 1.7 times that of Mexico).

Mexican scientists' third largest area of ISI publication was plant and animal sciences, and the eighth largest was agriculture. As a percentage of world output, Mexican scientists published 1.04% of all ISI plant and animal science publications, and 0.89% of all ISI agriculture publications. Only in astrophysics did Mexican scientists make a greater contribution to global totals (1.7%). Though the total number of ISI publications in the agricultural sciences grew from 79 in 1990 to 157 in 1999, the quantity as a percentage of all Mexican ISI publications decreased from 5.3% to 3.5%. The increase of ISI plant and animal science publications from 170 in 1990 to 524 in 1999 represented a small change in the share of all Mexican ISI publications that were published in the fields of plant and animal sciences (from 11.5% to 11.7%).

From 1990 to 1994, papers with at least one author from the UNAM represented 50% (5,010) of the total, while for the following five years from 1995 to 1999 the percentage contribution of the UNAM dropped to 32% (9,013) in spite of increased production. The research institutes belonging to the Secretaría de Salud[21] occupied second place in output of papers, with 1,826 (18.2% of the total) in the first five year period and 3,276 (11.6% of the total) in the second. In third place the CINVESTAV had a total output of 1,070 (10.7% of the total) and 2,311 (8.2% of the total) in the two peri-

19. Mexican Foreign Ministry.

20. *Mexican Journal of Physics*.

21. Health Ministry.

ods, respectively. Of the state universities only the Universidad Autónoma de Puebla (UAP) figured among the ten top producers. From 1990 to 1994, this university published 818 papers, a figure which dropped to 551 in 1995-1999. The percentage contribution of the UAP showed an even more notable drop from 8.2% to 2% of national mainstream output. The SEP/CONACYT research institutes produced a total of 1,070 papers in the first period and 2,510 in the second, representing a slight decrease in their contribution to the total number of Mexican papers in the two periods, 10.7% and 8.9%, respectively. Overall the increase in production of mainstream articles of the top ten most productive Mexican research institutions from 1990 to 1999 was not as great as the increase seen in total Mexican production, suggesting that minor institutions played a greater role than the major ones in the increased presence of national science in the mainstream literature.

The geographical distribution of Mexican papers published between 1995 and 1999 showed that at least one author was affiliated to an institution within the federal district in 63.5% of these, 6.5% in the State of Morelos, 5.0% in the State of Puebla, 4.0% in the State of Guanajuato, and 3.9% in the State of Baja California.

The 1990s saw the strengthening of collaborative research in the national context with 85% of papers published in this decade having authors from more than one institution, 57.6% were in international collaboration. The countries with the most co-authored papers with Mexican scientists from 1995 to 1999 in descending order were the USA (37%), France and Spain (both with 7%), England (5%), Canada and Germany (both with 4%) and Brazil (3%).

The publication productivity of IFS grantees in Mexico is examined in Chapter 6. The productivity of IFS grantees will be analysed in terms of ISI productivity and total publication productivity, including production in local journals and other media forms.

## 2.9 Present Situation and Policy

According to a report published by CONACYT in 1998, Mexican S&T capacity has expanded considerably in recent years. Presently, the country has a relatively small group of highly competent scientists and engineers. Scientific infrastructure has been expanded and access to telecommunications is widespread within the university system. Institutional arrangements have become more flexible, particularly within the leading universities and research centres, and priority has been given to teaching and research quality and its evaluation.

In spite of important progress made in these areas, other issues are still being addressed of which, perhaps, the most pressing is the insufficient number of scientists and engineers. Although the numbers with postgraduate training has increased in recent years, there is a continuing need for more young people to pursue advanced courses of study in the best national and foreign institutions. Decentralisation of research facilities continues to be a key issue in spite of progress made. Other priority areas are the strengthening of research areas, such as health, environment, computer science, and food production, to satisfy the demands of Mexican society; the strengthening of effective links between academic research and industry; the need for a greater diversification of research funding sources including increased participation of private investment; and the implementation of a powerful national strategy for innovation. International partnerships and networks are regarded as essential inputs for the major national endeavours already in progress. International flows of trade, knowledge and people are seen as increasingly important to the success of R&D policy in Mexico.

Box 5
**Dr Maria Valdés**

Though IFS grants are relatively small, their impact can be considerable. IFS grants produce results at many levels: the grant strengthens scientific capacity in developing countries, it is a catalyst for the creation of innovative development solutions, and it can also be a key turning point in a young researcher's career. For Professor Maria Valdés, this is self-evident.

Since her childhood in a Mexican desert town near the US border, Dr Valdés has had an interest in the problems encountered by people living in an arid environment. As an undergraduate student her specific interest in plants and erosion led her to the study of soil microbiology. Between 1962 and 1964 she continued her studies at the French public research institute for development, ORSTOM (now IRD). After graduating, she returned to Mexico as a teacher at the Instituto Politecnico Nacional (IPN) and began research that led to her PhD from the University of Caen in France in 1968. Shortly thereafter, she was promoted to professor at IPN.

Dr Valdés stumbled upon IFS by chance. In 1974 IFS had just begun its operations, and Dr Valdés had newly embarked upon a research career focusing on mycorrhizae (symbiotic fungal associations). During the same year, she met Dr Peitsa Mikola, an IFS Scientific Adviser, at an international mycorrhizae conference in the USA and was encouraged to apply for a grant. Her grant application *Mycorrhizal innoculation and the afforestation of the deep Valley of Mexico* was approved, and Dr Valdés became the 39th IFS grantee and the first from Mexico.

Difficulty in arranging international money transfers initially interrupted Dr Valdés' research. However, the university made it possible to arrange temporary funding of the project. "This was," in Dr Valdés words, "the first positive effect of the grant at a time when no institutional funding was available for research in Mexican teaching institutions." At that point, she says, "the IFS grant is not only US $10,000. Receiving money from an international funding institution gave rise to the interest of professors and the administration towards me."

However, the interest aroused by the IFS grant would not have been sufficient to strengthen her young reputation if her work had not been of excellent quality. "While I had not been publishing much after my thesis, I really began to publish after the IFS grant." She continues: "The Foundation money also had secondary effects, stimulating other funding from my institution and from other local sources. This funding contributed to my research activities and complemented my salary."

During her time as a grantee, IFS travel grants enabled Dr Valdés to supplement her scientific training in foreign laboratories, network with fellow scientists, and identify potential collaborators. After the completion of her second renewal grant, she had become an established Mexican scientist with international credentials and membership in the Sistema Nacional de Investigadores. Dr Valdés has twice been elected president of national scientific societies, six times presented with national awards (once, by the Mexican Academy of Sciences, for results from her IFS supported research), and received research support from numerous funding agencies.

In addition to being an active teacher and researcher, Dr Valdés is currently collaborating with other researchers at IPN and the Instituto Nacional de Investigaciones Forestales Agricolas y Pecuarias (INIFAP) to develop a national program for biofertilization. Dr Valdés is investigating the potential for utilising mycorrhizae to grow alternative crops in order to assist farmers who do not have the means to acquire chemical fertilizers.

In retrospective, Dr Valdés believes that the IFS grant marks the real beginning of her career. And, as is the case with many former IFS grantees, she has maintained her connection with IFS throughout her career. Since 1990 she has contributed her time and expertise to IFS as a Scientific Adviser.

# 3. Applicants and Grantees in Mexico

Mexican scientists have submitted applications to IFS and been awarded research grants since 1974 (see Box 5). In this chapter the process of applying for IFS funding is briefly reviewed, followed by a description of the applicants and grantees in Mexico, their distribution among institutions, and their research areas. Also considered are the success rates of applicants, based upon the characteristics mentioned above. Further information regarding the 138 grantees that are considered in this report, and those that were not, can be found in Appendix 2.

## 3.1 The application process

Applications for IFS support are accepted year-round, and funding decisions are made twice annually. The primary type of support provided by IFS is in the form of a research grant - in the maximum amount of USD 12,000 - which can be awarded to a researcher up to three times. After an initial pre-screening at the Secretariat, applications for IFS support are submitted to a group of Scientific Advisers who have an expertise in the applicant's field. The Scientific Advisers send their evaluation of the application to a Scientific Advisory Committee consisting of between four and eight senior scientists, where a decision is made regarding the application. Regardless of the decision, the comments and constructive criticisms of the Scientific Advisers are compiled and forwarded to the applicant. Unsuccessful applicants are encouraged to review the comments of the Scientific Advisers and to submit an improved application.

## 3.2 Applications

IFS uses diverse strategies to advertise its activities to potential applicants. However, IFS can improve the effectiveness of its advertising campaigns by collecting feedback on how scientists in Mexico learned about IFS. The interviews with grantees suggest that many grantees found out about the IFS granting programme from other Mexican colleagues, only some of which were IFS grantees. IFS Scientific Advisers, in particular two Scientific Advisers in animal production, Dr Reg Preston based at the UADY (Mérida) during the 1980s and Dr Carlos Galina based at the UNAM (Mexico City), later played an active role in informing their Mexican students and colleagues about the IFS granting programme. Their involvement partly explains the greater number of animal production grantees in Mexico (see Table 4 below). Other Scientific Advisers met potential applicants at international conferences or at workshops organised by IFS. Meanwhile, some grantees were introduced to IFS by staff members that were visiting Mexico or holding information seminars in, or outside, Mexico. Thus far, very few grantees have learned about IFS through the Internet: among the 48 grantees interviewed, one from CINVESTAV (Irapuato) found the IFS Home page while surfing on the Internet and another found IFS via a link from the CONACYT home page.

Information regarding applicants to IFS is available from 1985 onward[22]. During the years 1985-1999, 417 applications for a first research grant were received from Mexican scientists at the IFS Secretariat. Fourteen of those applications arrived in late 1999, and were not considered by the SACs until 2000. Of the remaining 403 applications, 124 were approved for funding. During the period 1974-1985, only 14 grantees were awarded first grants. Thus the period covered (1985-1999) is largely representative of the whole period between 1974 and 1999.

### *3.2.1 Number of first grant applications per year and per research area*

As shown in Table 3, the number of first grant applications per year varies greatly, from 11 in 1985 to 42 in 1989. The application peaks during

22. For this study, most data regarding applications was entered into the database manually, as it only existed electronically from 1996 onwards.

| Year | Number of applications | % |
|---|---|---|
| 1985 | 11 | 2.6 |
| 1986 | 14 | 3.4 |
| 1987 | 31 | 7.4 |
| 1988 | 40 | 9.6 |
| 1989 | 42 | 10.1 |
| 1990 | 39 | 9.4 |
| 1991 | 20 | 4.8 |
| 1992 | 21 | 5.0 |
| 1993 | 20 | 4.8 |
| 1994 | 18 | 4.3 |
| 1995 | 38 | 9.1 |
| 1996 | 41 | 9.8 |
| 1997 | 26 | 6.2 |
| 1998 | 31 | 7.4 |
| 1999 | 25* | 6.0 |
| **Total** | **417** | **100.0** |

* Fourteen of these applications arrived late in 1999, and were not considered by the SACs until 2000.

Table 3
**Number of applications per year (1985-1999)**

| Area | Applications | % |
|---|---|---|
| Animal Production (B) | 99 | 24.6 |
| Crop Science (C) | 89 | 21.6 |
| Aquatic Resources (A) | 73 | 17.1 |
| Food Science (E) | 56 | 13.3 |
| Natural Products (F) | 43 | 10.6 |
| Forestry/Agroforestry (D) | 39 | 9.5 |
| Rural Technology (G)* | 7 | 1.8 |
| Environmental Sciences (H)* | 6 | 1.5 |
| **Total**** | **412** | **100.0** |

* Discontinued Research Areas
** Five applications had unknown Research Areas, and are not included here.

Table 4
**Number of applications per Research Area (1985-1999)**

1987-1990 and 1995-96 coincide with visits during the previous years by IFS staff members. This suggests that IFS staff visits are effective for recruiting new grantees.

Animal production (Area B) is the scientific area receiving most applications (Table 4), followed by crop science (Area C). Rural technology (Area G) and environmental sciences (Area H) were the areas with the fewest applications. This is due to the relatively short time that these areas were in existence.

### *3.2.2 Number of applications per institution*

The number of applications considered here is 398[23]. These applications came from 71 different institutions. Single applications were received from 32 institutions (45.1% of all institutions). At the other extreme, six institutions were home to ten or more applicants during the 1985-1999 period (see Table 5). Those six institutions provided a total of 217 applicants (54.5% of all applicants). Of these six institutions, the Universidad Nacional Autónoma de México (UNAM) tops the list with 61 applications, followed closely by the Universidad Autónoma de Yucatán (UADY) in Mérida with 50 applications.

## 3.3 Success rates

During the 1985-1999 period, 124 applications submitted by Mexican scientists (renewal applications are not considered) out of 403[24] were approved. This gives a success rate of 30.8%. For the period 1990-1999, Mexican applicants had a 30.6% success rate. This was higher than the 28.3% success rate for Latin American applicants during 1990-1999. In comparison, the global success rate for IFS applicants was 24.8% for the period 1985-1999 and 19.4% for the period 1990-1999. It is clear that Mexican applicants have been among the most successful groups in terms of winning grants from IFS.

The success rates of Mexican applicants varied from year to year, from 46% in 1996 to only 10% in

23. On five additional applications the home institution was not correctly registered, hence they were excluded. Furthermore, fourteen applications arrived late in 1999 and were not included in the analysis.

24. As is noted at the beginning of the chapter, fourteen applications that were received in 1999 were not considered by the SACs until 2000, thus they are not included in this figure.

| Institution | City | Region | Number of applications | Total applications |
|---|---|---|---|---|
| **Universidad Nacional Autónoma de México (UNAM)** | San Patricio | Jalisco | 1 | **62** |
| | Cuautlán Izcalli | Mexico | 2 | |
| | Coyoacán | Mexico, DF | 3 | |
| | Iztapalapa | Mexico, DF | 2 | |
| | Mexico City | Mexico, DF | 41 | |
| | Tlalnepantla | Mexico, DF | 1 | |
| | Cuernavaca | Morelos | 8 | |
| | Martinez de la Torre | Veracruz | 2 | |
| | Mérida | Yucatán | 1 | |
| Universidad Autónoma de Yucatán (UADY) | Mérida | Yucatán | 45 | **50** |
| | Mérida | Yucatán | 5 | |
| **Centro de Investigación y de Estudios Avanzados (CINVESTAV) del IPN** | Irapuato | Guanajuato | 18 | **29** |
| | Mexico City | Mexico, DF | 2 | |
| | Mérida | Yucatán | 9 | |
| | Mexico City | Mexico, DF | 1 | |
| **Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias (INIFAP)** | Chihuahua | Chihuahua | 4 | **25** |
| | Celaya | Guanajuato | 1 | |
| | Colonia San Rafael | Mexico, DF | 1 | |
| | Cuajimalpa | Mexico, DF | 1 | |
| | Mexico City | Mexico, DF | 4 | |
| | Jiutepec | Morelos | 2 | |
| | Nuevo León | Nuevo León | 1 | |
| | Oaxaca | Oaxaca | 1 | |
| | Veracruz | Veracruz | 1 | |
| | Mérida | Yucatán | 3 | |
| | Calera | Zacatecas | 4 | |
| | Montecillo, Texcoco | Mexico | 1 | |
| | Morelia | Michoacán | 1 | |
| **Universidad Autónoma Metropolitana (UAM)** | Iztapalapa | Mexico, DF | 16 | **25** |
| | Mexico City | Mexico, DF | 8 | |
| | Xochimilco | Mexico, DF | 1 | |
| | Querétaro | Querétaro | 3 | |
| | Guyamas | Sonora | 2 | |
| | Torreón | Coahuila | 1 | |
| Colegio de Postgraduados en Ciencias Agrícolas (CP) | Montecillo, Texcoco | Mexico | 1 | 17 |
| | Mexico City | Mexico, DF | 1 | |
| **Universidad Autónoma de Nuevo León (UANL)** | Linares | Nuevo León | 8 | **11** |
| | Monterrey | Nuevo León | 1 | |
| | Nuevo León | Nuevo León | 1 | |
| | San Nicolas | Nuevo León | 1 | |
| | | | **Total** | **219** |

Table 5
**Institutions in Mexico with more than 10 applicants**

| Year | No. of applications | No. of grants | Percent successful |
|---|---|---|---|
| (1985) | (11) | (1) | (9) |
| 1986 | 14 | 6 | 43 |
| 1987 | 31 | 10 | 32 |
| 1988 | 40 | 12 | 30 |
| 1989 | 42 | 13 | 31 |
| 1990 | 39 | 7 | 18 |
| 1991 | 20 | 5 | 25 |
| 1992 | 21 | 2 | 10 |
| 1993 | 20 | 7 | 35 |
| 1994 | 18 | 7 | 39 |
| 1995 | 38 | 12 | 32 |
| 1996 | 41 | 19 | 46 |
| 1997 | 26 | 8 | 31 |
| 1998 | 31 | 7 | 23 |
| (1999) | (11) | (8) | (73) |
| **Total** | **403** | **124** | **30.8** |

Table 6
**Success rates by year**

1992 (Table 6). However, the date recorded for the grant was the year that the grant was awarded, this is usually after the date that the completed application arrived at IFS. This leads to inevitable errors in the success rates for the beginning and the end of the period, 1985 and 1999, hence they are excluded from Table 6.

As shown in Table 7, success rates by scientific areas varied greatly from 50% to 17% for the research areas still belonging to the research programme. Forestry/agroforestry (Area D), food science (Area E) and animal production (Area B) had the highest success rates, and crop science (Area C) and natural products (Area F) had the lowest.

The success rates of the applicants from institutions that were home to ten or more applicants are shown in Table 8. The three institutions that were home to the most grantees had success rates that were greater than average for Mexico. The Universidad Autónoma de Nuevo León (UANL) displays an exceptional success rate of 64% while many other universities in the Provinces have very low

| Area | No. of grants | No. of applications | Success rate (%) |
|---|---|---|---|
| Forestry/Agroforestry (D) | 19 | 38 | 50 |
| Food Science (E) | 22 | 53 | 42 |
| Animal Production (B) | 36 | 98 | 37 |
| Rural Technology (G) | 2 | 7 | 29 |
| Aquatic Resources (A) | 17 | 68 | 25 |
| Crop Science (C) | 21 | 86 | 24 |
| Natural Products (F) | 7 | 42 | 17 |
| Environmental Sciences (H) | 0 | 6 | 0 |

Table 7
**Success rates by Research Area (1985-1999)**

| Institution | Applications received* | Grants approved | Global success rate (%) |
|---|---|---|---|
| Universidad Nacional Autónoma de México (UNAM) | 61 | 20 | 33 |
| Universidad Autónoma de Yucatán (UADY) | 50 | 20 | 40 |
| Centro de Investigación y de Estudios Avanzados (CINVESTAV) del IPN | 28 | 13 | 48 |
| Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias (INIFAP) | 25 | 6 | 24 |
| Universidad Autónoma Metropolitana (UAM) | 25 | 7 | 28 |
| Colegio de Postgraduados (COLPOS) | 18 | 6 | 33 |
| Universidad Autónoma de Nuevo León (UANL) | 11 | 7 | 64 |
| **Total** | **218** | **79** | **36** |

* Four applications that arrived late in 1999 and were not considered by the SACs until 2000 are not included

Table 8
**Success rates of applicants from the institutions with more than 10 applicants (1985-1999)**

| Area | Grant period | | | | | | Total |
|---|---|---|---|---|---|---|---|
| | 1st period | | 2nd period | | 3rd period | | |
| | active | completed | active | completed | active | completed | |
| A | 6 | 5 | 3 | 3 | 1 | 0 | 18 |
| B | 12 | 14 | 7 | 9 | 3 | 1 | 46 |
| C | 12 | 5 | 2 | 2 | 0 | 0 | 21 |
| D | 6 | 7 | 4 | 2 | 0 | 1 | 20 |
| E | 3 | 7 | 3 | 5 | 3 | 3 | 24 |
| F | 3 | 3 | 0 | 0 | 1 | 0 | 7 |
| G | 0 | 1 | 0 | 1 | 0 | 0 | 2 |
| Subtotal | **42** | **42** | **19** | **22** | **8** | **5** | |
| **Total** | **84** | | **41** | | **13** | | **138** |

Table 9
**Grantees in Mexico: number of grants by Research Area, research period, and activity status**

success rates. Some institutions with between 5 and 10 applicants present high success rates too, like the Centro de Investigación Científica de Yucatán (CICY), 63%, and the Centro de Investigación en Alimentación y Desarrollo (CIAD), 50%. Overall, reputable research centers of excellence such as CICY, the Centro de Investigación y de Estudios Avanzados (CINVESTAV), and the Instituto de Ecología have a success rate around 50% and above.

## 3.4 The grantees

Table 9 sorts the 138 grantees in Mexico for the period 1974-1999 according to the following variables: research area, research period (the 1st period is the first grant, the 2nd period is the first renewal, and the 3rd period is the second renewal), and funded research status (active or completed). As one can see, a large majority of the grantees have received only one grant (60.8%), and few have received three grants (9.4%) (See chapter 8 for a discussion of the selection process).

Animal production (Area B) had the greatest number of grantees (34% of the total number), and the other areas have a more or less equal number of grantees, between 13% and 18% (Figure A1 in the appendix), with the exception of the natural products (Area F) research area. Area G can be disregarded, since it was only open to applications and grants for a short period of time.

The number of grantees receiving support from IFS at the time of this study was equal to the number that no longer received support. The distribution of grants per research period and active/closed grants is illustrated in Figure A2 in the appendix. There are an equal number of active and closed grants in the first granting period, and slightly more closed than active grants in the second, while the reverse is true for grants in the third period.

### *3.4.1 Distribution of grantees by region and institution*

The states of Yucatán and Mexico together with Mexico, DF are the regions where IFS has the most grantees (Table 10).

IFS grantees in Mexico are both highly concentrated and widely dispersed. More than half of the grantees (54.7%) are concentrated in two regions (Yucatán and Mexico, DF) and half (51.1%) in four institutions. Meanwhile, there are 17 institutions with only one grantee. Table A1 in the appendix describes the distribution of grantees by region, by city and by institution at the time of the first grant. Ninety-eight first grants were awarded to grantees affiliated with an institute of higher education and

| Region | No. of grantees |
|---|---|
| Aguascalientes | 2 |
| Baja California Norte | 1 |
| Baja California Sur | 7 |
| Chiapas | 1 |
| Coahuila | 1 |
| Colima | 1 |
| Durango | 2 |
| Guanajuato | 14 |
| Guerrero | 1 |
| Jalisco | 1 |
| Mexico | 6 |
| Mexico, DF | 30 |
| Michoacan | 2 |
| Morelos | 4 |
| Nuevo León | 7 |
| Puebla | 2 |
| Querétaro | 2 |
| San Luis Potosí | 1 |
| Sinaloa | 2 |
| Sonora | 3 |
| Tabasco | 1 |
| Veracruz | 5 |
| Yucatán | 39 |
| Zacatecas | 2 |
| **Total** | **137** |

Table 10
**Geographical distribution of grantees by region at the time of the first grant**

39 to grantees affiliated with a government research institute. The institutions with two or more grantees are listed in tables 11 and 12. Institutions with only one grantee (only one of these, the Centro de Investigación y Astistencia en Tecnología y Diseño del Estado de Jalisco (CIATEJ), is a government research institute, the rest are institutes of higher education) are listed in Table A2 in the appendix.

| Institute of Higher Education | No. of grantees |
|---|---|
| Universidad Autónoma de Yucatán (UADY) | 26 |
| Universidad Nacional Autónoma de México (UNAM)* | 21 |
| Universidad Autónoma Metropolitana (UAM)* | 8 |
| Universidad Autónoma de Nuevo León (UANL)* | 6 |
| Colegio de Postgraduados (COLPOS) | 6 |
| Instituto de Ecología (INECOL) | 3 |
| Instituto Politécnico Nacional (IPN)* | 3 |
| Instituto Tecnológico Agropecuario (ITA) # 2 | 3 |
| Instituto Tecnológico de Mérida (ITM) | 2 |
| Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM)* | 2 |
| Universidad Autónoma de Baja California (UABC)* | 2 |

* Grantees in more than one location

Table 11
**Institutes of higher education with two or more IFS grantees in Mexico**

| Government Research Institute | No. of grantees |
|---|---|
| Centro de Investigación y de Estudios Avanzados (CINVESTAV) del IPN* | 14 |
| Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias (INIFAP)* | 9 |
| Centro de Investigaciones Biológicas del Noroeste (CIBNOR) | 6 |
| Centro de Investigación Científica de Yucatán, A C (CICY) | 5 |
| Centro de Investigación en Alimentación y Desarrollo (CIAD)* | 4 |

* Grantees in more than one location

Table 12
**Government research institutes with two or more IFS grantees in Mexico**

# 4. Main characteristics of the population of grantees in Mexico

In this chapter we characterise the population of IFS grantees in Mexico using statistics based on both the overall population of grantees, and on the 105 grantees who responded to the questionnaire. Given the satisfactory response rate to the questionnaire (76%), it can be assumed that the latter population is representative of the entire IFS grantee population in Mexico, at least as far as the characteristics described below are concerned.

## 4.1 Age, gender and civil status

Close to two-thirds of the grantees (72.4%) were 35 years old or younger when they submitted their first application to IFS, and half of them (50.7%) were between 31 and 35 years of age. The average age at the time of the first application was 33.5 years old (see Figure 2). Not surprisingly, 27 years after the first grant was awarded, the age distribution of the respondents to the questionnaire is wider, with a concentration (70.2%) of scientists between 36 and 45 years old. The mean age of the respondents to the questionnaire is 41 years old.

Out of 138 grantees, only 32 (or 23.2%) are women. This is slightly more than the proportion of female IFS grantees in the world (21.9%), but substantially less than the average for Latin America and the Caribbean (34.1%). It is also less than the percentage of female scientists in the SNI system in Mexico (29.0%) and much less than the overall proportion of women working in activities related to S&T in Mexico (42.4%). If grantees are sorted according to research area, one sees that in food science and natural products the representation of women is relatively high, while in forestry/agroforestry, they are few (Table 13).

The large majority of grantees in Mexico (81%) are married. The Western standard seems to have been adopted for the number of children that grantees have. Close to half of them (45%) have two children and the average number of children per grantee is 1.6 (the average for married and widowed grantees was slightly less than 1.9 children per person).

Information was also collected regarding the occupation of grantees' spouses. One third of spouses

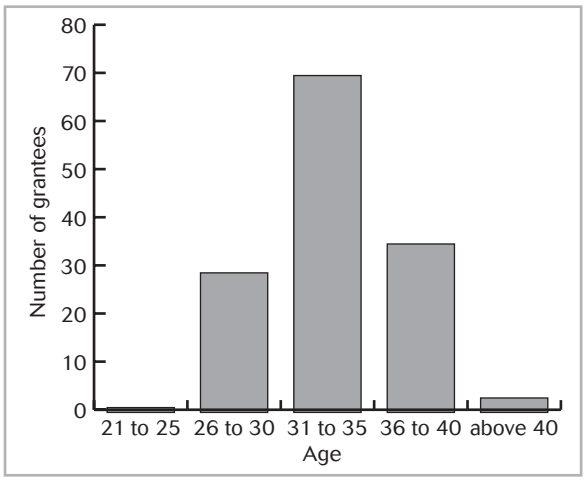


Figure 2
**Age of the IFS grantees**

| Area | No. of grants | No.of female grantees | % female |
|---|---|---|---|
| Rural Technology (G) | 2 | 1 | 50.0 |
| Food Science (E) | 22 | 10 | 45.5 |
| Natural Products (F) | 7 | 3 | 42.9 |
| Crop Science (C) | 21 | 5 | 23.8 |
| Aquatic Resources (A) | 17 | 4 | 23.5 |
| Animal Production (B) | 36 | 7 | 19.4 |
| Forestry/Agroforestry (D) | 19 | 2 | 10.5 |

Table 13
**Female grantees by Research Area**

are housewives (no husbands stayed at home), twice the percentage that was obtained in a similar survey for African scientists (Gaillard and Furó Tullberg, 2001). One possible explanation is that, contrary to what was found for Africa, many Mexican scientists have income levels that allow their spouse to stay at home. Of the remaining spouses that work, 31% are researchers (20.2%) or teachers (10.7%). This endogamous trend seems to be stronger among women researchers than among men, since more than half of them (58.8%) married research scientists. In general, most spouses have highly skilled or qualified jobs (Figure 3).

## 4.2 Institutional framework

As shown in chapter 3, more than two-thirds (71%) of the grantees were affiliated with an institute of higher education at the time of the first application, with a concentration in two large public universities, the UNAM in Mexico City and the UADY in Mérida. The remaining 29% were affiliated with a government research institute. The distribution is slightly different for the respondents to the questionnaire (Figure 4), though public universities remain by far the main institutional framework for the IFS grantees[25].

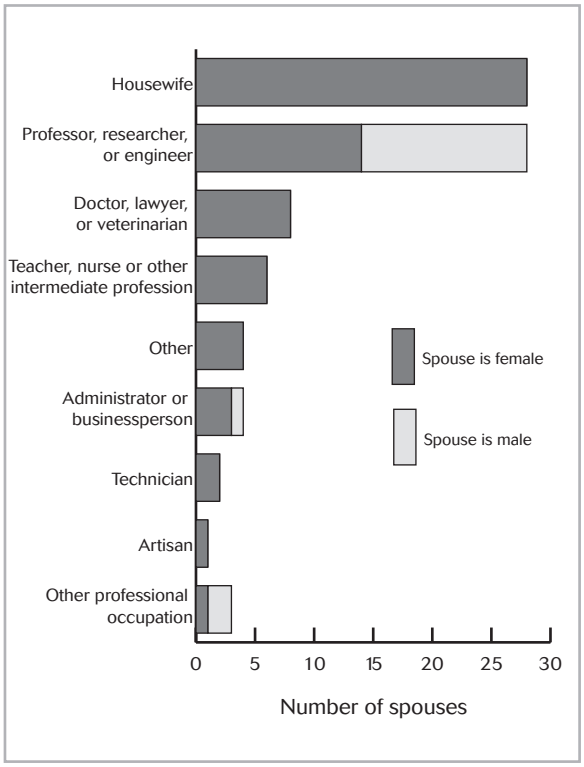


Figure 3
**Principal occupations of the grantees' spouses (Q9)**

## 4.3 Degrees held

In this section, only 134 grantees are considered. Two shared grants were disregarded, as well as two grants to non-Mexicans. Efforts were made to estimate the levels of all the different degrees taken in 14 different countries and to converge them into three categories: Bachelor of Science (BSc), Master of Science (MSc) and Doctor of Philosophy (PhD). In particular, the first degree taken in veterinary sciences in Mexico (doctor en medicina veterinaria or licenciatura), is said to equal a BSc degree, while that in other countries is more likely to equal a MSc degree.

The degrees held by the grantees at the time of the first grant are listed in Table 14. The majority of the grantees held a PhD when they applied for the first time to IFS. Of the seven with a BSc, six were doctors in veterinary medicine (from Mexico, thus the equivalent of a BSc) and one was an engineer.

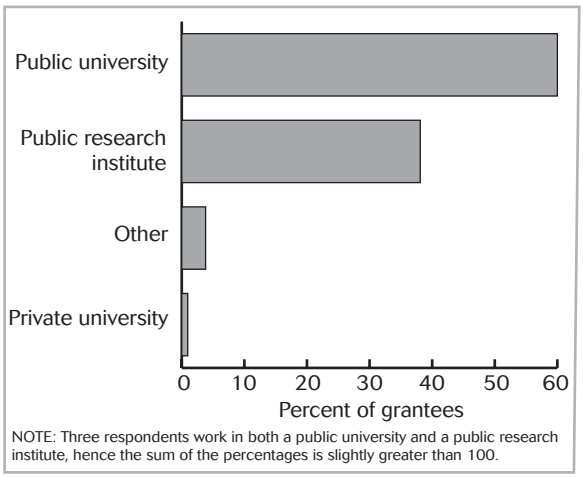


Figure 4
**Institutional framework of the respondents to the questionnaire (Q22)**

| Degree | Number of grantees | % |
|---|---|---|
| BSc | 7 | 5.2 |
| MSc | 46 | 34.3 |
| PhD | 81 | 60.4 |
| **Total** | **134** | **100.0** |

Table 14
**Degrees held at the time of the first grant**

25. Some respondents to the questionnaire indicated that they were employed both by a public research institute and a public university, hence the sum of the percentages in Figure 3 is greater than 100%.

| Country | Period | | | | | | Total | |
|---|---|---|---|---|---|---|---|---|
| | 1974-1980 | | 1981-1990 | | 1991-1999 | | | |
| | No. | % | No. | % | No. | % | No. | % |
| Mexico | 2 | 33 | 21 | 39 | 32 | 43 | 55 | 41 |
| USA | 2 | 33 | 9 | 17 | 15 | 20 | 26 | 19 |
| United Kingdom | - | - | 10 | 18 | 9 | 12 | 19 | 14 |
| France | 1 | 17 | 9 | 17 | 5 | 7 | 15 | 11 |
| Canada | - | - | 3 | 5 | 1 | 1 | 4 | 3 |
| Japan | - | - | 1 | 2 | 3 | 4 | 4 | 3 |
| Australia | 1 | 17 | - | - | 2 | 3 | 3 | 2 |
| Germany | - | - | - | - | 2 | 3 | 2 | 1 |
| Belgium | - | - | - | - | 1 | 1 | 1 | 1 |
| Norway | - | - | - | - | 1 | 1 | 1 | 1 |
| Spain | - | - | - | - | 1 | 1 | 1 | 1 |
| Sweden | - | - | - | - | 1 | 1 | 1 | 1 |
| Czech Republic | - | - | 1 | 2 | - | - | 1 | 1 |
| The Netherlands | - | - | - | - | 1 | 1 | 1 | 1 |
| **Total** | **6** | **100** | **54** | **100** | **74** | **100** | **134** | **100** |

Table 15
**Country of the highest degree held at the time of the first grant**

At the time of the first grant, more grantees had earned their highest degree in Mexico than in any other single country (Table 15). During the period 1974-1980, 33% of the degrees were taken in Mexico, during 1981-1990, this figure rose to 39%, and during 1991-1999 it rose to 43%. This progression can be interpreted to indicate an increase in self-sufficiency of the Mexican higher education system as a degree provider.

The main foreign countries where degrees were taken are the USA (19%), the United Kingdom (14%) and France (11%). During the last decade, the USA slightly increased its dominance as the main foreign country to award degrees to Mexican grantees. During the same period, the main European degree-awarding countries, the United Kingdom and France, decreased in importance, particularly France, which was very strong in this respect earlier.

| Area | BSc | MSc | PhD | Total |
|---|---|---|---|---|
| A | 1 | 3 | 14 | 18 |
| B | 5 | 21 | 17 | 43 |
| C | 0 | 6 | 15 | 21 |
| D | 0 | 4 | 15 | 19 |
| E | 0 | 11 | 12 | 23 |
| F | 0 | 1 | 6 | 7 |
| G | 0 | 0 | 2 | 2 |
| **Total** | **6** | **46** | **81** | **133** |
| **%** | **4.5** | **34.6** | **60.9** | **100** |

Table16
**Degree held at the time of the first grant by Research Area**

Looking at the distribution by scientific area and by degree (Table 16), differences between the scientific areas become apparent. Animal production (Area B) is the only scientific area where the PhD holders (39.5%) do not dominate compared to the MSc and BSc holders (60.5% together). In food science (Area E), the proportions are more or less equal between MSc and PhD holders. In the other scientific areas, the proportion of PhDs is over 71% (Area A: 77.7%; Area C: 71.4%; Area D: 78.9% and Area E: 85.7%).

If one compares tables A3 and A4 in the appendix, it is also very clear that Mexican grantees that had studied abroad applied for an IFS grant holding a higher degree than their colleagues with degrees obtained in Mexico. For information on all the different institutions where degrees were obtained, refer to Table A13 in the appendix.

## 4.4 Individual support and research teams

Although IFS support is targeted to individual researchers, IFS grantees were overwhelmingly (91,3%) working in research teams. As illustrated in chapter 8, IFS has had a number of catalytic effects including increased collaboration and team building opportunities. This is confirmed in many interviews (see Box 6 for an example). Furthermore, 82% of IFS grantees in Mexico work in multidisciplinary research teams. Though some grantees feel isolated at the beginning of their career, the scientists with whom they communicate the most frequently are, by order of frequency of communication, the scientists in their own department, and scientists from other institutions in Mexico (see chapter 5).

## 4.5 SNI membership

Of the 138 IFS grantees in Mexico, 85 (or 61.6%) were members of the SNI at the time of their first application. The results of the questionnaire survey suggest that most applicants who were already members, were members at the candidate level. At that level, it is premature to conclude that a scientist is established in his or her field. Nevertheless, this rate of membership is extremely high in comparison to the national rates of membership in the SNI (2.55% of scientists with a PhD). Such a difference indicates that IFS provides grants to an elite population of Mexican scientists.

## 4.6 Conclusions

The data presented in this chapter is a foundation for the results, analyses and conclusions that are found in the following chapters. Based upon information regarding grantees' age, academic degree, and SNI affiliation at the time of the first grant, it is clear that IFS grantees are not strictly representative of the Mexican scientific community. IFS usually supports young, promising researchers that work in public institutions. Information regarding the sex of grantees provides a first indication that Mexican grantees are not representative of grantees in other Latin American countries. Furthermore, the deviation from the mean percentage of female grantees found in the different research areas is a first example of the wide variation of characteristics that can be found between grantees in different research areas.

Box 6

**Dr Luis Manuel Peña Rodriguez**

At the time of his first IFS grant, Dr Luis Manuel Peña Rodriguez was the only PhD working in the area of Natural Products Chemistry in all of Southeast Mexico. This isolation is one reason why he trained and worked in Canada and the USA at various points in his career, but it is also part of the reason why he returned to the Centro de Investigación Científica de Yucatán (CICY) in the city of Mérida. Determined to build a research team and to establish a project for the evaluation of Yucatecan medicinal plants, Dr Rodriguez found the means to do so with IFS research grants.

Dr Rodriguez became acquainted with IFS through a friend who had received IFS support. When Dr Rodriguez himself applied for IFS funding in 1990, he was awarded a small research grant (USD 6,200). At that time, CICY lacked an infrastructure for organic chemistry research, and for Dr Rodriguez the IFS grant made "the difference." Despite the relatively small amount of money awarded, the grant launched his project by allowing him to purchase equipment and recruit his first research group (two undergraduate students and himself).

In 1994, after returning from a year-long research position in New Brunswick, Canada, Dr Rodriguez's dedication to working in the South was reinvigorated by his IFS supported attendance at a scientific meeting in Chile. There he met scientists with similar interests to his own who were working in other Latin American countries. He says that this meeting was a revelation that opened tremendous opportunities for collaboration with colleagues in Argentina, Bolivia and other countries. In 1998 he was invited to the same meeting as a lecturer (also supported by IFS).

A renewal grant from IFS in 1995 for USD 8,330 was one of the foundations for a new research group that Dr Rodriguez continues to co-ordinate today. That team has continued its work to detect, isolate and identify bioactive metabolites produced by Yucatecan medicinal plants. Dr Rodriguez's relationship with IFS continued with a third grant in 1997 (USD 12,000).

Dr Rodriguez finds it challenging to carry out scientific activities in a region remote from the capital (Mexico City) and the administrative agencies. On the one hand, it is difficult to attract PhD holders from central Mexico and abroad to work in what they may see as an isolated scientific community, and on the other hand it is difficult to fight for federal funding from a distance. Despite these challenges, Dr Rodriguez and his colleagues feel that they are contributing to the development of the region through their efforts to build and strengthen the scientific capacity of Yucatán. Dr Rodriguez does not see his role as that of a reknowned international scientist, but rather as a builder of future scientific research groups.

# 5. Research practice, communication and research funding

To effectively direct support to the regions and countries where there is the greatest need and potential impact, it is important for IFS to understand the context in which its grantees work. In the following chapter, results from the questionnaire survey are presented and analysed that illustrate researchers' work environment, both their resources and their rewards, and their connections to the global scientific community. The results and analysis provided in the following pages lead to a discussion of the role of IFS in the Mexican scientific community.

## 5.1 Salaries and additional employment to supplement income

One-third of grantees in Mexico believed that their basic salary[26] as a scientist was adequate to support themselves, and if applicable, their families. As would be expected, members of the SNI were more satisfied with their basic salaries than were non-members, but the difference was not great (36% of SNI members had an adequate salary versus 31% of non-SNI members). In terms of Research Area, Area A and Area F represented the extremes. Seven of the fifteen grantees (47%) in Area A had adequate basic salaries while the same was true for only three of thirteen grantees (23%) in Area F.

Grantees' mean basic salary as a teacher/scientist was 13.4 times greater than the minimum salary in Mexico (see Figure 5). Those who responded that their salary was adequate in question 20 had salaries ranging from 4.5 to 50 times the minimum salary, giving an average of 19.3 times the minimum. Inadequate salaries ranged from 4 to 24 times the minimum salary, and averaged 10.1 times the minimum salary. Grantees' marital status did not affect the adequacy of salaries, possibly due to the tendency for grantees to marry other professionals (see section 4.1). Furthermore, grantees' number of children (see section 4.1) was not related to grantees' response regarding the adequacy of salaries.

Grantees were asked to describe the salary scale, retirement benefits, social benefits, institutional productivity bonus programmes, career development opportunities, the SNI, and job security as an advantage or a disadvantage at their place of employment. Since most grantees work at a public research institute and/or a public university (n=100), the responses were grouped accordingly (see Figure 6). In general, grantees working at research institutes saw slightly fewer advantages than those working in public universities, the exception being institutional productivity bonus programmes, which grantees at research institutes were slightly more likely to consider an advantage than their colleagues at public universities. Overall, grantees were generally pleased by their career development opportunities, the SNI, and institutional productivity bonus programmes (see Chapter 9), and they were nearly unanimous in their approval of job security. They were more ambivalent, however, regarding salary scale and retirement

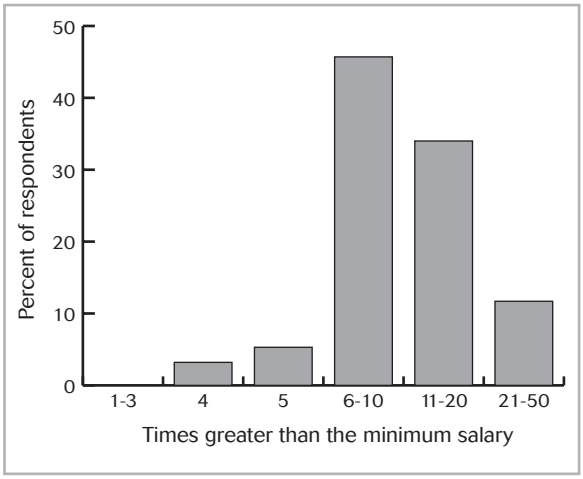


Figure 5
**Respondents' salaries compared to the minimum salary in Mexico (Q21)**

26. Although many were dissatisfied with their basic salaries as scientists, institutional and national (SNI) bonus systems significantly increase many researchers' total income to levels that are highly competitive. In fact, sometimes bonus systems provide more income than the basic salary (see chapter 2).

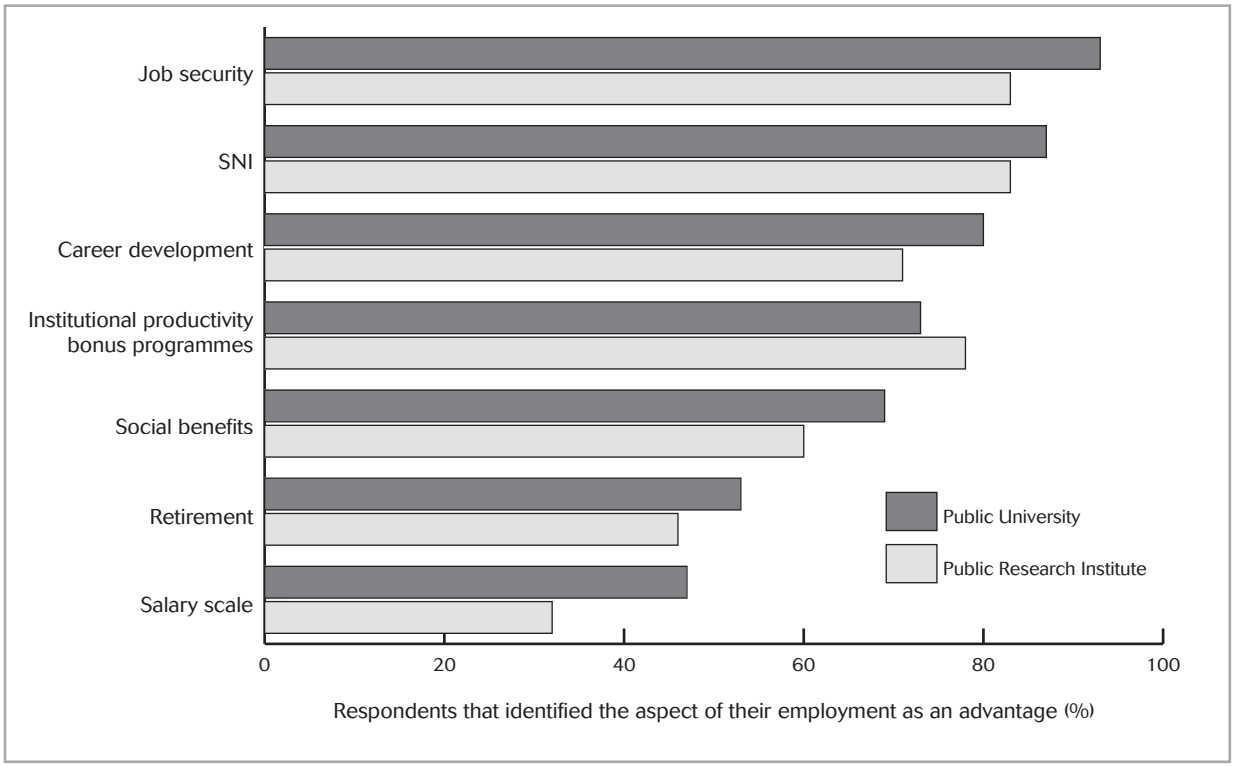


Figure 6
**Advantages' of working at universities and research institutes (Q23)**

benefits[27]. Basic salary, in fact, was seen as a disadvantage by a slight majority of those at public universities, and over two-thirds of those working at public research institutes. However, 19% of those who cited their basic scientific/teaching salary as being inadequate to support themselves (and their family) described the salary at their institution as an advantage.

Only 23 of 105 grantees reported that they had an extra job. There is no correlation between adequacy of basic scientific/teaching salary and likelihood to have an extra job, however those with inadequate salaries tended to work more hours at their extra job (9.6 hours per week in comparison to 6.9 hours per week for those who have adequate scientific/teaching salaries). Figure 7 lists the types of extra jobs that grantees reported having (not all reported, and some reported more than one). Of those with adequate salaries, half (4 of 8) were teaching, one was a journal editor, and one was a proofreader. Of those with inadequate salaries, one-third were teaching (6 of 17), while more than half were involved in a consultancy or private practice. Membership in the SNI does not appear to be related to extra employment; 9 of 36 non-SNI

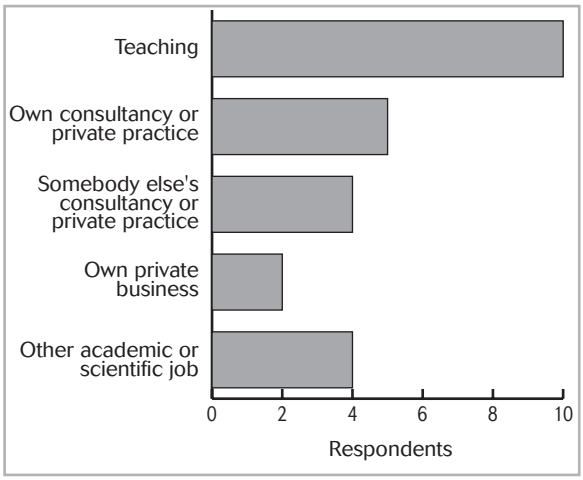


Figure 7
**Respondents' extra jobs (Q26)**

respondents (25%) reported extra jobs and 14 of 67 SNI respondents had extra jobs (21%).

## 5.2 Time allocation of work activities

Grantees were asked to estimate the percentage of their work time that was used for teaching, research, administration, extension, consultancy,

27. Retirement benefits are related to basic salary levels and exclude the "extra" benefits from productivity schemes including the SNI.

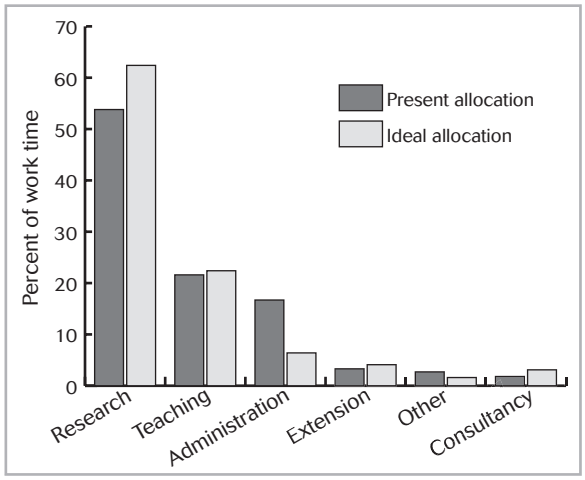


Figure 8
**Time allocation of work activities (Q17)**

and other tasks. They were also asked what the ideal distribution of their time would be. Overall, Mexican grantees' allocation of their work time is rather close to that which they describe as the ideal (see Figure 8). The main difference between their present work and their ideal allocation of work time being that they would prefer to spend about 10% more time doing research and 10% less doing administration (which currently consumes nearly 17% of their time). This corresponds with their complaint that they do not have enough time to carry out their research (see Chapter 8).

## 5.3 Access to the Internet and bibliographic databases

Most grantees in Mexico have access to the Internet (95%), and fewer, but still a large majority, have access to bibliographic databases (83%). Of the five grantees that reported not having Internet access, two were at the research institute Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias (INIFAP), and the other three were at public universities outside the capital. That one does not have access to the Internet does not necessarily mean that one does not have access to bibliographic databases. Three of the five that did not have Internet access were using bibliographic databases such as ISI and Current Contents. The highest concentration of grantees (n=6) without access to bibliographic databases was in the Yucatán. Three grantees in Mexico DF did not have access, and the remaining eight were distributed throughout other states.

## 5.4 Communication with scientists and other people

Grantees were asked to estimate how often they communicated with different groups regarding their research (see Figure 9); they could choose between never, rarely, annually, monthly, and more often. It was found that grantees communicate most often with scientists in their department, and least often with scientists in Asia. Of 104 grantees, 69 communicate with other scientists in their department more than once per month and 23 do so monthly. Only one grantee never speaks to others in his department; he most frequently communicated with NGOs, consultancy groups and extension workers. More grantees (42) responded that they speak with scientists from other institutions in Mexico monthly than any other time frame. Slightly more than half speak to funding agencies annually. Mexican scientists communicated somewhat more often with scientists in the US and Canada than they did with scientists in other Latin American countries and Europe. Communication with extension workers was at the same level as was communication with European scientists. However, the response curve was more flat for extension staff. This is partially explained by differences between the areas, Area B researchers are much more active in their communication with extension staff than are the other areas (Figure 10). The most common frequency of communication with private clients, NGOs, consultancy groups, scientists in Asia, and scientists in Africa/Australia was "never". For the latter two groups, more than half of the respondents answered "never".

It is clear from grantees' patterns of communication that, with the exception of the national context, their links to the science community in the North are much stronger than their links to the scientific community in the South. Given IFS's experience with promoting science networking and its large reservoir of grantee, adviser, and Member Organisation contacts in the South, the facilitation of South-South co-operation may be an area in which IFS can have a positive impact for Southern research communities.

## 5.5 Conference attendance

Grantees were asked to list the number of conferences that they have attended in six geographic areas, and the source of funding for their attendance, since the beginning of their careers. Table

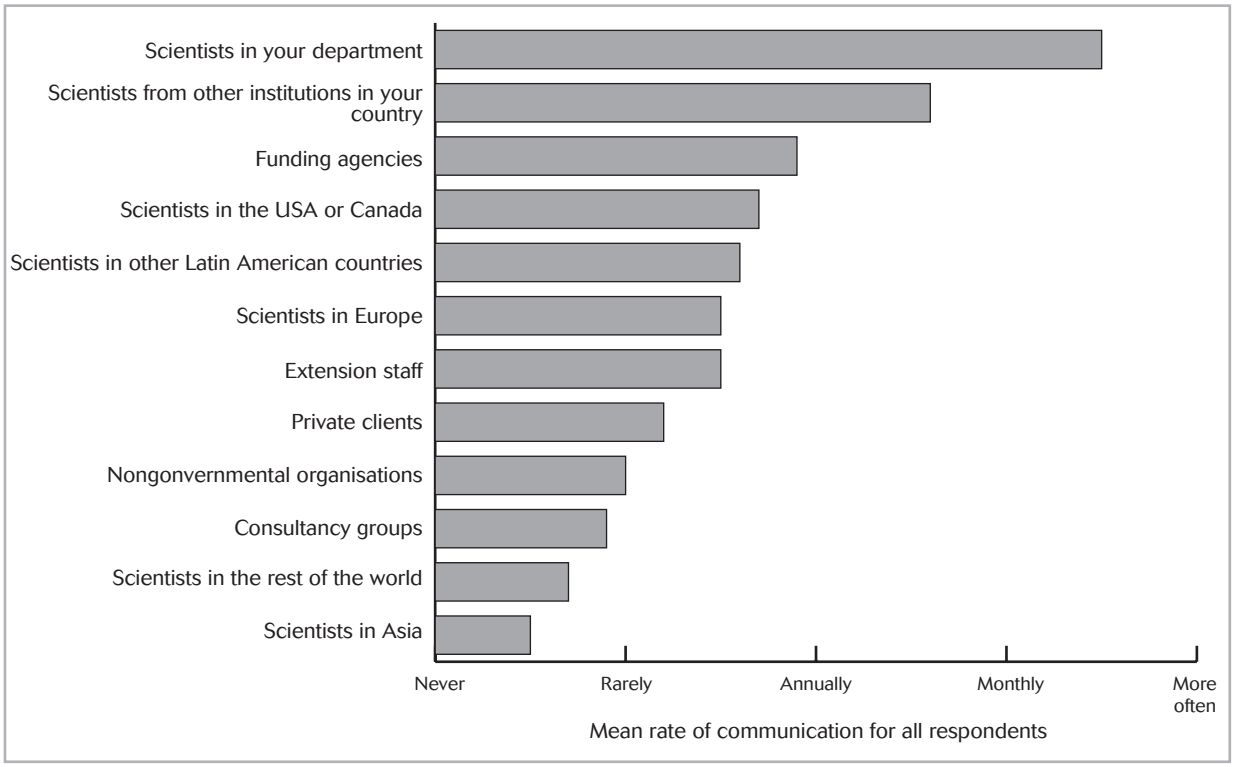


Figure 9
**Scientific and professional communication (Q33)**

17 provides the aggregate results as means. The results are similar to the results for question 33 discussed in section 5.4. By a very large margin, scientists most often went to conferences in Mexico, followed by the US and Canada, Latin America and the Caribbean, Europe, Asia, and the rest of the world, respectively. On average, grantees had gone to about 29 conferences, although there was a great deal of variation. National support was the largest source of funding for travel to conferences in all regions, but most national support was used to support attendance at conferences within Mexico. Most IFS travel grants supported attendance at conferences in other Latin American and Caribbean countries. Meanwhile, other foreign funding most often sponsored travel to conferences in the US and Canada. The average grantee had attended 23 conferences with national support, one with IFS support, three with other foreign support, and two using personal funds.

Given that IFS support for travel to conferences is relatively minor in comparison to Mexican and other foreign funding agency support, IFS must consider the most effective way of using its limited resources. Among the responding grantees, IFS travel grants supported only 7.9% of their attendance at conferences outside of Mexico. The majority of those conferences were in Latin America and the Caribbean. However, Mexican funding supported four times as many conference visits in the region, and other foreign funding agencies supported twice as many as IFS did. If IFS wanted to have a greater impact on South-South communication and collaboration, IFS could consider providing preferential support to grantees wishing to attend conferences in developing countries outside

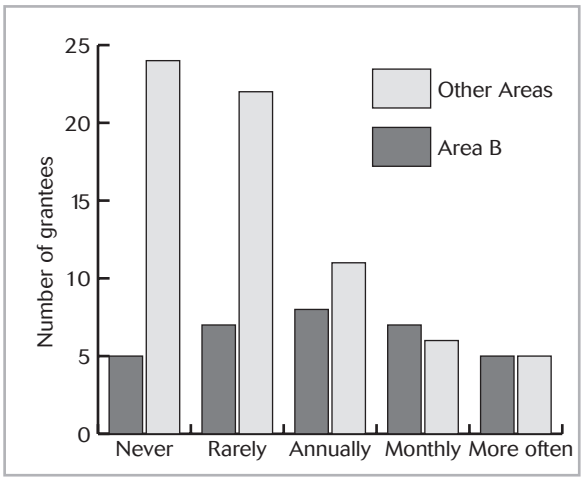


Figure 10
**Communication with extension staff: Area B vs Other Areas (Q33)**

| Conferences | With national support | With IFS support | With foreign support | Self-supported | Total of means |
|---|---|---|---|---|---|
| In Mexico | 17.46 | 0.18 | 0.19 | 1.82 | 19.66 |
| In the USA and Canada | 2.55 | 0.15 | 1.14 | 0.17 | 4.01 |
| In Latin American and the Caribbean | 1.66 | 0.40 | 0.80 | 0.13 | 2.99 |
| In Europe | 1.30 | 0.14 | 0.60 | 0.06 | 2.10 |
| In Asia | 0.19 | 0.06 | 0.17 | 0.00 | 0.42 |
| In the rest of the World | 0.07 | 0.01 | 0.10 | 0.00 | 0.18 |
| **Total of means** | **23.23** | **0.95** | **3.00** | **2.18** | **29.36** |

Note: 99 Grantees responded to this question

Table 17
**Mean number of conferences attended by region and by source of funding (Q37)**

of the region; ie in Africa and Asia. A shift towards support for such South-South travel would generate a significant increase in intercontinental communication among developing country scientists.

Variation was great when grantees were asked how many conferences they had attended during the last five years (see Table 18). Up to 18 had not gone to a conference, and 55 had gone to less than one per year. Meanwhile, six especially busy grantees had gone to fifteen or more conferences, one of which had gone to 50 (Area D). The mean number of conferences attended during the past five years was 4.9. Grantees from Area E went to the most conferences, while grantees in research Area B went to the fewest (Figure 11). Notice the difference in Area D when the one grantee that went to 50 conferences is excluded.

| Number of conferences attended | Number of Grantees |
|---|---|
| 0* | 18 |
| 1-5 | 65 |
| 6-10 | 12 |
| 11-15 | 6 |
| 16-20 | 2 |
| 21-30 | 0 |
| 31-40 | 1 |
| 41-50 | 1 |
| **Mean** | **4.9** |

* Eighteen grantees did not respond to this question, this was interpretted as a 0. Hence, the actual mean could be slightly higher than the one provided above.

Table 18
**Number of conferences attended outside Grantees' own country during the last five years (Q38)**

## 5.6 Research funding

The mean grantee research budgets for 1999, based on a range from USD 0 to USD 200,000 (Figure 12), was USD 22,300. Grantees at public universities had slightly more research funding (mean = USD 21,500) than those at research institutes (mean = USD 19,000). Meanwhile, SNI membership proved to be an indicator of research funding. While candidates had only slightly more fund-

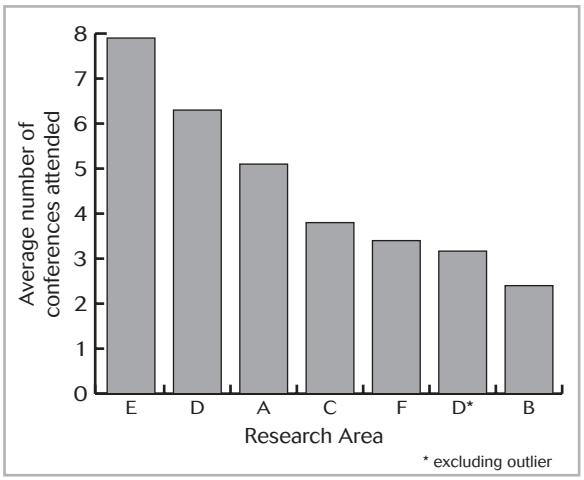


Figure 11
**Respondents' mean number of conferences attended during the last five years by Research Area (Q38)**

ing than non-members, the mean funding available to grantees rose noticeably as grantees attained higher ranks in the SNI (Figure 13). Noticeable differences in funding were also found between the research areas (Figure 14). Area E and Area A proved to be the most resource rich areas, and Area D lagged far behind with an average of just USD 12,600.

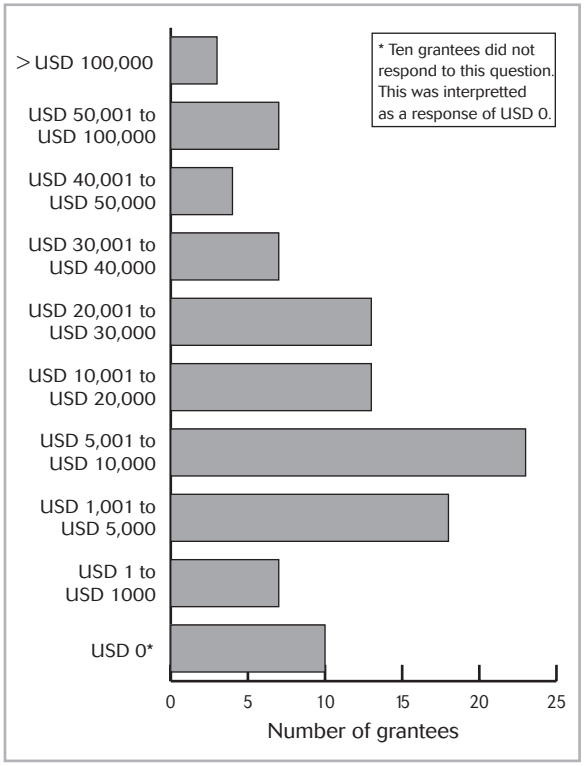


Figure 12
**Research budgets for 1999 (Q46)**

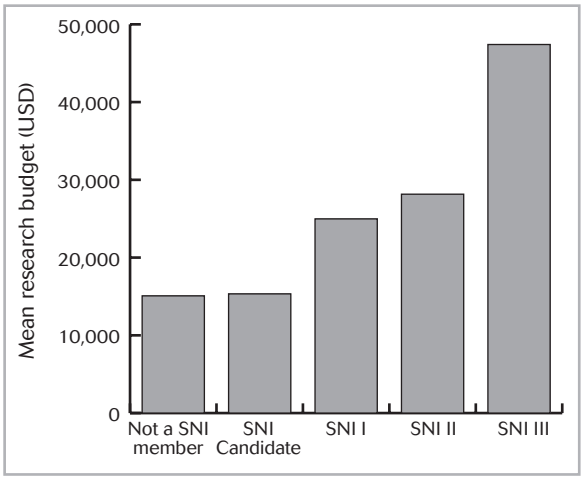


Figure 13
**Research budgets sorted by SNI status (Q46)**

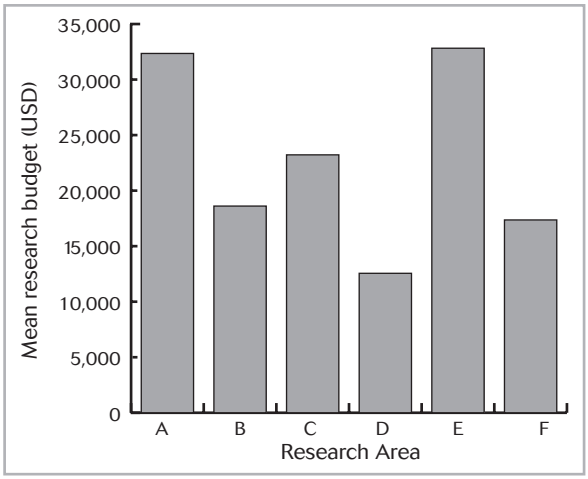


Figure 14
**Research budgets sorted by Research Area (Q46)**

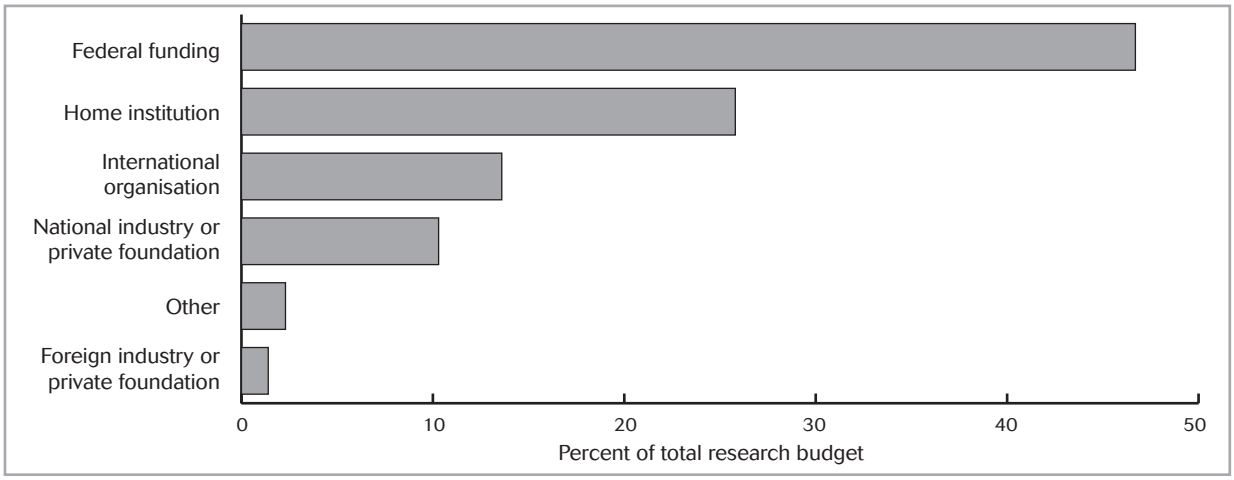


Figure 15
**Sources of research funding (Q47)**

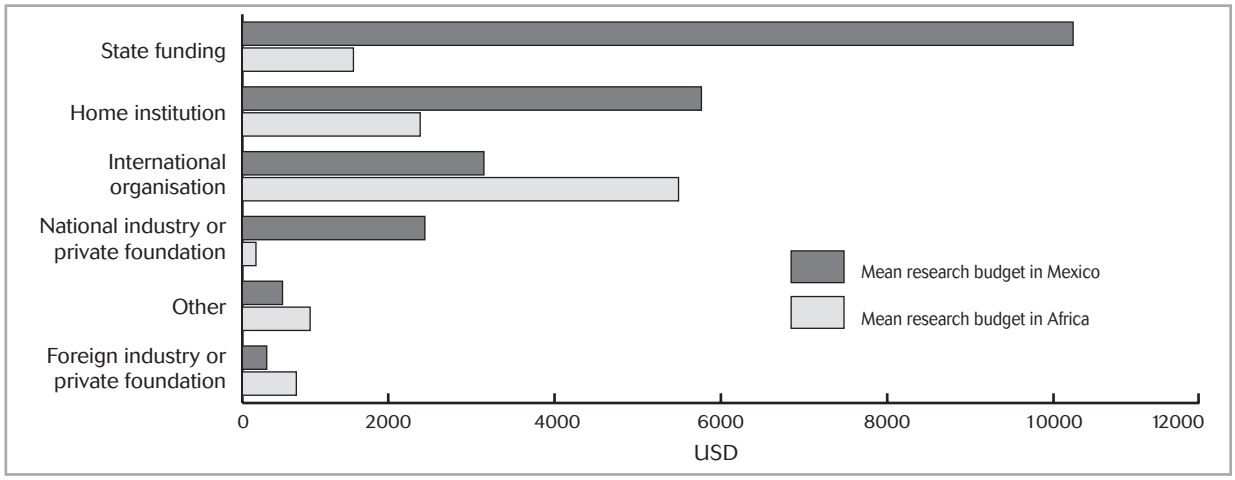


Figure 16
**Comparing mean research budgets in Africa and Mexico (Q46 and Q47)**

Grantees were also asked to explain from where their research funding originated (see Figure 15). The Mexican government is the primary source of funding for research, providing nearly 47% of all grantees' funding. Grantees' home institution (generally state funding as well) provided another 26% of the research budget. International organisations provided less funding to grantees, accounting for only 14% of their budgets. Nevertheless, the interviews with grantees document several cases where international support played a large role for individual scientists (See Box 7 for an example). Industries, private foundations, and other sources accounted for the remainder.

The funding environment in Mexico is very different from the one in which IFS grantees in Africa find themselves (Figure 16). There, the average research budget is less than half that of Mexican grantees, and the primary sources of funding are international organisations (Gaillard and Furó Tullberg 2001).

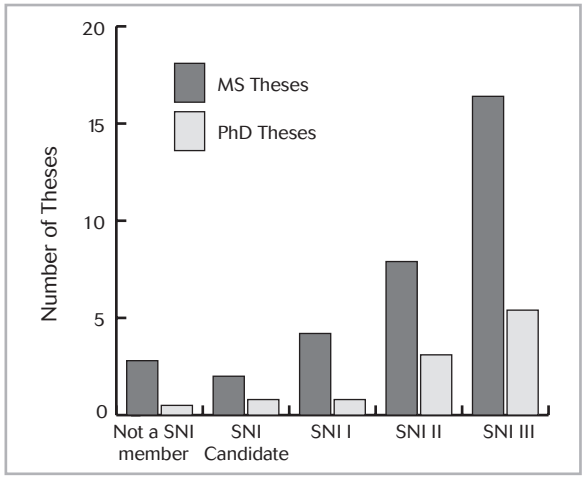


Figure 17
**Theses supervision and SNI membership (Q18)**

## 5.7 Supervision of postgraduate theses

One indicator of maturation as a scientist is the number of Masters and PhD theses that a scientist has supervised. The average IFS grantee has supervised 4.7 Masters theses and 1.3 PhD theses with a distribution from 0 to 28 and 0 to 11, respectively. Grantees at public research institutes supervised an average of 3.3 Master theses and 1.3 PhD theses. Meanwhile colleagues at public universities supervised 5.4 Masters theses and 1.1 PhD theses. Supervision of theses was much more likely if one was an advanced member of the SNI (Figure 17).

Most grantees (79%) regularly teach postgraduate level courses. This trend is slightly stronger at public universities than at research institutes (80% vs 76%). However, the striking difference with respect to teaching is found between SNI members and non-members. Out of 54 current members of levels I, II, and III, 51 answered that they regularly teach postgraduate level classes. Of the 37 non-SNI members, 23 teach postgraduate classes.

## 5.8 Conclusions

The results in this chapter reveal that the financial role of IFS grants may be less important in Mexico than it is in other parts of the world. For example, national funding supports Mexican research com-

munities to a much greater extent than is the case in Africa (see Gaillard and Furó Tullberg, 2000). International funding for research and conferences is small compared to the amount made available by the Mexican government. In chapter 3 it was described that Mexican grantees apply for renewal grants less often than do grantees from other countries. This could be partially explained by the higher levels of funding that are available in Mexico.

Mexican researchers are well connected via conferences to the national and the Northern scientific community. However, a more effective allocation of IFS resources in Mexico might be achieved by allocating travel grants to grantees who intend to participate in conferences in the South, especially those in developing countries in other regions. Most grantees also have access to the Internet and bibliographic databases, so IFS's efforts to develop such resources are better directed towards less resource rich countries.

Box 7
**Dr Armando Shimada Miyasaka**

In 1977 Dr Armando Shimada Miyasaka became one of the first IFS grantees in Mexico. At the time, Dr Shimada Miyasaka worked for the Mexican government's institute of forestry, agriculture and animal research (INIFAP) in Mexico City. In 1985, he was appointed Director of the INIFAP's Centro Nacional de Investigación en Fisiología y Mejoramiento Animal (National Centre for Research in Animal Physiology and Breeding) in Ajuchitlán. Later, in 1995, Dr Shimada Miyasaka took on a full-time appointment as a professor at the Facultad de Estudios Superiores-Cuautitlán (FES-Cuautitlán); this faculty belongs to the Universidad Nacional Autónoma de México (UNAM).

Dr Shimada Miyasaka is one of his country's most successful researchers in veterinary and animal science. At 59, he has more than 100 papers in three national and 14 international journals to his credit. Many of his works are published in the INIFAP's primary journal, Técnica Pecuaria en México, as this is institutional policy (being a public institution, research results are considered government property). Furthermore, he was the first of the few scientists in this field to have attained the highest level in the SNI, level III. Dr Shimada Miyasaka has also reached the highest level in the lecturer's scale at the UNAM.

In addition to his success as a publishing scientist, Dr Shimada Miyasaka has been extremely successful in finding both national and international funding for his work. At the international level, he has been funded by IFS, IDRC (in association with CONACYT) in Canada, IAEA in Vienna, the NSF in the USA, and the FAO in Rome. At the national level, he has found support from CONACYT and UNAM.

Dr Shimada Miyasaka mentions three turning points in his scientific career. Firstly, access to international groups through international funding such as IFS. Secondly, his designation as level III in the SNI in 1990 and his incorporation the following year as a member of the SNI's review committee. Thirdly, his appointment to full professor at the UNAM and the fact that he enjoys more academic freedom than ever.

# 6. Publication output of Mexican grantees

Ultimately, scientific research, to be of value, must be available. This is essential for research scientists, both individually and as a community, and for users. The most common way of making research public is through publication. Publishing is at the heart of the science. In addition, it can be used as a measure of productivity and an important criterion for promotion in many countries. Publication in international journals is considered the most important criterion for promotion of scientists in Mexico, as demonstrated from the questionnaire survey (see Figure 35 in section 7.6).

A bibliometric study was carried out using the publication lists of the IFS grantees in Mexico in order to estimate the nature and volume of grantees' scientific output in Mexico, and the impact of IFS support. All grantees in Mexico were asked to send a list of their publications to IFS or CONACYT. These publication lists are the basis for the bibliometric study presented in this chapter.

Even though the scientists in this study were not chosen to represent the scientific community in Mexico, this is the first detailed analysis of the total scientific output of a large group of scientists in Mexico. We anticipate that the results will prove to be a valuable source of comparisons for similar studies conducted in the future.

We will attempt to establish whether IFS support had a positive effect upon publication levels in general, publication in English, and in mainstream scientific journals (see Box 8 on the following page for a definition of this term, and others used in this chapter). We will also look at possible differences between current grantees and former grantees, SNI (Sistema Nacional de Investigadores) members and non-members, and IFS research areas. Furthermore, we will consider possible differences in the effect of IFS grants on grantees who were based at the UNAM (the oldest and largest university located in the capital city), and those working at the UADY (a major regional university). By looking at these and other variables, we attempt to understand how the IFS grant influences the careers of grantees in Mexico.

## 6.1 Local science and international mainstream science

A distinction is often made between local science and mainstream science. Local science is scientific research that is often important within the context of a country or region, and consequently does not have great international visibility. Local science has implications for the solution of local problems. As a result, research findings are often made available through local journals and published in the language of the countries concerned. International, or mainstream, science has high visibility, and, because the findings are relevant for researchers across geographic boundaries, results are published mainly in international journals. The most common language for publication of international science is English. In developing countries, there is generally greater prestige associated with carrying out international science than there is with local science.

A universally used measure of a scientist's performance is the quantity of their publications that are indexed in international scientific publication databases. In particular, evaluators use the databases produced by the Institute for Scientific Information (ISI) in the United States (see chapter 2). The ISI databases of scientific publications cover some 5,700 journals from diverse fields of natural science, including approximately 3,500 contained in the Science Citation Index (SCI). Nevertheless, ISI is highly selective and screens only the world's most prestigious scientific journals (ie the ones whose articles are most frequently cited). Its SCI focuses on what has become known as "mainstream science," the most internationally visible science carried in the most highly cited journals, most of which are published in the North. For the year

2001, Mexico is represented in the SCI by only 4 journals, Argentina by 4 and all of Latin America by 12. Numerous studies indicate that in any given country-specific field, a large portion of the research produced by developing country scientists is published in local journals (Russell and Galina, 1987; Chatelin and Arvanitis, 1989).

The question of adequately representing science produced in the developing world in international databases was the main consideration at a 1985 conference organised at ISI in Philadelphia. The final conference report, "Strengthening the coverage of Third World Science", pointed to a large gap by stating that "the workshop participants estimated that about only half of the scientific output of the third world which meets international standards of excellence is included in the SCI" (Moravcsik, 1985, p3). Although developing country scientists, and Mexican scientists in particular (SEP-CONACYT 2000) tend to publish more papers in mainstream journals today than in previous years, a large part of their scientific production remains locally published and of low visibility (Gaillard 1989; Cetto 1998).

Box 8
**Definitions**

***Total publications:*** All publications regardless of type listed in the 105 publication lists collected by IFS and CONACYT

***IFS supported publication:*** All publications in grantees' publication list that were the direct or indirect result of their IFS supported research, as indicated by the grantees themselves.

***Non-IFS supported publication:*** Publications cited in grantees' publication lists that were not the direct or indirect result of IFS supported research.

***Mainstream publication:*** For the present study mainstream publication refers to research results that were published as an article in any of the journals indexed in any one of the ISI databases.

***Current grantees:*** Researchers that have received one or more IFS grants and who are still believed to be pursuing their IFS research. Their file is open at the IFS Secretariat.

***Former grantees:*** Researchers who have received one or more IFS grants and who are no longer actively supported by IFS funding. Their file is closed at the IFS Secretariat.

## 6.2 Methods

In March 2000, questionnaires and requests for publications lists were sent to all 138 present and former IFS grantees who are working, or were working in Mexico. When grantees responded to the questionnaire, but neglected to submit a publication list, they were contacted again and encouraged to submit their list. Grantees who sent incomplete lists were also encouraged to submit a complete list. Additional lists were also collected during interviews of grantees.

Most bibliometric studies conducted on Mexican science have thus far been based on publication output in mainstream science (Delgado and Russell, 1992; Russell 1995; Arvanitis, Russell and Rosas, 1996). However, because we wanted to measure the total publication output of grantees in Mexico, we did not limit this bibliometric study to only those publication found in the ISI databases. Instead we consider all scientific work produced by grantees in Mexico using their complete publication lists.

The complete bibliographical information (title, date, pages, publisher, etc.) of each reference in the publication lists was recorded in a database. Entries were classified by publication type: journal article (AI), full paper in conference/seminar proceedings (CP), book chapter (CH), grantee authored or edited book (BK), abstract (AB), report (RE), and other research publications and communications (PS). PS is a broad category that includes material such as: posters, theses, bulletins, booklets, monographs, movies, manuals, patents, maps, technical documents, and papers presented at seminars or conferences.

In addition to the bibliographic information for each publication, a great deal of other information was coded for analysis. Publications by IFS grantees could be sorted by the following variables: grant number, research area of grantee, number of authors, language of publication, grantee as first author, host institution of grantee, national or foreign highest degree of grantee, past or present grantee, number of grants awarded, year of first IFS grant, year that IFS support was terminated, and IFS-supported publication. Where possible, information from the publication lists was cross-referenced with data from the questionnaire survey that was sent by IFS and CONACYT to all grantees in Mexico. However, not all grantees that submitted a

publication list, also submitted a questionnaire, or vice versa.

The collected information was fed into an Excel spreadsheet consisting of over 150,000 cells and manipulated using simple statistical processes. Values for statistical significance of the results presented below were not calculated; hence the observations made in the following pages should be treated as trends to be confirmed by further studies.

## 6.3 Response rates

Of the 138 grantees, 105 participated in the survey by providing publication lists. Current grantees were more likely to participate than former grantees. Nearly 87% of current grantees participated (60 out of 69), while 64% of former grantees submitted publication lists (45 of 69). Although the overall rate of participation in the bibliometric study is very satisfactory (76%), it is not known if those grantees that did not respond are individuals who have published less often or not at all.

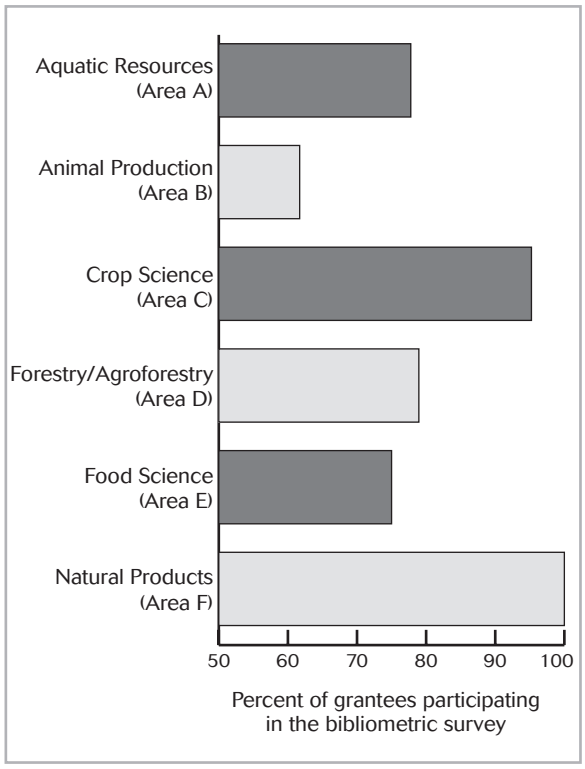


Figure 18
**Grantee participation in the bibliometric study by Research Area**

There was variation in participation rates when grantees were sorted by IFS Research Area (Figure 18). In general response rates were greater than 75%. However, the largest IFS Research Area in Mexico, animal production (Area B), had a lower response rate (63%, or 29 of 46 grantees).

The response rate among Area B grantees to the questionnaire survey was 70%, somewhat higher than the response to the request for publication lists. It is contrary to expectations that the response rate for the questionnaire survey is higher than the response rate for the publication lists. One would expect that completing the IFS questionnaire is a much more time intensive activity than providing a publication list that, for many Mexican scientists today, is readily available. This is particularly true for the productive scientists who are members of the SNI. This raises the question, why did five Area B grantees, who were not SNI members, fill in questionnaires but not provide publication lists[28]? It is possible that they have not published (or published little), and therefore do not have publication lists. If this is the case, one should treat the publication statistics provided for Area B scientists in this report as an upper limit of the true output of scientists in this research area. However, definitive conclusions cannot be drawn until non-respondents are contacted (see below for further discussion of Area B grantees).

The greatest numbers of publication lists were received from two universities, the UNAM with 18 and the UADY with 17, and one research centre, IPN - CINVESTAV, with 12. The institutional affiliation and SNI membership status of the respondents are contained in Table A5 in the appendix. Present SNI members represented 70.5% of the respondents compared to 61.6% in the overall population of Mexican grantees.

## 6.4 Publication output

The 105 publications lists contained a total of 4,234 publications, of which 441 (10.4%) were identified as IFS publications[29] (Table A5). The average number of total publications and IFS publications per grantee for the years before and after the first grant are provided in Figure 19. Figure 20 shows the break-down of all publications by type.

28. With the exception of Area A (15 questionnaires, 14 publication lists) the other areas provided equal or greater numbers of publication lists than questionnaires.

29. It should be noted that many of the more recent grantees reported IFS supported studies in press or submitted for publication. These, however, were not taken into consideration in the analysis.

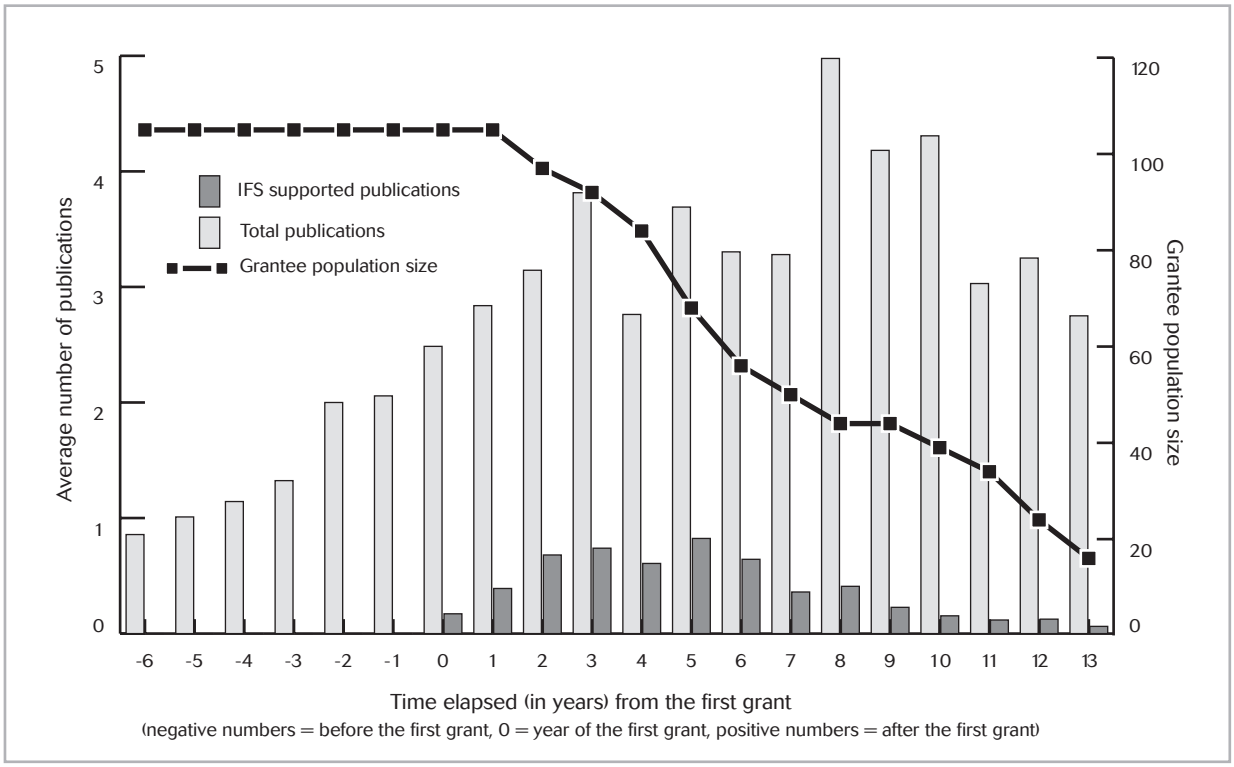


Figure 19
**Average publication output in relation to the first grant**

### *6.4.1 Journal article productivity*

After segregating the publications by type (see Figure 20), the publication lists contained 2,049 journal articles (47.9% of all publications) published in 619 different journals. A total of 112 journals (18.1%) had five or more articles by IFS grantees, while 316 titles (52.1%) had only one. At the former extreme, two Mexican journals, Técnica Pecuaria en México and Veterinaria-México had 109 and 90 articles by grantees, respectively. Table 19 below provides the list of scientific journals in which IFS grantees in Mexico have published ten or more articles (For a list of journals with more than five articles, see Table A6 in the appendix).

Among the 17 journals in which grantees publish most, national or Latin American journals dominate. The international mainstream journal with the most articles by IFS grantees in Mexico was Aquaculture, with 20 articles. However, eight local journals had more articles by IFS grantees than did Aquaculture. This is an indication of the importance of local journals in the publication strategy of the IFS grantees in Mexico. Local journals are used to publish research results despite the fact that they are considered to be one of the least important criteria for promoting scientists in Mexico (see Figure 37 in chapter 7).

The results from grantees' IFS supported research are more often published as journal articles than are the results from grantees' other research. Over 52% of grantees' IFS supported publications appeared as journal articles in contrast to 47.9% of their other publications (Figure 20). Among former grantees, articles in journals accounted for 54.8% of IFS supported publications, and only 44.1% of their other publications.

Language, visibility and impact are among the many factors that can influence a researcher's choice of journal in which to publish research results. As mentioned earlier, publications in international mainstream journals are an advantage for Mexican scientists when seeking professional advancement (see Figure 37 in chapter 7). However, the acceptance of an article for publication in an international mainstream journal is not dependent only on scientific quality[30]. Mainstream journals are generally not interested in publishing articles that do not have broad geographical and/or disciplinary relevance, and they most often publish articles in English (see below). Furthermore, when results are relevant to a limited audience, researchers may choose a non-mainstream journal that is especially accessible and targeted at the intended audience. Hence, findings regarding propagation of a local crop in Mexico, for example, are more likely to be published in ***Agricultura Técnica en México*** than in

30. For a detailed discussion on this issue see Arvanitis and Gaillard (1992).

| Journal Title | No. of articles |
|---|---|
| Técnica Pecuaria en México | 109 |
| Veterinaria México | 90 |
| Revista Latinoamericana de Microbiología | 28 |
| Revista Mexicana de Fitopatología | 28 |
| Micología Neotropical Aplicada | 26 |
| Agrociencia | 25 |
| Biotecnología | 24 |
| Revista Biomédica de Yucatán | 22 |
| Revista de la Facultad de Química (UADY) | 21 |
| Aquaculture | 20 |
| Proceedings Gulf | 20 |
| Revista Mexicana de Micología | 19 |
| Theriogenology | 17 |
| Biochimica et Biophysica Acta | 16 |
| Biotechnology Letters | 16 |
| Fitopatología | 16 |
| Tecnología de Alimentos | 16 |
| Avances en Ingeniería Química | 15 |
| Ciencia y Desarrollo (CONACYT) | 15 |
| Ciencia (Academia de la Investigación Científica) | 15 |
| Applied Animal Behaviour | 14 |
| Hydrobiología | 14 |
| Turrialba | 14 |
| Water Science and Technology | 14 |
| Journal of Shellfish Research | 13 |
| Agricultura Técnica en México | 12 |
| Applied and Environmental Microbiology | 12 |
| Avance y Perspectiva | 12 |
| Terra | 12 |
| American Oil Chemists' Society Journal | 11 |
| Biotechnology Techniques | 11 |
| Boletín de Educación Bioquímica | 11 |
| Comparative Biochemistry & Physiology | 11 |
| Environmental Technology | 11 |
| Journal of Animal Science | 11 |
| Process Biochemistry | 11 |
| World Journal of Microbiology & Biotechnology | 11 |
| Florida Entomologist | 10 |
| Journal of Bacteriology | 10 |
| Journal of Dairy Science | 10 |
| Plant Physiology | 10 |

Table 19

**Journals in which IFS grantees in Mexico have published ten or more articles**

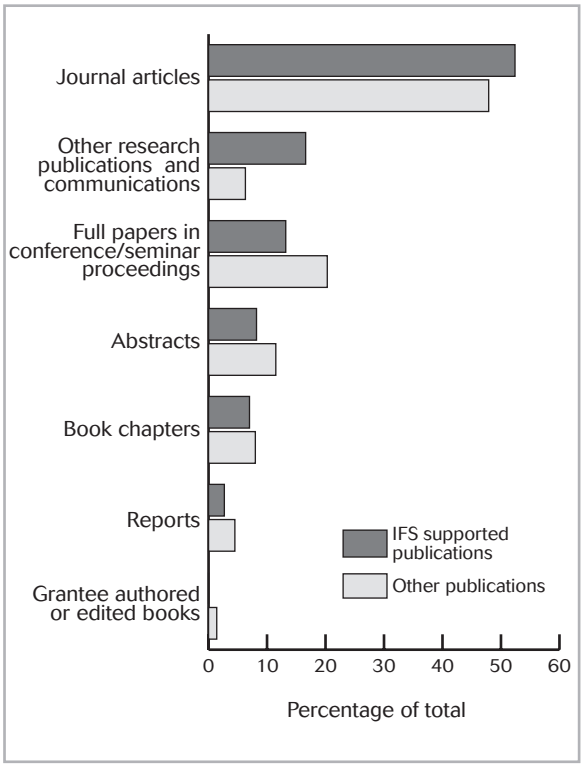


Figure 20

**IFS supported publications and other publications by type**

***Tropical Agriculture***, even if ***Tropical Agriculture*** is more prestigious.

IFS is concerned with how its support affects researchers' choice of journal. Do IFS networking activities broaden the relevance of research? Does the IFS requirement that correspondence and reports be submitted in English or French improve the likelihood that grantees (in the case of Mexico) publish their research findings in English via mainstream journals? Clues can be found in the results presented in the following pages.

Of the 619 journals found in the publication lists, about half (292) appear in the ISI master list of journals[31]. Journals indexed in the information services provided by ISI such as Science Citation Index and Current Contents, are considered to represent the mainstream of international scientific publication. The Master List of journals referred to in the present study, used to check whether titles were mainstream or non-mainstream, includes all journals included in all ISI products. Of the 292 mainstream journals used by grantees in Mexico, 53% (154) are European titles, 37% (108) are edited in the US, and only 3% (8) are Latin American. The language of publication of 93% (272) of these journals is English, 4 titles are published

31. http://www.isinet.com

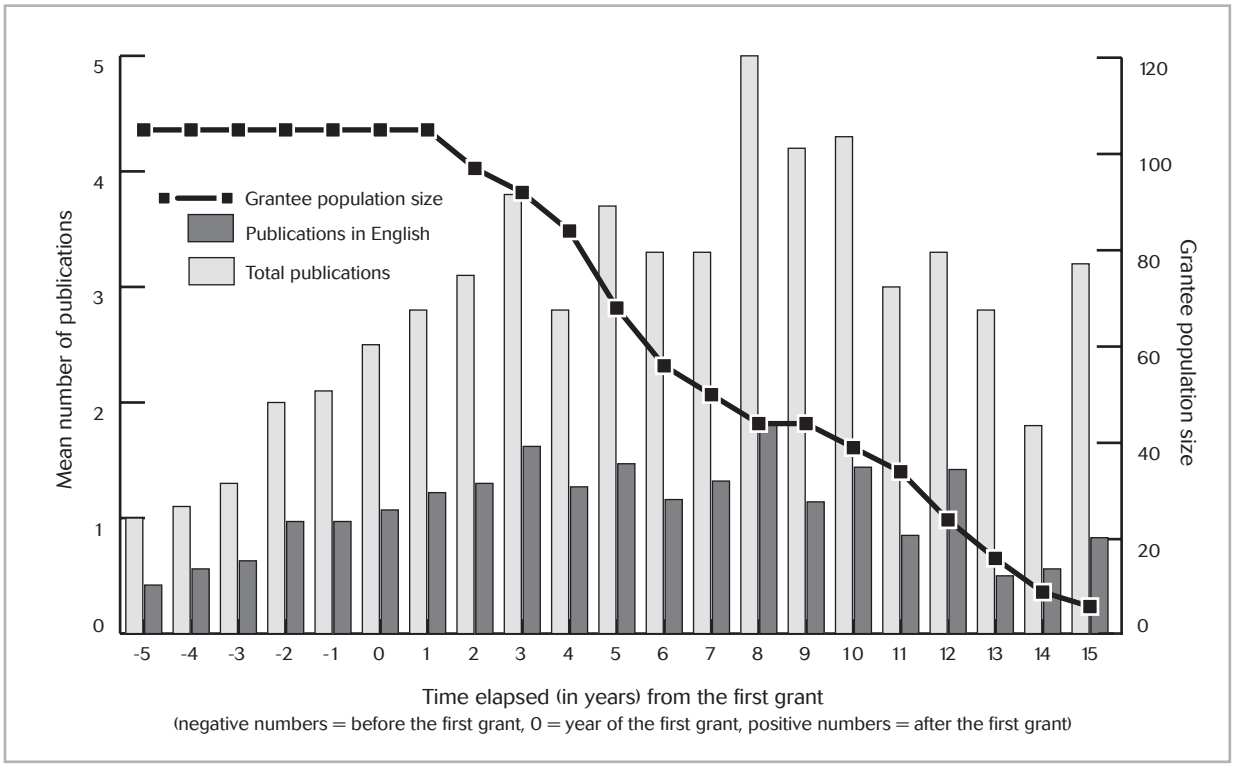


Figure 21
**Publication language: a time analysis**

in Spanish, and 3 in French. Bilingual publication was found in another 7 titles (3 English/Spanish, 3 English/German and 1 English/French) and trilingual (English/French/German) in 6 instances.

IFS plays a significant role in supporting grantees' production of articles in mainstream scientific journals. Of 2,049 journal articles in the grantees' publication lists, 887 were published in mainstream journals. Over 15% of these articles were the result of IFS supported research. Furthermore, while less than half (41%) of non-IFS supported articles appeared in mainstream journals, 59% of IFS supported articles were published in these prestigious journals.

Of all the mainstream international journals, the British journal ***Aquaculture*** published the greatest number of articles by IFS grantees (n=20), while the US publication ***Journal of Shellfish Research*** had the greatest number of IFS-supported articles (n=9), followed by the US journal ***Comparative Biochemistry and Physiology*** (n=5). Four IFS-supported articles were published in the US journal ***Applied and Environmental Microbiology***, and the British title ***Aquaculture Research***.

### *6.4.2 Language of publication*

IFS requires that grant applications, progress reports, and final reports be submitted in English or French, and most grantees in Mexico choose to communicate with the Secretariat in English. Does the fact that grantees in Mexico communicate with the IFS Secretariat in English have an effect on their choice of language when they publish the results from IFS supported research? If this is the case, one would expect to find that IFS supported publications are more often published in English than are grantees' non-IFS publications.

A time analysis of all grantees' publications (Figure 21) shows that publication in English begins to increase prior to the first grant, and reaches a peak around the third year after the grant was awarded. Notwithstanding, Spanish was the grantees' most frequent language of publication (58.8% of all documents), followed by English (39.9%) and French (1.2%). Documents in other languages included 2 in German, and 1 each in Italian and Portuguese (see Figure 22).

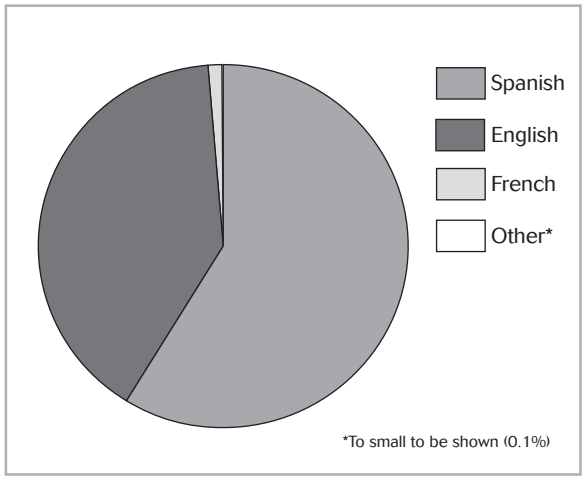


Figure 22
**Language of all publications**

Several factors explain why Spanish is the most frequent language of publication. One obvious reason is that it is easier for Mexican grantees to write in their mother tongue. Writing in English is, for many of them, a very difficult, or even impossible task without the help of colleagues[32]. Furthermore, it is felt, especially by the youngest scientists, that referees from local journals are more understanding or easier to deal with than those from mainstream journals[33]. Also, by publishing in Spanish in local journals, scientists in Mexico, especially those in applied fields, are more likely to reach potential local users (starting with their own students) while, at the same time, strengthening the quality and sustainability of local journals.

Nevertheless, the IFS grant does seem to have an effect on language choice. Unlike grantees' other publications, IFS-supported publications are more often published in English than in Spanish. Of the 441 IFS-supported publications, 56% were published in English. The trend is even more striking among articles, 74.9% of IFS supported articles are published in English, while the corresponding number for non-IFS supported articles is only 47.7%. Moreover, the 45 former grantees published a smaller percentage of their IFS supported articles in English (66%) than did current grantees. This may indicate that English is increasingly a preferred language of publication among the younger generation of Mexican scientists.

Since IFS supported research is more likely to result in internationally accessible and recognized publications, one may expect that IFS support improves grantee visibility and provides better chances for advancement within promotional systems that reward scientists for mainstream publications. Nevertheless, IFS support has not encouraged young scientists to abandon their career as *Mexican* scientists for a career in the North, as demonstrated in chapter 7 (see section 7.9). Grantees generally believe that science should support their country's development (see chapter 9), and this is also in part reflected by their continued publication of a majority of their work in Spanish.

### *6.4.3 Format*

The rapid development of new electronic means for distributing information, such as electronic journals, was not reflected in grantees' publication lists. Only 19 publications were reported in electronic format, 10 of which were Other Research Publications (PS) and 9 were Abstracts (AB). No publication in electronic journals was reported.

### *6.4.4 Co-authorship and patterns of collaboration*

IFS provides incentives in the form of research grants to individual scientists while recognising that scientists generally achieve their best results through collaboration. Grantees' patterns of collaboration suggest that the individual nature of the IFS grant does not hinder scientists from working in teams.

Regardless of whether their research was supported by IFS or another organisation, researchers' publications were equally likely to be produced in collaboration with other scientists. Rates of collaboration were identical (84%) for the two sets of documents: all publications, and IFS-supported.

For both total publications and only IFS supported publications, it was most common to publish as a team of between two and four scientists (see Figure 23). These data indicate that IFS support does not

32. The capacity to express oneself in English varies a lot between advanced research institutions in and around Mexico City and universities in the more remote states. For example, many interviews in the states could not be conducted in English, and most questions at an information seminar given in English at the UADY in Yucatán during 2001 were asked in Spanish.

33. A senior scientist from the UNAM, also claimed that "prestige does not play a major role in the choice of publication until you are really established and ready to battle the referees in established journals that most of the time don't care a damn about work in developing countries or don't understand the problem at all".

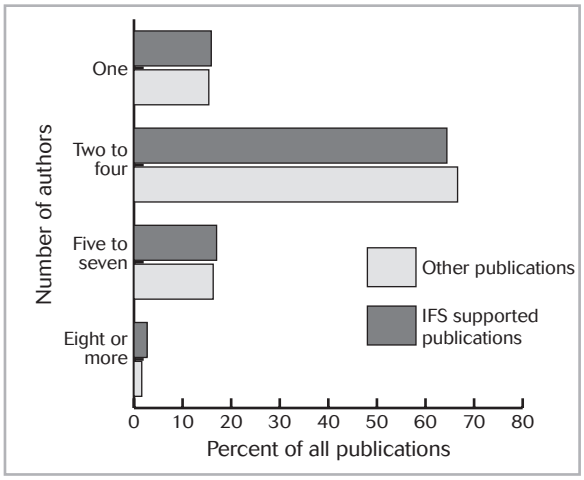


Figure 23
**Coauthorship patterns**

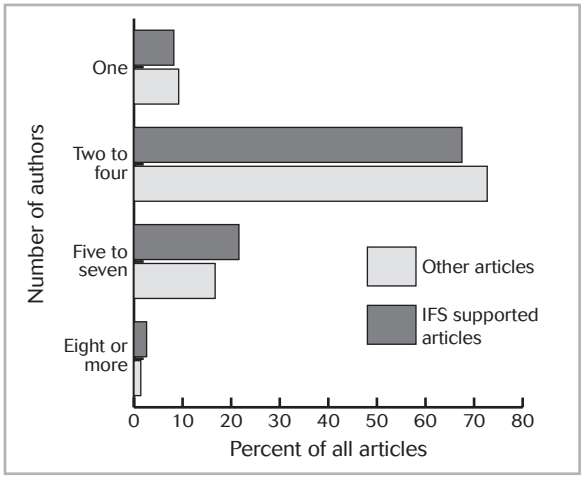


Figure 24
**Coauthorship of journals**

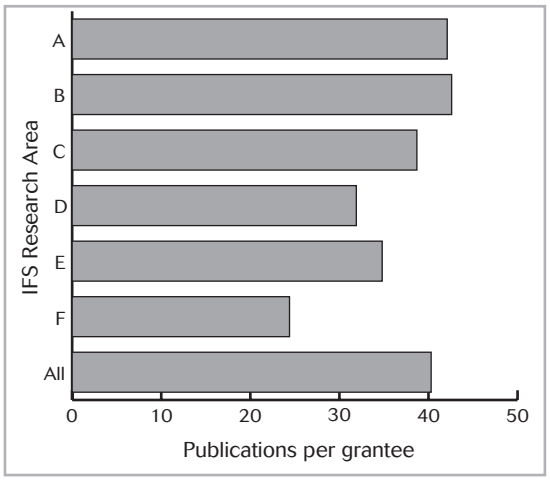


Figure 25
**Total publication by research area**

alter the trend toward working in small research teams (2 - 4 individuals).

The same trend is more strongly illustrated by co-authorship patterns of journal articles (Figure 24). In this instance, the percentage of grantees working in small research teams is slightly greater for all articles than for IFS supported articles (73% for non-IFS articles, 68% for IFS-supported articles).

### *6.4.5 Author position*

The frequency with which grantees were the first author of a publication was slightly greater when the publication was the direct or indirect result of IFS support. In 48% of all non-IFS publications the grantee appeared as first author, whereas among IFS-supported publications the percentage increased to 54%. In the case of total article production, the grantee was first author in 45% of both non-IFS articles and IFS-supported articles. This suggests that the author position of the IFS grantee is unaffected by IFS funding.

### *6.4.6 IFS Research Areas*

These data suggest that there are important differences in publication productivity between scientists from the different research areas (see Figure 25 and Figure 26). For example, Area B researchers had the greatest mean number of IFS supported publications (5.3), but they had the fewest number of IFS-supported articles (1.5). Meanwhile, Area A researchers had a similar number of publications (5.2), but two and a half times the number of articles (3.8) of Area B researchers. The overall mean for all areas was 4.2 IFS publications and 2.2 IFS articles.

As shown in the preceding paragraph and in the previous pages, Area B researchers' output is consistently different from that of other IFS Research Areas in Mexico. For instance, they use journal articles as outlets for their research results much less frequently than other researchers. Nevertheless, when one considers all publication types, animal production grantees are among the most productive (see Figure 26). Rather than publish less, they more often publish abstracts or items that were defined as "other" in this study (see Figure 27). It may be of relevance that during interviews at the UADY in Mérida, Area B grantees indicated that the main mandate of their institution was teaching

and transfer of technology, not research. Of course, one could also argue that the main mandate of any Faculty in Mexico (not only at the UADY) is teaching, but this does not prevent faculty members from publishing in journals. Thus, it remains to be shown whether Area B grantees' mandate has an effect on their journal article production.

A time analysis of publication output by Area B researchers reveals that their publication patterns are quite different from the IFS grantees as a whole. Area B researchers published more often prior to the first grant than did their colleagues in other research areas. However, their number of publications shows only small increases after the grant, while other research areas show a stronger increase that continues well beyond the first grant (Figure 28). If one considers only articles, Area B grantees and others share a trend towards increasing article publications until one year after the first grant. At this point Area B grantees' article production levels off and then decreases five years after the first grant. Meanwhile, the other areas continue to increase their article production into the tenth year after the first grant (Figure 29). The lower level of article production is offset by production of other types of publications.

### 6.4.7 Number of grants

Former grantees that received one or two renewal grants subsequently produced more IFS supported publications. However, the increase was not as strong as might be expected. The average number of publications for all former grantees was 5.1 (n=45) and for those who received only one grant (n=27) the corresponding figure was 4.4. Fifteen former grantees received two grants, and only three received three grants. The share of articles in the total of IFS-supported publications increased with the number of grants: one grant, 50.8%, two grants, 56.2%, and three grants, 73.7%.

### 6.4.8 Former grantees

The effect of IFS funding on publication output for the 45 former grantees (regardless of the number of grants they received) is shown in Figure 30. Year zero is the year when the grantees received their first grant. Publication output was already increasing during the five years previous to the award of IFS funding, and it showed a continued upward trend thereafter. IFS-supported publications reached a

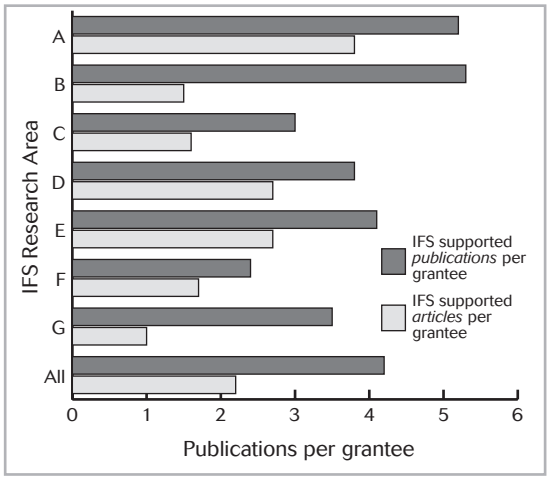


Figure 26
**IFS supported publication output by Research Area**

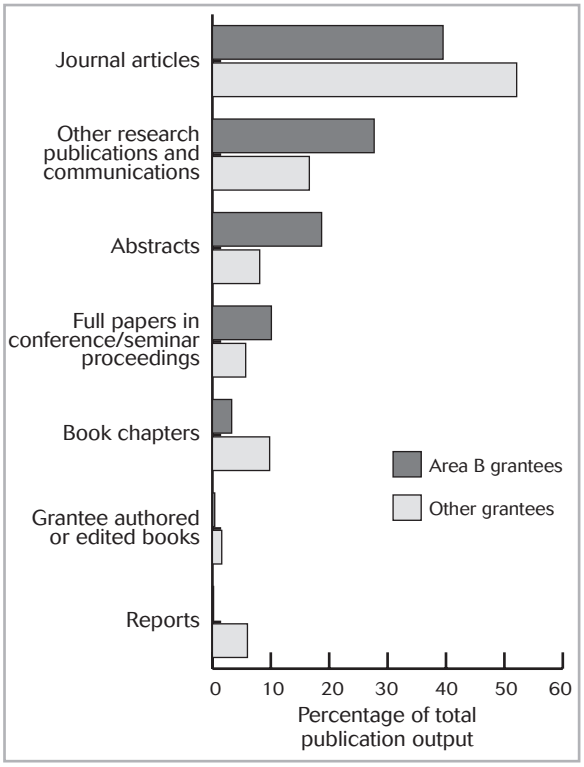


Figure 27
**Publication output: Area B vs Other Research Areas**

maximum between three and five years after funding and were still being publishing 15 years after the first grant.

Figures 31 and 32 show annual mean publication output for former grantees who received only a first grant, and former grantees who received one or two renewal grants, respectively. From the third year onwards, mean total publication output per year for former grantees receiving two or more grants is greater than for those who received only one

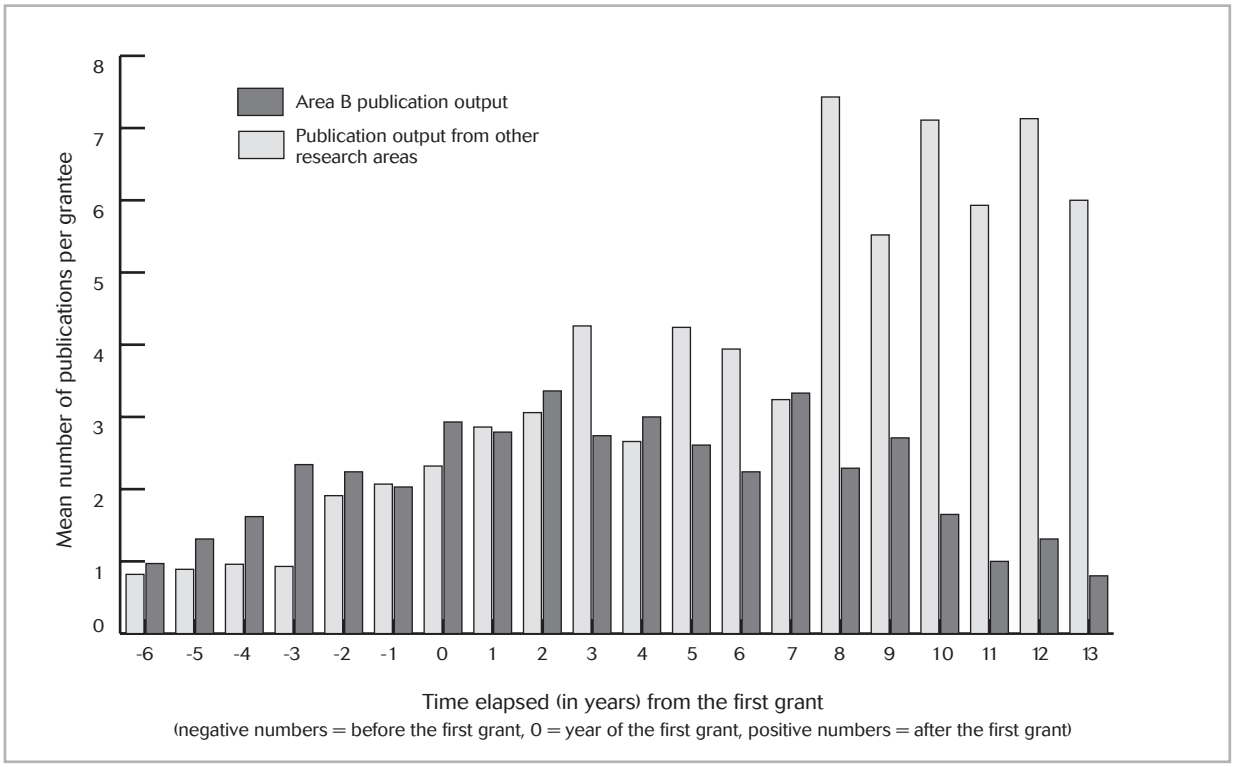


Figure 28
**Mean publication productivity per year: Area B vs Other Research Areas**

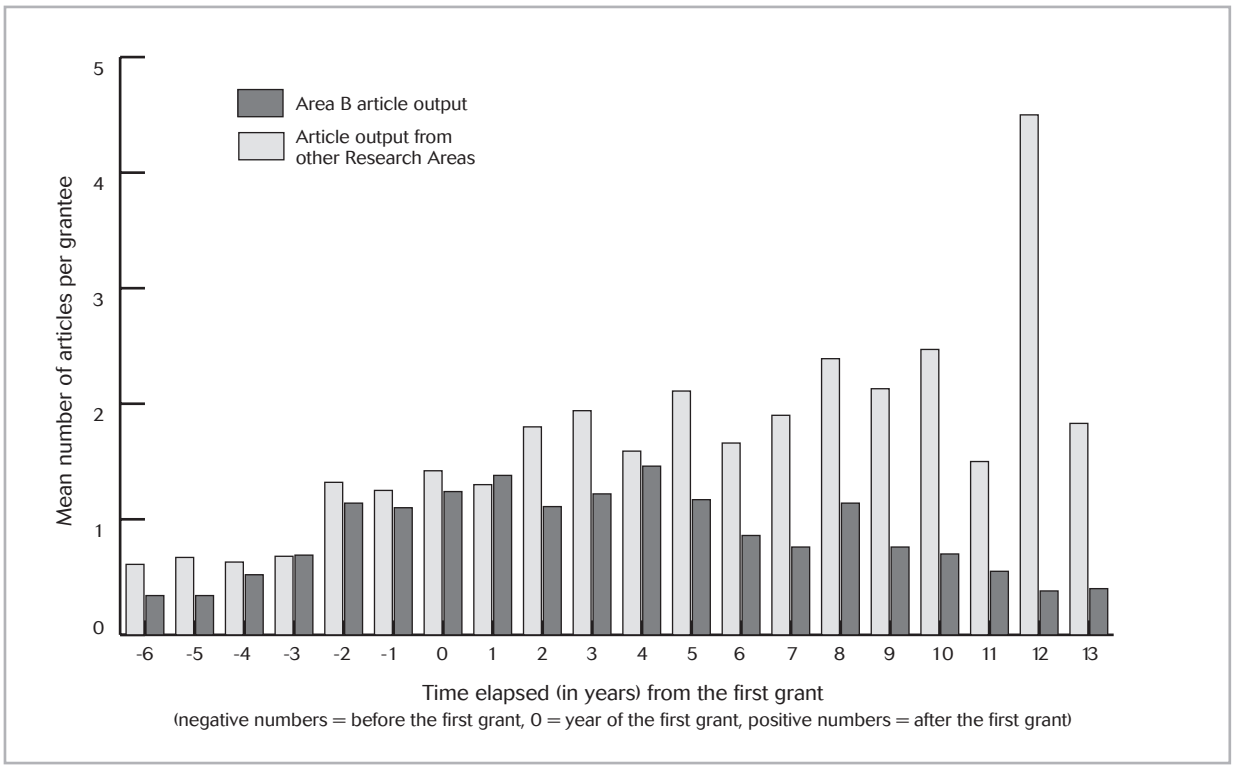


Figure 29
**Mean article productivity per year: Area B vs Other Research Areas**

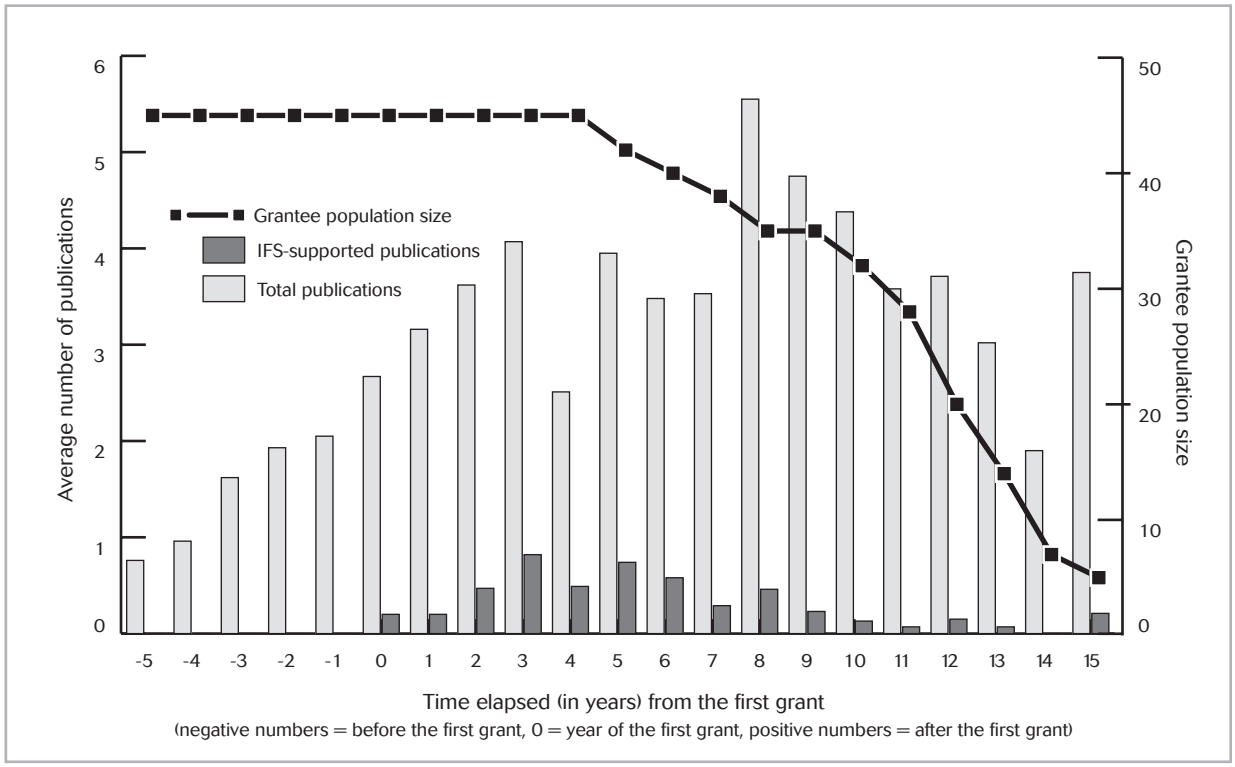


Figure 30
**Publication output of former grantees: a time analysis**

grant. The number of IFS publications per grantee is also greater after the third year for the group receiving more than one grant. This production is sustained for a greater number of years, as would be expected. However, Figure 31 and Figure 32 show that the number of former grantees who received only one grant begins to fall after the fourth year, whereas for those receiving two or more grants this decrease occurs during the seventh year, thereby affecting the total number of publications.

It is interesting to note that even though a more sustained production of IFS-supported publications is seen in the group receiving more than one grant (up to year 15), in the group with only one grant IFS-supported publications appear up to 12 years after they were assigned funding. Nonetheless, these data suggest that the former grantees who received more than one grant are generally more productive than those who received only one grant. The first group reached production levels >6 publications per former grantee per year in year 8 after funding (Figure 32) compared to between 4 and 5 publications per former grantee per year of the second group in year 5 after funding and again in year 8 (Figure 31).

### *6.4.9 Membership in the SNI*

Many Mexican researchers aspire to SNI membership because it is both prestigious and financially beneficial (see chapter 2). Of the more than 260,000 individuals working in S&T who have postgraduate training, only an elite 2.6% are members of the SNI. Researchers who qualify for the first level of membership achieve their status primarily based upon their mainstream scientific publications and their contribution to the recruitment and training of new scientists. Hence, it is not a surprise that in this study significant differences were found between the publication records of the 75 grantees who are presently SNI members and the 30 who are not. However, it would be incorrect to state that the SNI completely disregards publications in local journals. The two Mexican journals topping the list of journals in which IFS grantees have published more than 10 articles (see Table 19 in section 6.4.1) *Técnica Pecuaria en México* and *Veterinaria México* are considered important journals in the SNI system. Two former IFS grantees who are established and recognized as successful researchers in Mexico have published the largest part of their publication output in these two journals. Both of them are SNI level III (see Box 7 in Chapter 5 for an example). Nevertheless, it is of interest to discover that IFS grants have greater

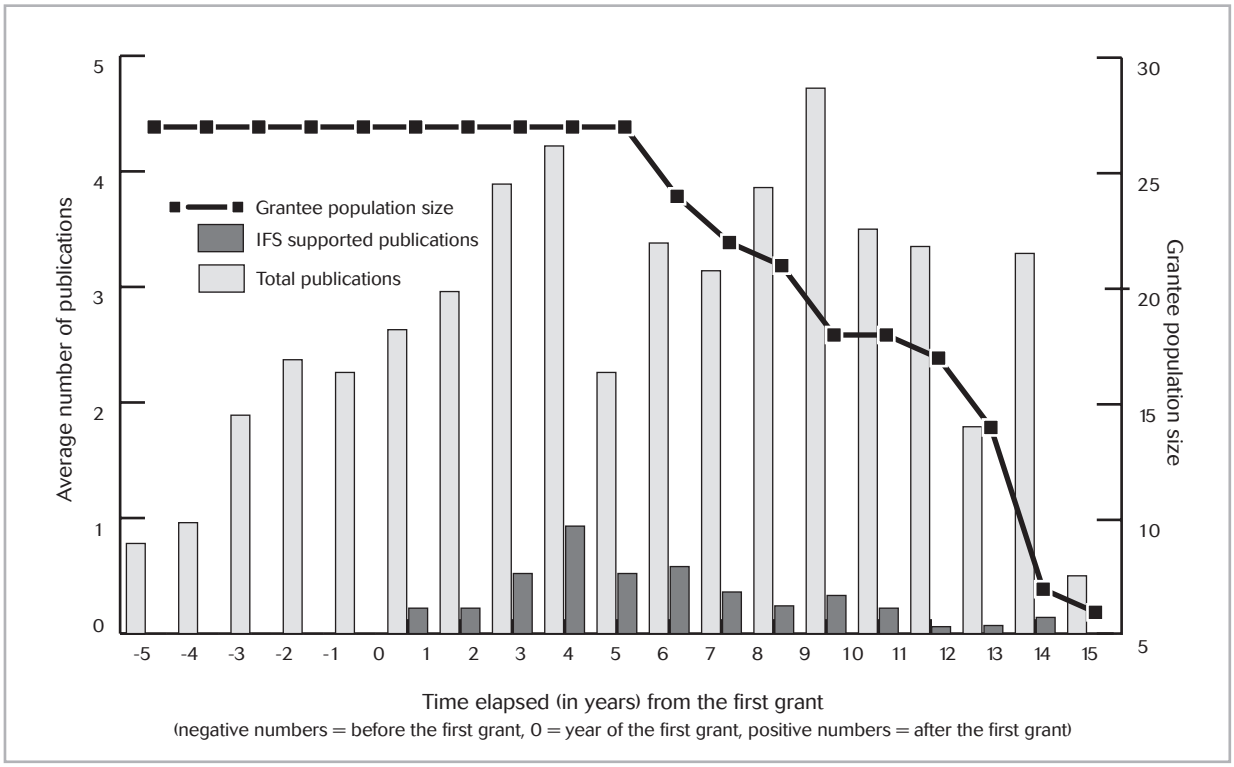


Figure 31
**Publication output of former grantees that received one grant: a time analysis**

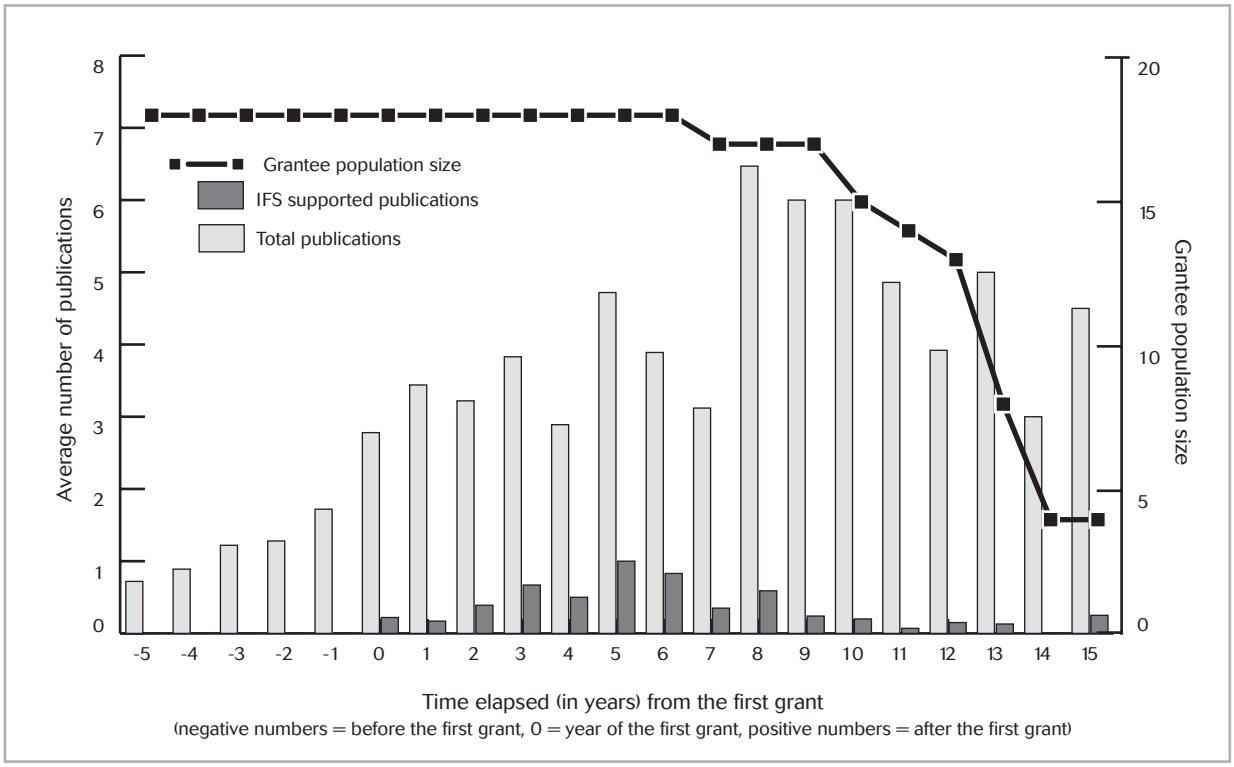


Figure 32
**Publication output of former grantees that received multiple grants: a time analysis**

impact on the publication output of non-SNI members than those presently in the SNI. The data presented below are sorted according to SNI membership status, regardless of whether membership was attained before or after the IFS grant was awarded.

Among respondents, SNI members' publication lists were, on average, more than twice as lengthy as those belonging to grantees that are not members (47.7 publications/SNI member, and 21.8 publications/non-SNI member). By the nature of the SNI selection process, it is expected that SNI members will be much more productive and probably have their publication lists in order and handy. However, there was not a great difference in the average number of IFS publications produced by SNI members and non-SNI members (4.3 and 3.9, respectively). SNI members averaged slightly more renewal grants than non-SNI members, and there was almost no difference when the total number of IFS-supported publications was divided by the number of IFS grants (SNI = 2.9 IFS publications per grant, non-SNI = 2.8 publications per grant). IFS publications accounted for 17.8% of all non-member publications, and members' IFS publications accounted for 9.1% of the members' total publication record. Hence, in terms of total publications, SNI members did not publish IFS research results significantly more often than did non-SNI members. In addition, the IFS grant was significantly more important to non-SNI member productivity than it was to SNI members.

Grantees that are members of the SNI tend to produce many more English-language publications than do grantees that do not belong to the SNI (SNI members produced 1486 English-language publications accounting for 41.5% of their total output while non-SNI members produced 200 English-language publications accounting for 30.6% of their total output). However, IFS support was behind a greater percentage of non-SNI members' English-language publications than it was for SNI members. Of non-SNI members' English-language publications, 26.5% were IFS supported. In contrast, 12.9% of SNI members' English-language output was supported by IFS. Hence, one may conclude that IFS support had a greater impact on non-SNI members' output of English-language publications than it did on their SNI counterparts.

Differences were found in the rates of article publication among SNI and non-SNI grantees as well. SNI members are much more likely to publish articles; they published an average of 23.9 articles per scientist, accounting for about half of their total publication production. Non-SNI members published an average of 8.7 articles per scientist accounting for 38.7% of their total publications. Furthermore, SNI members published 58% of their articles in English while less than 39% of non-SNI members' articles were in English. IFS-supported research was the foundation for 19.4% of non-SNI members' English article production and 14.6% of SNI members' article production.

If IFS support has a significant impact on researcher output, then one might expect that an IFS grant will further a researchers' career by providing a solid publication basis on which to apply for SNI membership. Surprisingly, this is generally not the case. Most of the SNI members discussed here were members prior to their first grant from IFS; 42 became members at least one year prior to the first grant, 15 became members the same year as their first grant, and 14 became members after the first grant[34]. Furthermore, when the mean year of the first grant was calculated for members and non-members, the difference was minimal (members = 1992.3, non-members = 1992.5). Nevertheless, as shown in chapter 7, most of the grantees have progressed significantly in the SNI system since receiving their first grant.

The information presented in this section consistently shows that IFS support contributes to a significant percentage of all grantees' publications, regardless of SNI status. However, it is clear that the impact of IFS support is greater for Mexican scientists who are not yet SNI members, than it is for SNI members[35]. IFS research consistently accounts for a greater percentage of their publications and articles, regardless of publication language. Hence, a simple step towards increasing the effectiveness of IFS support could be to provide grants only to those researchers who are not already full members of the SNI (ie non-members and those at the "candidate" level). The mechanism for this already exists in the IFS guidelines, whereby researchers deemed to be "too established" are not eligible for IFS support.

34. Four grantee members that received their grant prior to the foundation of the SNI in 1984 are not included.

35. It should be noted, however, that, as is shown in chapter 7, some grantees entered the SNI system during their IFS-supported project.

### 6.4.10 Comparing the UNAM and the UADY

As mentioned in Chapter 3, an initial eligibility criterion for those seeking IFS support is that their country's GNP is less than that of the average of all upper-middle income countries. Yet, many eligible countries have laboratories and faculties that are of very high quality, by any standard of measure. In Mexico a number of well equipped, well staffed and well funded institutions are outstanding centres of excellence.

Whether or not applicants from centres of excellence should be eligible for support is a difficult issue for IFS. For example, during a visit to the Institute of Biotechnology in Cuernavaca, a Mexican scientist told us that his working conditions and environment were of a better standard than the university in France where he recently got his PhD. Thus far, scientists working under such conditions have been eligible for support, partially due to the difficult logistics of establishing a list of eligible and ineligible institutions across the globe.

This study presents the opportunity to examine the publication output of grantees at two very different universities (see chapter 2 for a discussion of universities), one with research facilities of international standard, Universidad Nacional Autónoma de México[36] (UNAM), and the other of more recent creation and moderate resources, Universidad Autónoma de Yucatán (UADY). As a result, we have the opportunity to analyse the differential impact of IFS support within these two research environments.

The UNAM and the UADY are each home to over twenty present and former IFS grantees (see Table 20). Of these, 18 from the UNAM and 17 from the UADY participated in the bibliometric survey. UADY grantees received a total of 27 grants and those from the UNAM received 30 grants. By adding the total number of years expired since receipt of the first grant for all UNAM grantees, we see that UNAM grantees have had a total of 170 post-grant years during which they could publish. For the UADY, the total is 143 years. In simpler terms, UNAM grantees have on average received their first grant roughly one year earlier than UADY grantees, meaning that publication outputs are likely to have slightly favoured the UNAM. Furthermore, the UNAM population of participating grantees consisted of 14 SNI members distributed over the various research areas (from 0 in Area A to 4 each in Area B, Area D and Area E). UADY grantees were primarily scientists in Animal Production (12 grantees) and only three were SNI members[37].

| | UNAM | UADY |
|---|---|---|
| Responding grantees | 18 | 17 |
| Number of grants | 30 | 27 |
| Average no. of yrs since 1st grant | 9.4 | 8.4 |
| Total Publications | 1096 | 347 |
| IFS Publications | 87 | 63 |
| IFS-supported publications as a percentage of the total | 7.9% | 18.2% |
| SNI members | 14 | 3 |
| Area A | 0 | 0 |
| Area B | 4 | 12 |
| Area C | 1 | 1 |
| Area D | 4 | 0 |
| Area E | 4 | 4 |
| Area F | 2 | 0 |
| Area G | 2 | 0 |

Table 20
**A comparison of the UNAM and the UADY**

Participants from the UNAM produced 1,096 publications and 87 IFS-supported publications. UADY participants produced much less; 347 publications and 63 IFS supported publications. However, IFS support resulted in 18.2% of the total output of grantees at the UADY, over ten percent more than at the UNAM. For the twelve Area B grantees at the UADY, IFS-supported publications accounted for 19.2% of their total publications, which is greater than the 12.5% for all Area B grantees at all institutions. Although any recommendation for a change in IFS policy should be based upon a greater number of case studies, these data could be used to support the argument that IFS support has

36. One should note, however, that the UNAM is complex and far from uniform. There is in particular a gap in resources between the research institutes and teaching faculties. One cannot compare the resources and community of the Institute of Biotechnology with the Faculty of Veterinary Medicine, for instance.

37. This is a low number, even for the participating population of Area B grantees. In general, slightly more than 50% of Area B grantees are members of the SNI. Nevertheless, even this rate of SNI membership is much higher than the general rate for scientists holding a PhD in Mexico.

greater impact at weaker institutions. IFS has also had an important impact on the career development of many scientists at the UNAM (see Box 9 for an example), but the support from IFS has been of smaller relative significance.

## 6.5 Conclusions

A sizeable share of the IFS grantees' scientific production (and as much as 58.9% of IFS supported articles) is published in mainstream scientific journals. On the other hand, despite the fact that national publication is low priority for the promotion of scientists in Mexico, most of them do continue to publish in Spanish via local journals. This dual strategy of publishing both in mainstream and in local journals in basic and applied fields such as those supported by IFS is indicative of a healthy future for Mexican science. Moreover, Mexico has developed relevant local scientific journals that will hopefully continue to flourish as the Mexican scientific community gains clout in the international arena.

Differences in publication output between scientists in different research areas were notable. In particular, animal production researchers in Mexico, having the least number of published articles and IFS supported articles, stand out as a distinct group among IFS researchers. The difference in publication patterns between animal production scientists and other scientists also suggest that yardsticks for judging scientific production may also need to be geared towards the type of science that is being practised.

The publication trends among IFS grantees in Mexico revealed in this study point to a positive impact of IFS support on scientific productivity as measured by the total number of total publications and articles in scientific journals. The data suggest that IFS support is a contributing factor to grantees publishing more frequently, more often in English and increasingly in international mainstream journals. Significantly, each of these effects of IFS support is more pronounced among grantees who are not among the elite group of SNI members. The outcomes were also much more visible in the group of researchers at the Universidad Autónoma de Yucatán, a university with modest resources when compared to the Universidad Nacional Autónoma de México. Thus, IFS support in the form of small grants and network building may have a greater relative impact on scientists that have fewer resources to draw upon at their own institutions.

Box 9

**Dr Blanca Jiménez Cisneros**

Worldwide, there are few experts in Dr Blanca Jiménez Cisneros' field. Dr Jiménez has an undergraduate degree in environmental engineering from the UAM (Universidad Autónoma Metropolitana) in Mexico City (1976-1980), with a master's (1981-1982), a doctorate (1982-1985) and postdoctoral studies (1989) in water treatment and reuse from the INSA (Institut National des Sciences Appliquées) in Toulouse, France. Presently she is deputy director of the UNAM's Engineering Institute (II) in the areas of hydraulic and environmental engineering, environmental bioprocesses and process engineering.

Dr. Jiménez has followed parallel interests in her work: research, technological development, and transfer. Meanwhile, the economic realities of Mexico have always been one of her foremost concerns; through her work she aims to ensure that the country has sufficient water of acceptable quality. For this work she has received several important national awards including the UNAM distinction for young academics in the area of technological innovation and industrial design in 1996, and the Mexican Academy of Sciences prize in the area of technological research in 1997.

A decade earlier, Dr Jiménez had recently returned to Mexico and was trying to adapt what she had learned in France to the needs of her country. Because in Mexico sewage is normally used for irrigation for its nitrogen content, her PhD research on the treatment of nitrogen in residual water was highly relevant. However, she lacked research funding.

Dr Jiménez learned of IFS through a colleague at the UNAM and soon sent a grant application to IFS. The grant that she subsequently received in 1987 was her first research grant and the only international support open to her at the time. She was pleased to discover that the grant arrived without strings attached and could be used as seed money. The grant was critical for her research as it bought equipment and allowed her to establish a research team. The work that began with the IFS grant later produced a patented system for the extraction of nitrogen and carbon in residual water that has been installed in several residential blocks and industrial plants in Mexico.

The IFS grant also proved to be a catalyst for Dr Jiménez's publication productivity by allowing her the opportunity to maintain her publication output when it would have been difficult otherwise. In addition to the funding, she found that the IFS reporting model was helpful because it makes grantees put their research findings in writing, thus forming the basis for a paper.

Dr. Jiménez's five IFS supported publications were followed by an abundance of other works. In total, Dr Jiménez can be credited with more than 30 papers in international journals, 45 in international congresses, 31 in national proceedings, and 16 in national journals. She has over 100 internal research reports to her name, over 80 of which were written for sponsors. In addition, she has written a chapter on pollution in Mexico City for a UNESCO children's book, an educational package for postgraduates on water treatment as well as several manuals and books on sanitary and environmental engineering.

# 7. Quality of grantees' work, promotion, rewards and mobility

Publishing scientific papers and training a new generation of researchers (as discussed in chapter 5) are two of the main output and impact indicators in science. In the preceding chapter, we attempted to measure the extent to which IFS support had an impact on grantees' publication output.

To complete the analysis, we will now turn to some additional qualitative and quantitative indicators related to the IFS grantees' work, including the duration of the IFS research projects, the reasons for closing grants, the quality of renewal applications and final reports. We also look at academic and institutional promotions as well as awards received by IFS grantees in recognition of their outstanding work. Finally, we examine the international mobility of IFS grantees.

## 7.1 Duration of IFS research projects

During the period 1974-1999, 69 IFS supported research projects were completed and the corresponding files closed. Of the scientists carrying out these 69 projects, five were awarded three grants (ie a first grant and two renewals), 22 were awarded two grants (ie one renewal) and the majority, 42, received only a first grant. The average total duration of these projects is illustrated in Figure 33.

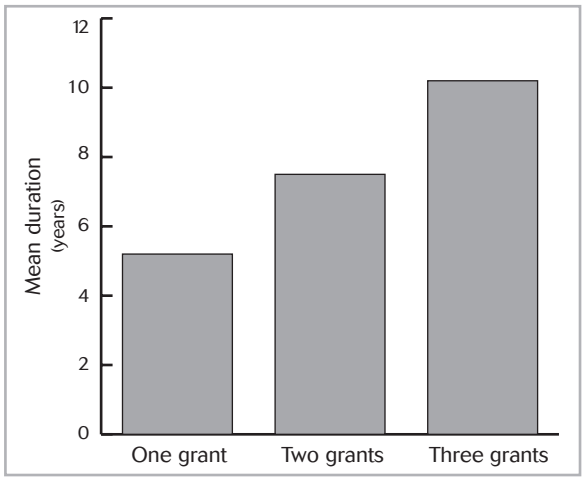


Figure 33
**Mean duration of IFS research projects grouped by number of grants received**

The average duration of a research period (time during which one grant is spent) is supposed to be between one and three years. However, scientists with one grant tend to finish in a little over five years, those with two grants in seven and a half years, and those with three grants in slightly more than 10 years. The average durations are all longer than the ideal (three, six and nine years for one, two and three grants respectively). This is particularly the case for grantees having only one grant. For them, delays are often due to report writing. Table A7 in the appendix presents the average duration of IFS research projects by research areas according to number of grants received.

## 7.2 Reasons for closing grants

The reasons for closing the files of the 69 former grantees are given in Table 21. Half of them (50.7%) were closed upon the receipt of a final report from the grantee. The quality of the reports is discussed below. Slightly more than a third (34.8%) were closed because the renewal application was not approved. The reasons for rejecting renewal applications are discussed below. In nine cases out 69, the grantees' files were closed with no final report. Although IFS has a routine in place to remind

| Reason | No. of grantee files | % |
|---|---|---|
| Completed with report | 35 | 50.7 |
| Renewal application not approved | 24 | 34.8 |
| Closed without report | 9 | 13.0 |
| Closed with partial report | 1 | 1.4 |
| **Total** | **69** | **100.0** |

Table 21
**Reasons for closing grants**

grantees to submit final reports and to comply with what they have committed themselves to do, too many failed to do so. In several cases, it was clear during the interviews that final reports were not submitted to IFS even when the grantees had everything that was necessary to prepare such a report. In one case, the report was even ready, but had not been sent to IFS. To improve the situation, an incentive might be needed to ensure that all final reports are submitted to IFS.

## 7.3 Rejecting renewal applications

Renewal applications from 24 grantees in Mexico were rejected by IFS (see Table 22). A majority were not accepted because fault was found with the scientific approach, the methodology was unsound or the work carried out was merely transfer of technology and not innovative science. Other renewal applications were not accepted because the candidates were considered too senior and too established. Our research shows that this decision, if not carefully explained, has a potential to create ill-will and misunderstanding. For example, two grantees that had renewal applications rejected because they were too established explained in their interview that, at the time, they felt that they were being punished by IFS for being too successful. Both claimed that this unexpected decision (given the quality of the results that they had obtained and partly published) disrupted the progress of their work since they were depending on the renewal of their grants. Meanwhile, if they had been told earlier that they would not be awarded a renewal, they would have actively looked for other funding. Several other grantees that were interviewed also mentioned that they would like to see the IFS rules revised and relaxed to allow greater continuity of funding. Evaluators also occasionally find the decision to reject renewal applications from established scientists a difficult one. They sometimes fear that they must make a decision without sufficient information.

It is a matter of policy that IFS does not support a successful and "established" grantee for another three years when it is possible to give a younger applicant with a strong project his or her first support. However, there is a need for clarification to avoid the situation where the work of a dedicated scientist is disrupted because he or she is successful. It is also very much regrettable when good applications cannot be supported with a grant due to a shortage of funds.

It became clear during the interviews that several grantees misunderstood or misinterpreted some of the IFS rules, and in particular those regarding age limit for eligibility. Some grantees celebrated their 41st birthday during their first research period and, assuming that they were no longer eligible, did not prepare a renewal application and, in some cases, never submitted a final report either. In truth, the age limit for grants only applies to the first grant; applicants for renewals can be over 40 years old.

## 7.4 Quality of final report

The final report (or the progress report when the renewal application was unsuccessful) is assigned one of five grades: unsatisfactory (1), poor (2), satisfactory (3), good (4), or excellent (5) at the time that it is reviewed by the IFS Scientific Advisers. For the 69 former grantees in Mexico, the quality of

| Reason | No.of grantee files |
|---|---|
| Scientific approach unsatisfactory | 14 |
| Applicant considered too senior and established | 5 |
| Renewal application good but shortage of funds | 2 |
| Renewal application postponed, then no reply | 2 |
| Renewal application not sent in | 1 |
| **Total** | **24** |

Table 22
**Reasons for not accepting renewal applications**

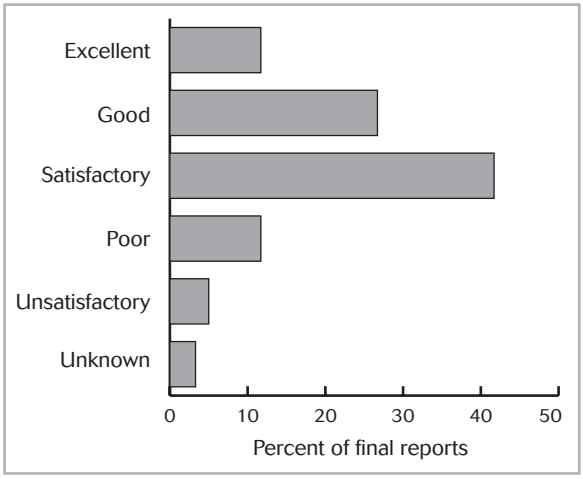


Figure 34
**Quality of final reports**

their final/progress reports is summarized in Figure 34 (see also Table A8 in the appendix).

It is encouraging to note that 80% of the grantees hand in a report that is satisfactory or better. But we could also have expected more reports being rated good or excellent, in particular given the IFS selection process and the fact that many grantees had an excellent academic background and training at the time of their first application. To refine the analysis, it will be attempted to see below if a correlation between the quality of the final report and a number of variables including the IFS scientific areas, the number of grants given, and the degree held at the time of the first application, can be found.

### *7.4.1 Research Area and granting period*

In order to compare the quality of reports among the different scientific areas, we used the scores given to the final reports and calculated averages (Table 23).

Areas F and G are excluded from the comparison because there are too few reports to draw any conclusions from. In all areas except forestry/agroforestry (Area D), the qualities of the reports decrease from 1X (project completed after one grant) to 2X (project completed after two grants). One explanation for this could be that grantees with two grants have been successful in getting funds from other sources and "forget" their obligation towards IFS. Having acquired other means of funding their research, they have less time to keep their promise. The effort is not worth the time it takes. Again, to improve the situation, an incentive might be needed to improve the quality of final reports submitted to IFS. These conclusions are also supported by grantees' responses in a number of interviews: in many cases one grant may have been enough to establish a grantee as a scientist.

| Area | Granting period | Mean quality |
|---|---|---|
| Aquatic Resources (A) | 1X | 3.3 |
| | 2X | 2.5 |
| Animal Production (B) | 1X | 3.0 |
| | 2X | 2.0 |
| | 3X | 3.0 |
| Crop Science (C) | 1X | 4.0 |
| | 2X | 3.5 |
| Forestry/Agroforestry (D) | 1X | 2.5 |
| | 2X | 4.0 |
| | 3X | 4.0 |
| Food Science (E) | 1X | 3.6 |
| | 2X | 3.2 |
| | 3X | 4.3 |

Table 23
**Mean quality of the final report by scientific area and granting period**

### *7.4.2 Quality of final report and degrees held*

If one looks at the degrees held at the time that the grant was awarded and correlates them to the quality of the final report, it seems that the distribution is not that dissimilar between the 23 MSc-holders and the 31 PhD-holders. The main difference is that PhD-holders exhibit a larger proportion of good and excellent final reports than the MSc-holders (48% vs. 26%).

Does the place where the degree held at the time of the first grant was taken influence the quality of the final report? As far as the poor and unsatisfactory reports go, there is little difference between degrees taken in Mexico or elsewhere (Table 24). The majority of the reports are satisfactory when the grantees have taken their degree in Mexico (53%) or elsewhere (38%). A good report is written in 16% of the cases by grantees with degrees

| Report quality | Mexico | | Elsewhere | | Total |
|---|---|---|---|---|---|
| | No. of reports | % | No. of reports | % | |
| Excellent | 3 | 16 | 4 | 11 | 7 |
| Good | 3 | 16 | 12 | 32 | 15 |
| Satisfactory | 10 | 53 | 14 | 38 | 24 |
| Poor | 2 | 11 | 5 | 14 | 7 |
| Unsatisfactory | 1 | 5 | 2 | 5 | 3 |
| **Total** | **19** | **100** | **37** | **100** | **56*** |

Table 24
**Quality of the final report by country in which the degree held at the time of the first grant was obtained**

*The quality of two other reports had not been recorded

from Mexico, and twice as frequently by grantees having taken their degrees elsewhere (32%). Excellent reports result in 16% of the cases from grantees with degrees from Mexico, and in 11% of the cases from grantees with degrees from elsewhere. Overall, there is a slightly better chance for a grantee with a degree from a foreign institution to produce a final report of high quality. Whether this result is indicative of a general trend is not known, given the small size of the populations.

## 7.5 Degrees held at the time of the first grant and number of grants

Given the small population of 67 former grantees considered here, it is very hard to find any obvious correlation between number of grants ("granting period" in tables A9 and A10 in the appendix) and the degree held at the time of the first grant. In general, the proportion of MScs to PhDs increased between the first and second grants in the case of animal production (Area B) and forestry/agroforestry (Area D), and decreased for aquaculture (Area A). In food science (Area E), the proportion of MScs to PhDs increased between first and second grants, and decreased again for grant number three. The general trend seems therefore to be that more MSc holders than PhD holders get a second (or third) grant, which can be explained by the fact that having a higher degree helps the researcher to become independent, in terms of research funding, more quickly.

## 7.6 Promotion of IFS grantees

As shown in Figure 35, most IFS grantees (58%) achieved their present positions through promotion within their own research institutes. As discussed below, researcher mobility (between national institutions and between Mexico and the rest of the world) is low in Mexico. An explanation for the low mobility within Mexico is that pension schemes, productivity bonus programmes and years of service are not transferable from one institution to another due to the "autonomous" character of the majority of state-supported higher education institutions in Mexico. Also, because of the small size of the national research community, it is not easy to find groups and/or institutions of a similar high scientific standing.

Promotion in Mexico is governed by regular evaluations of the scientists' work. The large majority of

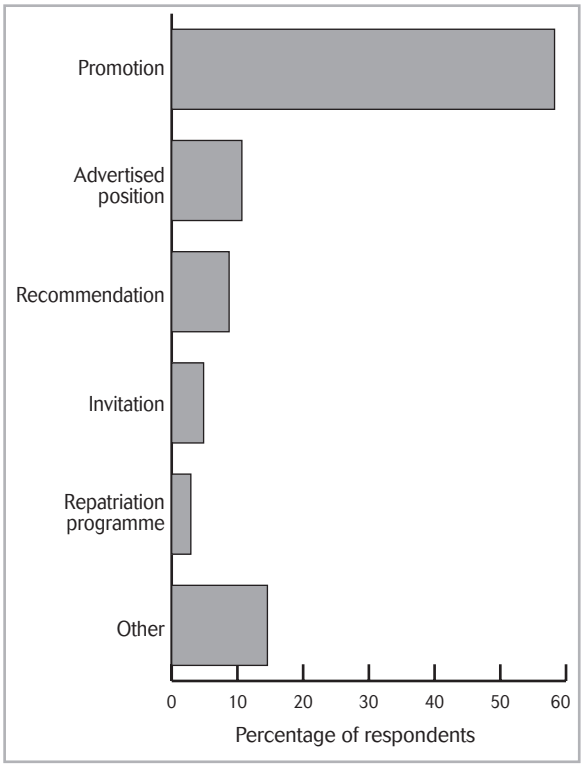


Figure 35
**How grantees achieved their present position (Q16)**

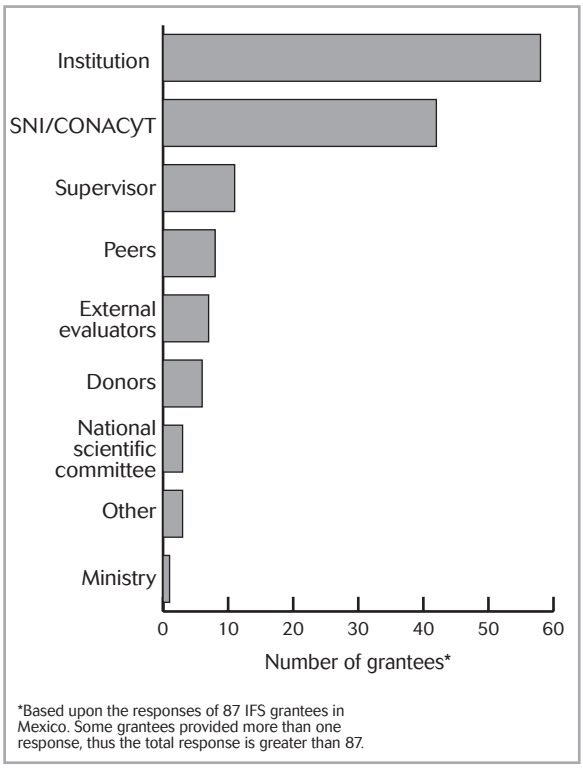


Figure 36
**Main evaluators of grantees' research work (Q45)**

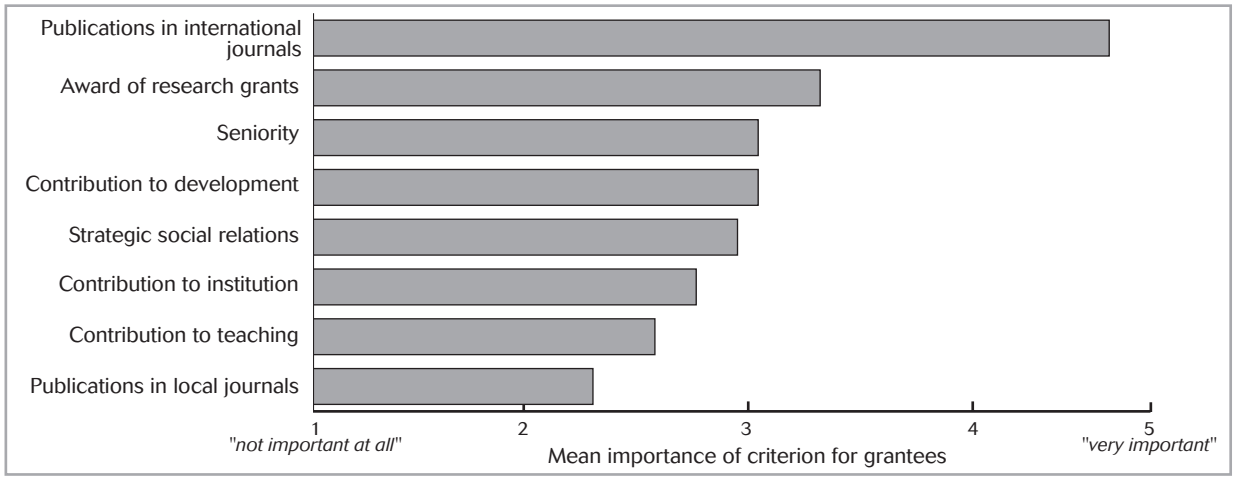


Figure 37
**Criteria for promotion of scientists in Mexico and their mean importance (Q43)**

the respondents to the questionnaire (86%) confirmed that their work was regularly evaluated. As shown in Figure 36, the main "authority" in charge of evaluating the grantees' work is by far their own institutions followed by the SNI and CONACYT.

Whereas publications in international journals is the primary criterion for promotion of scientists in Mexico (see Figure 37), award of research grants is second. Hence, though it is difficult to measure, receipt of an award from IFS could play a significant role in the promotion of the IFS grantees.

### *7.6.1 Academic promotion of IFS grantees*

If one looks at the 69 former grantees, most have remained at the same degree level that they had upon receiving their first grant. One stayed at the level of "doctor en medicina veterinaria (licenciatura)", 19 stayed at the level of MSc during the course of their project, and 39 who applied when they were already PhDs did not, of course, earn any supplementary academic degree during the IFS grant period. Excluding the two grantees that shared a grant, this leaves eight grantees that earned an extra academic degree during the course of their IFS support: one held a BSc degree upon receiving his first grant and earned a MSc during the time of the grant, and seven MSc holders earned a PhD during the time of the grant.

While we may consider that this rate of progression is rather low, we should also take into account that the large majority of grantees already had a PhD when embarking on the IFS project. Yet, of the 19 sceintists with a MSc that did not strive for a PhD during the time of IFS support, perhaps some could have done so.

17 post-doctoral positions were reported by 16 IFS grantees (seven former grantees and nine present grantees). All but two were carried out before applying for an IFS grant. Two post-docs were done during an IFS grant which is now terminated, one having lasted two research periods, and the other three. For a list of the institutions at which the post-docs were made, please refer to Table A11 in the appendix. The large majority of post-doctoral positions (71%) were located in the USA.

### *7.6.2 Institutional promotion of the grantees*

Information was assembled regarding the institutional promotions of the 69 former grantees in Mexico. Promotions to professor were not taken into account as the information was incomplete. The positions awarded to IFS grantees during and after the granting period are summarized in Table 25 (please note that some grantees have held several positions).

A few IFS grantees have been promoted to Dean or Vice Chancellor of Universities, or Director of Institutes. Examples include Raul Godoy, Vice Chancellor of the UADY (Mérida), Luis Zarco Dean of the Veterinary Faculty of the UNAM, and Miguel Velazquez del Valle, Director of the CEPROBI (Centro de Desarrollo de Productos Bioticos), of the IPN. Many more are today heads of departments and research units. Others play leading roles at the national level. One example is Enrique Galindo, who is the President of the Mexican Sci-

| Positions | During IFS grant | After IFS grant |
|---|---|---|
| Rector | - | 1 |
| Dean | 1 | 2 |
| Director of Research Centre | - | 3 |
| Deputy Director | 1 | - |
| Project Director | 1 | - |
| Head of research division | 1 | 2 |
| Head of department | 5 | 7 |
| Head of research unit / laboratory | 5 | 3 |
| Head of veterinary field service | - | 1 |
| Academic co-ordinator | 1 | 2 |

Table 25
**Positions held by IFS grantees during and after the grant (Q15)**

| Progression | Number of grantees |
|---|---|
| non SNI - candidate | 2 |
| non SNI - I | 4 |
| non SNI - II | 1 |
| candidate - I | 25 |
| candidate - II | 10 |
| candidate - III | 2 |
| I - II | 6 |
| I - III | 2 |
| **Total** | **52** |

Table 26
**Progression of IFS grantees in the SNI system (Q11)**

entific Association for Biotechnology. Although it is difficult to measure the impact that the IFS grant, as an international award, had in their promotion, most of these former grantees recognized that the IFS grant came at the right time, when they were striving to become independent researchers and to establish their research groups. In addition to confidence building, the IFS grant brought recognition, prestige and visibility, and all are very grateful to IFS for it.

## 7.7 Progression in the SNI system

Most of the grantees progressed significantly in the SNI system after becoming an IFS grantee. As mentioned earlier, 85 grantees (62%) belonged to the SNI system at the time of the survey. Information collected from 66 SNI members indicates that a large majority (52) progressed in the SNI system while they were a grantee (see chapter 2 for a description of SNI levels). Their progression is summarized below (Table 26).

Among the remaining 14, eight are at the candidate level in the SNI system and may not have produced enough publications to be promoted to a higher level. Most of them are scientists who have received their IFS grants recently.

## 7.8 National and international distinctions

There are three IFS award winners (King Baudouin and Silver Jubilee) among the IFS grantees in Mexico, all of whom were interviewed (Dr Enrique Galindo, Dr Miguel Gómez Lim, and Dr Emmanuel Rincón Saucedo). Based on the responses from the questionnaire survey (105 responses out of 138 grantees), at least 37 grantees received a national or international distinction in recognition of their outstanding scientific work. Among them at least 13 received the Mexican Academy of Sciences Award (Premio Nacional de la Ciencia) and two a University Award from the UNAM. All these awards are received with great pride and framed on the wall of the grantees' offices. "They are given in recognition of an outstanding work and/or career to which IFS undoubtedly contributed", says Enrique Galindo from the Institute of Biotechnology in Cuernavaca. They represent a very important incentive.

## 7.9 Mobility of IFS grantees

As mentioned earlier, mobility of scientists in Mexico is low. Yet, highly skilled Mexican scientists continue to establish themselves permanently abroad, mostly in the United States. This is mainly due to graduate studies abroad. Although graduate and postgraduate studies are increasingly taking place in Mexico, migration of Mexican students remains a stepping-stone to permanent skilled migration. Interestingly, while figures published by CONACYT (SEP-CONACYT, 2000) estimate that only 5% of former beneficiaries of CONACYT's

scholarship programmes live and work abroad (64%[38] of them in the United States), another survey shows that 30% of Mexican PhD graduates remained in the US after getting their PhD in the US (Finn, 1997). Even if in comparison to countries such as China (88%) and India (79%), it is a low rate, a large share of qualified Mexican graduate and post-graduate students studying abroad remain in the host country (Castanos-Lomnitz and Licea de Arenas, unpublished).

While, as shown in chapter 4, many of IFS grantees went abroad for postgraduate studies, most of them returned home immediately after or very soon after they received their PhD. Table 27 also clearly indicates that most of the time spent abroad was spent studying (4.7 years for higher education and training as compared to 5.2 years in total).

Many respondents to the questionnaire have been offered employment abroad (mainly in the US and in Europe), but very few accepted it (see Table 28). When they accepted it (three positions in Latin America, two in North America, three in Europe, and two in Asia), it was for a relatively short period and, to the best of our knowledge, all but two returned to Mexico (see below). Even if IFS supports scientists that have already decided to return or have already returned to Mexico at the time they apply for their first grant, it is an outstanding result.

Nevertheless, embarking on a research career in Mexico is not necessarily easy for a young scientist. Hardships may sometimes lead to the decision to temporarily emigrate. This is the case of Dr Peña Rodriguez (see Box 6 in chapter 4) who, despite a good start in his career, returned to Canada, where he had studied earlier, to take up a post-doctoral position after two years in Mexico. His decision followed a professional crisis: "the research project was progressing slowly, the institution was facing big changes and many of my colleagues were leaving. I had the feeling that I was dying professionally and felt really isolated". But soon after, he realised that he had made a mistake and that he had to go back to Mexico whatever the difficulties. He is today back in Mérida where he has formed a research team as well as strong professional ties with colleagues in many countries in Latin America. "These collaborations", he says, "are much stronger than the ones I still develop with colleagues in the North".

| Number of years spent abroad | For higher education and training | | For all reasons | |
|---|---|---|---|---|
| | No. of grantees | % of all | No. of grantees | % of all |
| 0.1 - 2 | 15 | 20.0 | 11 | 14.9 |
| 2.1 - 4 | 24 | 32.0 | 24 | 32.4 |
| 4.1 - 6 | 21 | 28.0 | 19 | 25.7 |
| 6.1 - 8 | 10 | 13.3 | 13 | 17.6 |
| 8.1 - 10 | 4 | 5.3 | 4 | 5.4 |
| 10.1 - 12 | 1 | 1.3 | 1 | 1.4 |
| 12.1 - 14 | 0 | 0.0 | 1 | 1.4 |
| 14.1 - 16 | 0 | 0.0 | 0 | 0.0 |
| 16.1 - 18 | 0 | 0.0 | 0 | 0.0 |
| 18.1 - 20 | 0 | 0.0 | 1 | 1.4 |
| **Responses** | **75** | | **74** | |
| **Mean number of years** | **4.7** | | **5.2** | |

Table 27
**Time spent abroad (Q13 and Q14)**

| | No. of Respondents | Responses | |
|---|---|---|---|
| Offered employment abroad | 49 | Accepted offer | 10 |
| | | Declined offer | 38 |
| Not offered employment abroad | 50 | | |

Table 28
**Offers of employment from abroad (Q28)**

Other, more personal, reasons may also lead to the decision to emigrate temporarily or permanently. This was the case of Martha Fuentes Rangel who left her institution in Mexico to accompany her husband while he was working for an international company, first in the United States and then in Venezuela. Today, she is back in Mexico, but she has not resumed her work as a scientist[39].

To the best of our knowledge, only two IFS grantees are true cases of external "brain drain": Dr Helbert Almeida Dominguez and Dr Miguel Garcia-

38. In 30 years, CONACyT's Scholarship Program has given a total of 100,021 Awards. This study is based on a sample of 2000 former beneficiaries.

39. This information was provided by a former colleague of the former grantee as a result of attempts to locate her.

Winder[40]. Dr Almeida Dominguez left his institution in Mérida in 1997 to join Texas A&M University where he works at the cereal quality laboratory of the soil and crop sciences department. Dr Garcia-Winder is today Vice-President of a dairy company in the United States (see Box 10). At the age of 34, Dr Garcia-Winder left an already highly successful academic career to start an administrative career in the public sector in Mexico. He was about to set up his own business when he was offered his present job in the United States. His reason for leaving scientific research was purely economic, he says. Yet, he makes regular visits to Mexico. For example, he was interviewed at the UNAM where he had just taken part in a course on writing research proposals for the benefit of his younger colleagues from the UNAM.

## 7.10 Conclusions

While 80% of the grantees hand in a report that is satisfactory or better, in too many cases (9 out of 69) the grantees' files were closed with no final report. To ensure that all final reports are submitted to IFS, it is proposed to establish an incentive. It is also suggested that in many cases, one grant should have been enough to become an established scientist. Academic promotion of grantees during the time that they were supported by IFS was found to be relatively low but this is partly due to the fact that the large majority of them already had a PhD when embarking on the IFS project. Most of the grantees progressed significantly in the SNI system, many reported receiving a national or international distinction in recognition of their outstanding scientific work, and a tangible number enjoyed institutional promotions after becoming IFS grantees. Although it is difficult to measure the exact role that the IFS support played in these promotions and distinctions, many grantees recognized that the IFS grant came at the right time in their career and that in addition to confidence building, it brought recognition, prestige and visibility that contributed to their promotions.

While mobility of scientists in Mexico is comparatively low, highly skilled Mexican scientists continue to establish themselves permanently abroad, mainly after getting their academic degrees abroad, and mostly in the United States. Many of the IFS grantees went abroad for postgraduate studies, but most of them returned home immediately after or very soon after they received their PhD. Many respondents to the questionnaire have been offered employment abroad (mainly in the USA and in Europe), but very few accepted it. When they accepted, it was for a relatively short period and, to the best of our knowledge, all but two returned to Mexico. Even if IFS supports scientists that have already decided to return to or have already returned to Mexico at the time they apply for their first grant, it is an outstanding result that should be partly attributed to IFS.

40. We have attempted to identify the whereabouts of nine former grantees who did not respond to any of our correspondence. Using the Internet, six of them were found to be stil located in Mexico, leaving only three former grantees that are "missing". There is no evidence to suggest that the three remaining scientists have left Mexico, but it is nonetheless possible.

Box 10:
**Dr Miguel Jorge Garcia Winder**

Having moved to the United States in 1995, Dr Garcia Winder represents one of the few cases of brain drain among IFS grantees in Mexico. While he lives in the United States, he nevertheless maintains contact with the Mexican science community.

Dr Garcia Winder's first extended foray outside of Mexico was to pursue his education; first a Master's degree in Animal Sciences (1981-1983) and then a PhD in Reproductive Physiology (1983-1986) from the University of Nebraska, USA. During and after his work towards a PhD, he was a researcher and lecturer at Centro de Ganadería of the Colegio de Postgraduados (COLPOS) in the State of Mexico. In 1989 he was promoted to director and held that position until 1991 when he accepted the National Directorship of the Production and Technical Services in LICONSA (Leche Industrializada CONASUPO).

It was while working at the Centro de Ganadería that Dr Garcia Winder heard about IFS through a friend of a friend. After discovering the potential that IFS support had for starting his career as an independent researcher, he applied for funding. Subsequently, Dr Garcia Winder was awarded an IFS grant to study the effects of time and intensity of suckling on post partum reproductive efficiency in crossbred cows, and the effect of suckling on the performance of the cows and calves during the first 100 days after calving. He began his research in 1989 and got consistent results from the project over the next five years. This line of research continues today at the Colegio de Postgraduados and a Doctoral student will soon graduate using this field as his primary topic.

The IFS money was used to develop Dr Garcia Winder's laboratory through the purchase of equipment and reagents, and to graduate a Master's student. Dr Garcia Winder noted that though the monetary value of IFS grants is not great, it came at a critical point in his career. The grant provided him with peace of mind and freedom from the need to search for money, furthermore, it allowed him to begin on a productive line of enquiry that lasted for six years and was subsequently continued by Jaime Gallego, a colleague. The research results from the IFS supported project have since been used to modify some traditional suckling systems in the tropics. Calves are no longer kept continuously with their mothers, thus allowing the cow to produce milk for human consumption and to return more promptly to oestrus. Improvements have also been found in calf growth. More than a decade after receiving the grant, some of Dr Garcia Winder's IFS sponsored equipment is still being used by scientists at the research institute.

Dr Garcia Winder had a successful scientific career. He authored more than 30 papers in the national and international journals, and by the age of 30 (in 1987) he was already level II in the SNI. However, in 1995, Dr Garcia Winder left both his research career and Mexico to work as Vice President of International Marketing of T.C. Jacoby & Co. Inc., Dairy Product Merchants in Saint Louis, Missouri. While he had not been looking for a job in the USA, after two directorships during which he found it difficult to keep up with his research, teach, and earn a sufficient income, he had begun to consider founding his own consulting firm. At about the same time he encountered T.C. Jacoby, who offered him a position with his company in the United States.

Dr Garcia Winder still misses the research environment. He continues to be associated with researchers and enjoys taking part in courses from time to time. At the time of his interview (June 2000), he was considering a part-time teaching position at a university in the United States.

# 8. Limiting factors for research and IFS support

It is essential for the success of IFS that the organisation has an understanding of what the needs of its beneficiaries are, and what effect the provision of IFS support has for the amelioration of those needs. In the following chapter we present both the grantees' evaluation of the difficulties they face while conducting scientific research in Mexico, and their evaluation of the quality of IFS support. Results are based upon both the questionnaire survey and interviews of grantees.

## 8.1 Main factors limiting grantees' research

Grantees were asked, in an open question, to identify the three factors that most limited their research. Their responses were grouped in nineteen categories (n=231) and one miscellaneous group (n=39). Figure 38 shows that lack of funding, lack of time, and equipment constraints were the most important constraints limiting grantees' research in Mexico.

Next, grantees were presented with ten different recurring difficulties that are encountered while conducting research. They were asked to rate their magnitude as insignificant (1), tolerable (2), serious (3), or obstructive (4). Grantees evaluated the difficulty level for when they were young scientists and, if there had been a change, for the present. The response rate for each of these questions was high, ranging from 96 to 102 responses. Most answered the question regarding when they were young sci-

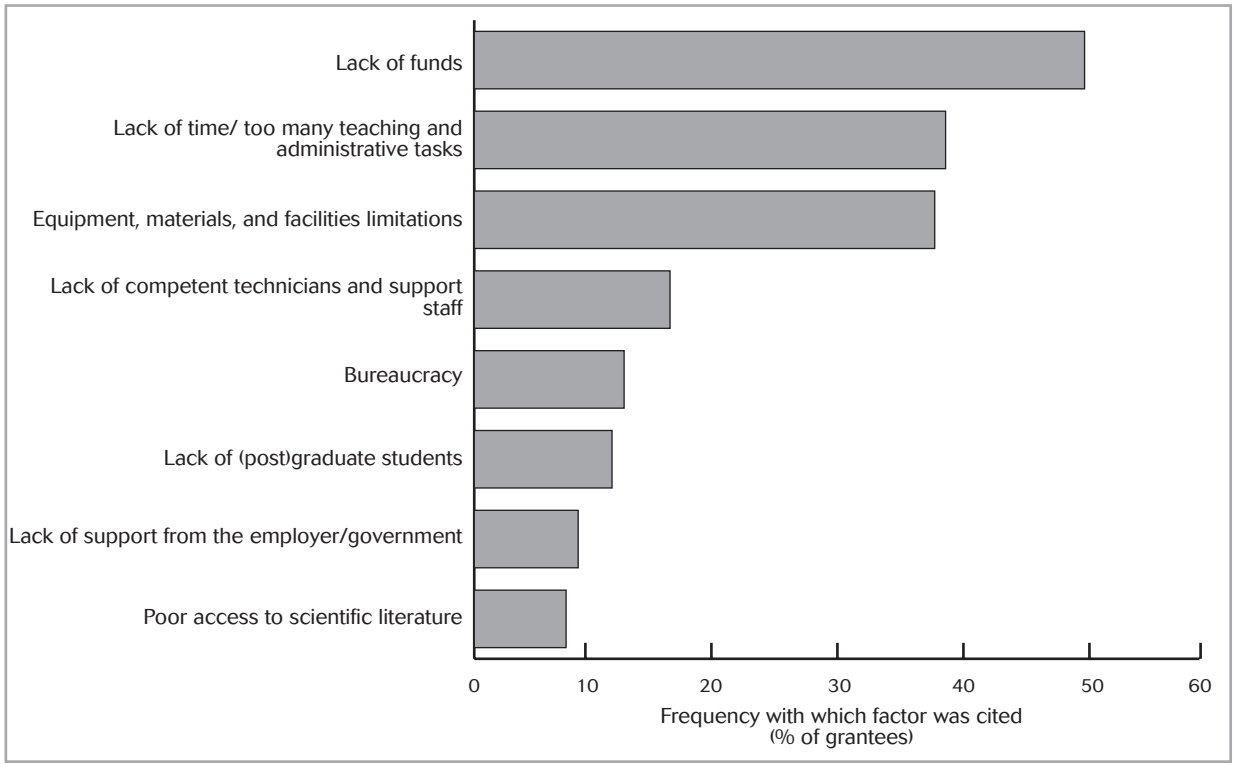


Figure 38
**Factors most limiting grantees' research in Mexico (Q39)**

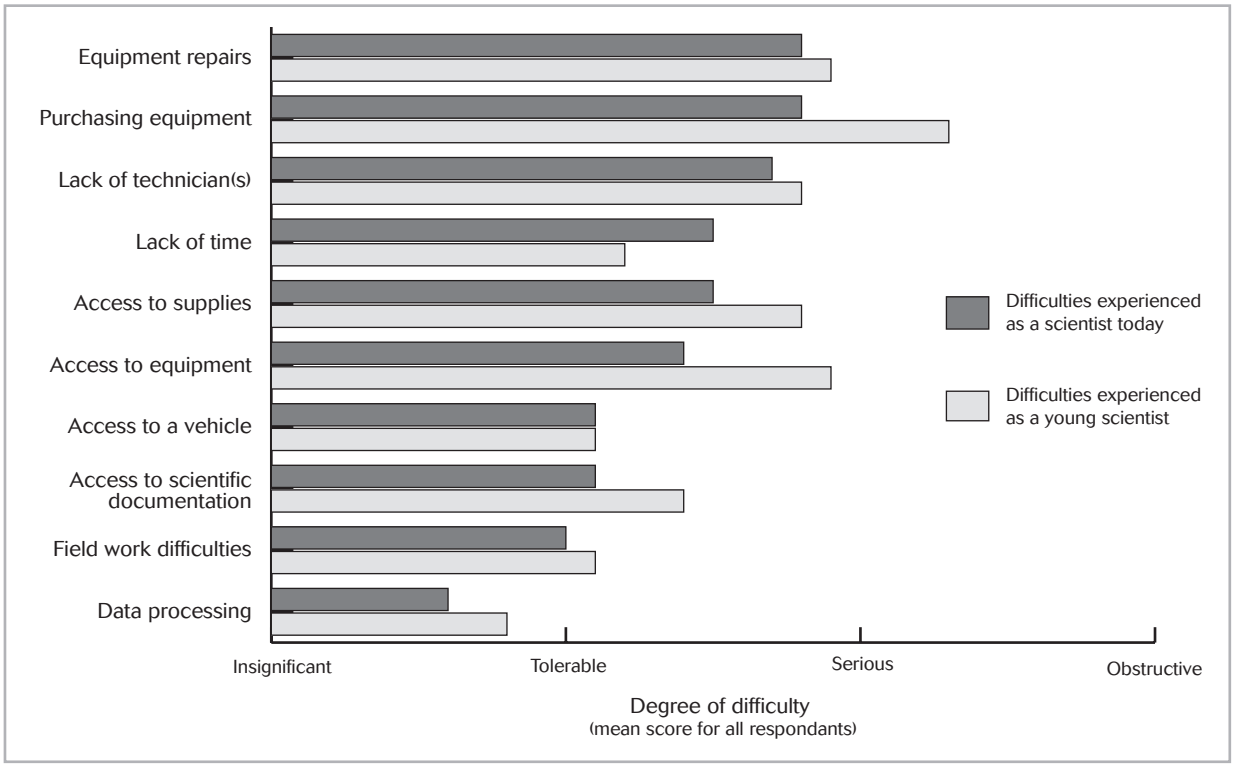


Figure 39
**Comparison of difficulties experienced as a scientist in Mexico (Q40 and Q41)**

entists, and about two-thirds reported a change between then and the present. If a grantee did not answer question 41 (recurring difficulties today), then their answers for question 40 were assumed to be true for "today" as well, and they were factored into the analysis for question 41 (see Figure 39).

For young scientists and grantees today, purchase of equipment was the difficulty that most consistently caused serious and obstructive problems. As young scientists, only 19 of 101 grantees felt that difficulties related to the purchase of equipment were tolerable, and for none was it insignificant. For grantees today, equipment purchasing is still one of the greatest difficulties. For some it has become easier, but for over half it is still a serious or obstructive problem (Figure 40). In addition, equipment repair was consistently a problem for grantees. Sixty-eight grantees felt that it was serious or obstructive when they were young scientists, and today 62 grantees still agree. Meanwhile, access to equipment has improved slightly with time.

As grantees age they become responsible for more administrative tasks and for more teaching. Hence, it is no surprise that lack of time was the one difficulty that increased in seriousness.

## 8.2 Relative importance of IFS support

In an effort to understand the importance of IFS support to grantees' research, they were asked to indicate whether they would have been able to continue their research without IFS funding (see Figure 41). Most of the respondents (73 of 105) would have carried out their research nevertheless, but in a substantially different form or on a reduced scale. A significant minority (17 grantees) would have been able to find other support, and four grantees could have carried out the work without any external support. Only nine grantees would not have been able to carry out their research without IFS support; thus suggesting that while IFS may not be essential to most scientists' research, it is a valuable catalyst for their work.

This conclusion is supported by the results from interviews with grantees in Mexico. Numerous grantees noted that the value of IFS support cannot be measured solely in terms of the monetary value of the grant.

However, in their interviews, many grantees believed that the maximum amount of the grant was far from adequate and should be increased. USD

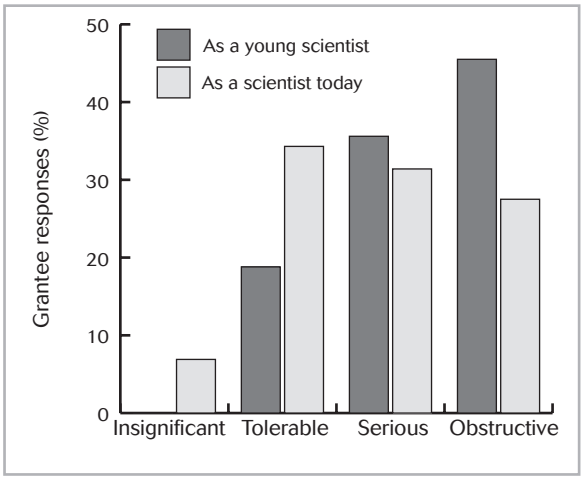


Figure 40
**Grantees' evaluation of the level of difficulty encountered with the purchase of equipment**

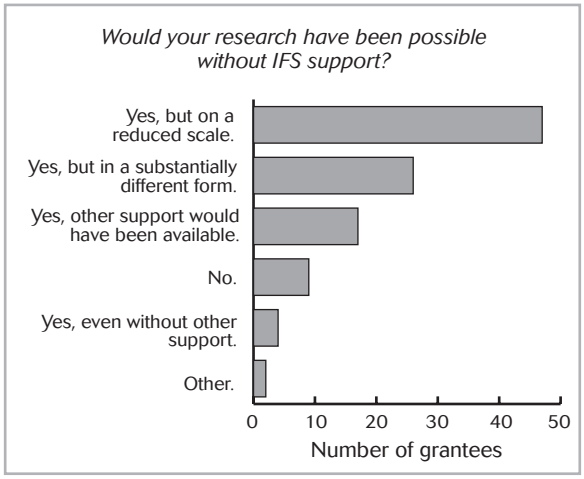


Figure 41
**Importance of IFS support to grantees' research (Q50)**

12,000 is considered to be too little to get started (particularly for the first grant). While many grantees shared the view that the small size of the grant is one of the main limiting factors of the IFS grant, a few remarked that because the Secretariat can purchase equipment at better prices and avoid some taxation, the money stretches further than it otherwise would. Others grantees that were unsatisfied with the grant size recognized that it could be enough for a young scientist who already has the basic infrastructure in which to work.

These results have implications for IFS policy. Given the relatively large amount of funding available nationally in Mexico (see chapter 5), the responsibility for easing equipment difficulties may be better assumed by Mexican institutions. However, if the IFS grant[41] is inadequate for the needs of researchers in Mexico, IFS should develop a strategy for increasing its size, or instead concentrate on promoting networking and information exchange rather than equipment purchase.

## 8.3 The catalytic role of IFS support

One reason for providing funding to young researchers, is to give them support when they are the most vulnerable. It is hoped that IFS support will carry with it networking opportunities and prestige that opens doors to additional funding. For many grantees, it appears that IFS does have a positive effect on funding opportunities (see Box 11). Of 88 responding grantees, 57% reported that it had become easier to obtain funding from their institution following IFS funding, and 53% had found it easier to obtain funding from national sources. As discussed in Chapter 5, international support for research in Mexico is relatively low, nevertheless 16% of grantees found it easier to obtain international support for their research after receiving IFS funding. Meanwhile, 48 out of 100 grantees found that it had become easier to obtain scientific and technical assistance from their institutions. While this is a positive indicator, the results from questions 40 and 41 on the questionnaire (Figure 39) remind us that those improvements have not eased the demand for assistance with equipment purchase, maintenance and repair.

The provision of networking opportunities is a form of support that IFS values highly, but is difficult to quantify for donors. Thus, it is informative that 80 of 101 respondents found that IFS support provided new networking opportunities, and for 90% of those grantees these collaborative relationships continued beyond the period of IFS support. One grantee remarked that "one workshop on Natural Product Chemistry organised by IFS in Chile in 1994 was for me a revelation. I had no idea before this meeting that this kind of work was done in Latin America. This opened up tremendous opportunities for collaboration with colleagues in Argentina and Bolivia among other countries." It may be worthwhile for IFS to support more of this type of South-South communication and col-

41. One should note that the grant has been adjusted upwards only once (from USD 10,000 to USD 12,000) during the history of IFS.

laboration. For, presently, grantees in Mexico are not entirely satisfied with IFS's networking support (discussed furher in section 8.4).

## 8.4 An assessment of IFS support

To assess the IFS mode of work and support, grantees in Mexico were asked to rate 13 activities from "selection process" to "follow-up activities once support was terminated" using a numerical scale from one to five (see Figure 42): unacceptable (1), poor (2), satisfactory (3), good (4), or excellent (5). The number of evaluations for each area ranged from 71 to 100. Though some of the activities are not directly central to the mandate of IFS (eg assistance in the publication of research results) and some have been discontinued (eg maintenance of research equipment), the comparison of the different activities can help to identify activities that deserve strengthening and areas that are problematic for grantees.

Grantees were very satisfied with IFS grant administration. Of 98 respondents, 78 found the grant administration to be excellent and 14 believed it to be good. This appreciation for IFS's grant administration became all the more apparent when, in many of the personal interviews, grantees favourably compared IFS's efficiency in this respect with CONACYT and/or their home institution (see Box 12).

As shown in section 8.1, grantees identified equipment purchase, access, maintenance and repair as top factors that limit their ability to engage in research. In question 55, the grantees provide a positive evaluation of IFS' efforts to alleviate equipment-related difficulties. The IFS purchasing department received high marks for their work assisting grantees to purchase needed equipment and arranging for its delivery. Of 92 respondents, 56 felt that their service was excellent and 27 believed it to be good; only two grantees were less than satisfied. Support for the maintenance of research equipment did not receive equally high marks, but nevertheless 44 grantees out of 78 believed it to be good or excellent, and only 13 were unsatisfied. A partial explanation for this response may be that the IFS equipment service and maintenance program was not active in Mexico. Hence, IFS has not been able to fill the needs of all grantees.

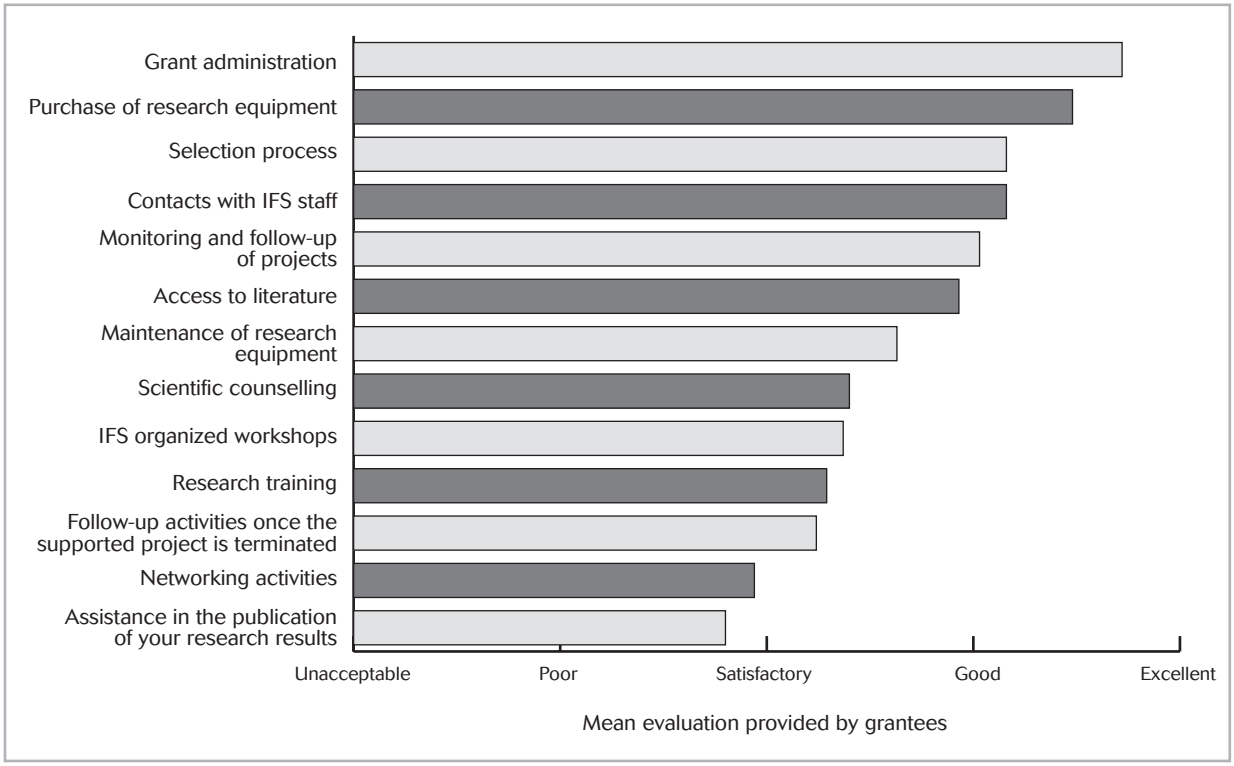


Figure 42
**Grantees' assessment of the IFS mode of work and support (Q55)**

Overall, most grantees are very satisfied with the selection process (85 of 98 found it to be good or excellent). This might not be too surprising since we are dealing with successful applicants. Yet, during the interviews, at least two for whom the first application was postponed and finally approved were grateful for the constructive criticisms received from IFS that enabled them to successfully rewrite their projects.

The interviews also revealed, not surprisingly, that grantees tend to be more critical when their renewal applications are not approved (reasons for rejection are discussed in greater detail in section 7.3), either because they do not agree with the criticisms made by IFS or because they do not agree that the renewal application should be refused on the grounds that the previous project gave negative results. In the latter case, a grantee claimed that one can learn from negative results and that negative results also contribute to the advancement of science. Equally important criteria for screening progress reports and renewal applications could be the publications of results, the social, economic or policy impact of earlier research, support for training of students, and the development of science infrastructure.

Grantees were very positive about their contacts with the IFS staff and the monitoring and follow-up of IFS supported research projects. Over 70% of 84 respondents felt that the access provided by IFS to scientific literature was of good or excellent quality. The mean scores for IFS's scientific counselling, workshops, research training, and follow-up activities after the termination of the IFS project fell in the satisfactory to good range. IFS believes that these activities are important services, but they are secondary to the Granting Programme in Mexico. Hence, grantees' variable experience with them is partially explained by the secondary priority that these activities receive in the IFS budget. Receiving the lowest score was assistance in the publication of research results. This is not unexpected given the *ad hoc* nature of IFS support for publication.

Box 11
**Interview excerpts (part one)**

In the interviews with grantees, several researchers remarked upon the importance of IFS funding with regard to opening doors to new opportunities for research support.

*"The grant allowed me sufficient resources with which to 'start work', to begin publishing in journals and to put me in contact with peers."*

*"Having an international recognition such as IFS gives a certain prestige in the institute and helps to obtain other benefits."*

*"My newly approved IFS grant (1999) was the first source of money I was granted for research. This project would not have been eligible by CONACYT because it was too basic. Soon after getting the IFS support, I was successful in obtaining funding from CONACYT through their programme to support "proyectos de instalación" for recent PhDs. Other funding sources secured around the same time were from the regional CONACYT funds (in Guanajuato, SIHGO-Sistema Miguel Hidalgo) and some funds from CONCICET. From these sources I received about 10 times the amount I received from IFS for a project that was predominantly applied, with some basic science elements. The fact that I was the first researcher at my institute to get an IFS grant helped me secure other support."*

Box 12
**Interview excerpts (part two)**

Like funding from one's home institution, CONACYT grants are generally highly regarded by Mexican researchers; they provide both for postgraduate studies (covering fees and medical insurance) and for the repatriation programme (covering travel costs to come back to Mexico and a salary for the first six months). However, when grantees compared their experiences with the administration of CONACYT and home institution grants, with their experiences of IFS grant administration, they clearly expressed their appreciation for IFS's administrative efficiency.

*"Although the IFS grant is small compared to other funding sources, it is more flexible."*

*"IFS is all CONACYT isn't."*

*"I used the IFS money to buy diving and computer equipment without having to deal with the usual university bureaucracy."*

*"The lack of bureaucratic problems associated with the IFS grant is a definite advantage."*

*"IFS was quick to approve the application and make the grant available whereas grant money from CONACYT was slow to be made available."*

*"The IFS grant is very flexible allowing money to be moved between different budgetary items."*

An issue that demands attention, however, is the fact that IFS networking activities received a less than satisfactory evaluation (see Figure 43). Networking is one of the key components of IFS support that justifies the relatively high overhead costs of the Secretariat. In the questionnaire survey, more grantees believed the networking activities to be of poor or unacceptable quality (n=29) than good or excellent (n=23); 20 were satisfied. Furthermore, only 72 grantees responded to this part of question 55, indicating that many did not have a strong opinion. In Africa, too (See Gaillard and Furó Tullberg, 2000), networking received a lower score than the other primary components of IFS support, but in Africa grantees were still generally satisfied with networking support (mean score was 3.3 in Africa and 2.9 in Mexico).

In contrast to the results from the Mexico questionnaire, during the interviews many grantees expressed their appreciation for the networking opportunities that their IFS grant provided. Hence, it is perhaps a subgroup of Mexican grantees that are being left out of IFS networking activities.

Except for IFS workshops[42], networking activities are most often made available only when they are requested. For example, on applications researchers are asked for the names of experts in their field with whom they would like to get in contact. If a list of experts is provided, IFS usually sends the application for the experts' review. IFS also provides travel grants to support conference visits, but normally this service is provided based upon a request by the researcher. Furthermore, as shown in section 5.5, the Mexican government sponsors most of the conferences that grantees attend. Thus, it is likely that some Mexican grantees already have strong networks and funding for travel, and that IFS support for networking is not necessary. This may explain why many Mexican grantees did not have an opinion regarding the quality of IFS support for networking. IFS should, however, review its methods of publicising opportunities for networking support, and modify its promotional material if it is found to be necessary.

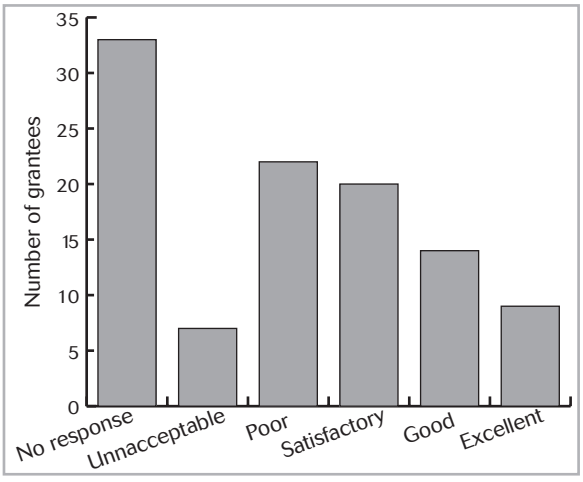


Figure 43
**Grantees' assessment of IFS networking activities (Q55)**

IFS can improve its networking support for grantees in Mexico by targeting it to have the greatest effect in the areas of greatest need. Specifically, links between grantees in Mexico and their colleagues in other developing countries are relatively weak compared to grantees' links with the North (see Chapter 5). By using IFS travel grants to encourage grantees in Mexico to establish working relationships with scientists in other developing countries, IFS would be targeting its resources to a niche that is under-emphasised by Mexican and other funding organisations. Furthermore, given the resources and the strength of the scientific community in Mexico, communication and collaboration between researchers in Mexico and researchers in countries with fewer scientific resources is likely to have a strengthening effect for the scientific communities of the latter countries. By concentrating its networking efforts in one thematic area, South-South networking, IFS can conceivably strengthen the effects of its support for the scientific community in Mexico, as well as for other countries in the South.

## 8.5 Conclusions

Grantees' responses make a strong case for the continuation of IFS support in Mexico. The questionnaire study indicates that though grantees may have been able to conduct research without the IFS grant, IFS support strengthened grantees' position within their own institution and made them more effective at finding subsequent funding.

Meanwhile, grantees in Mexico feel that further support for equipment maintenance and repair is needed to increase the effectiveness of their research efforts. However, given that international organisations (IFS included) are not the primary

42. Only one IFS workshop has been organised in Mexico (see Chapter 1).

research funding providers in Mexico, the role of IFS in the provision of equipment and maintenance service in Mexico deserves further discussion (See chapter 10).

Lastly, in this chapter we found that there is a significant gap between some grantees' expectations of networking support and the quality of support that they receive from IFS. Given the national and international resources available to scientists in Mexico, IFS should respond to these expectations by focusing networking activities on an area that is less emphasised by other funding sources: the facilitation of South-South communication and collaboration. Care should also be given to informing grantees regarding the availability and conditions of such networking support.

# 9. Science, society and career goals

How do grantees in Mexico value science, and how do they perceive their role in society? How do they evaluate the Mexican government's attitude towards research, and what do they know about the Mexican people's expectation from their work? What are their future career goals? Using information obtained from the IFS questionnaire study and interviews with grantees in Mexico, we will attempt to answer these questions in the following chapter.

## 9.1 Research: its perceived role

Grantees in Mexico were given 11 statements concerning the role of science and scientists in society and were asked to assign a score from 1 (disagree completely) to 5 (agree completely) to each statement. Figure 44 below and Table A12 in appendix 7 present the responses to the proposed value statements.

The three statements that grantees found most agreeable were: "science contributes to development", "science should first produce knowledge", and "scientific knowledge is universal". Despite the common belief that "Mexican people consider Mexican scientists to be unable to respond to the problems of the country", as was reported in several interviews, the respondents to the questionnaire were convinced that research should contribute, first and foremost, to solving the economic and social problems facing Mexico.

Most grantees in Mexico are affiliated with a public institution and, by law, their research results belong to the state. One may conclude from the general agreement expressed in the questionnaire survey to the statement that scientific knowledge is a public good, that grantees in Mexico are satisfied with this situation.

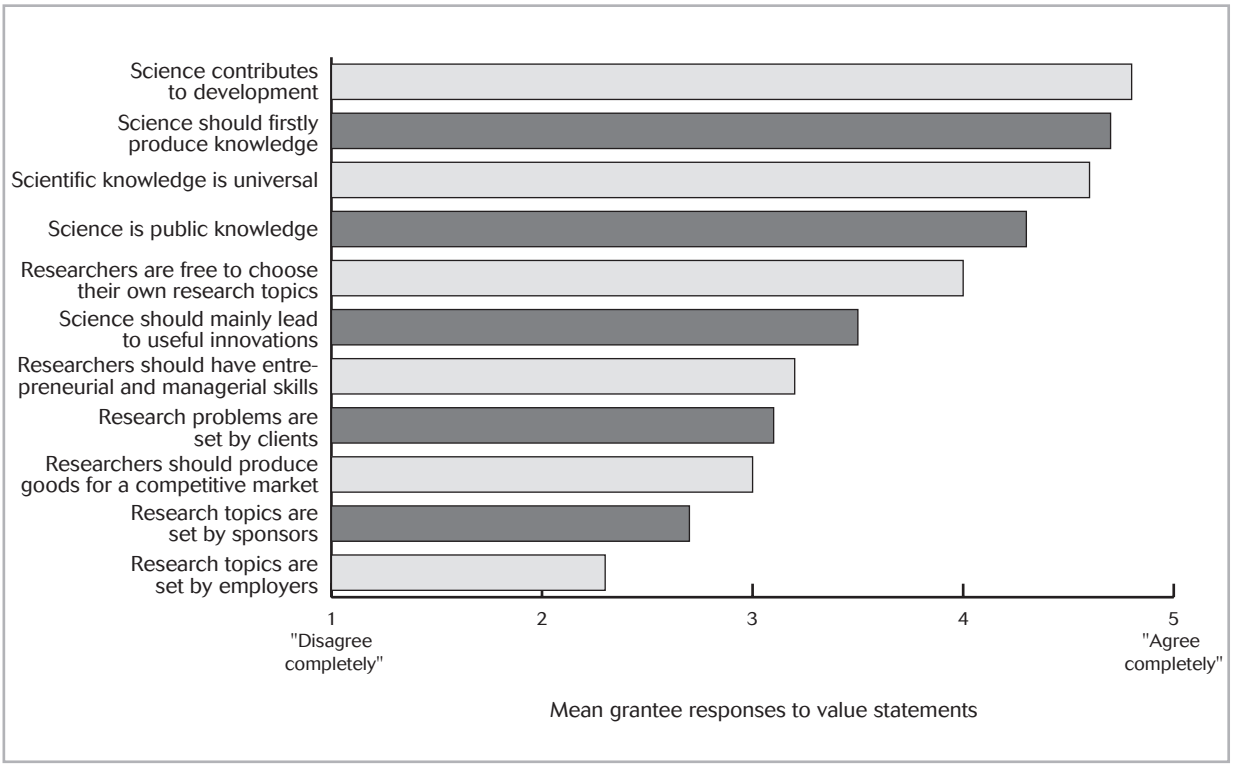


Figure 44
**Mean grantee responses to value statements (Q34)**

Meanwhile, the fact that grantees in Mexico assign much less importance to the market, potential clients, and sponsors for setting research problems suggests the absence or weakness of a "demand pull" from the Mexican economic or production system. Many grantees interviewed were of the opinion that collaboration between researchers and users/producers is very important for both parties. However, they recognise that it is a difficult partnership for a number of reasons including high turnover (problem of re-negotiating arrangements with new people) and the unwillingness to invest in long-term projects on the part of the private sector. Producers, they claim, tend to want short-term solutions, which scientific research is not usually able to provide.

Several grantees also mentioned that support from private industry or local producers was "in kind," such as provision of experimental animals or feed for experimental animals, rather than money. Others also mentioned that the protocols for these short-term applied projects funded by the industry were set by the sponsors rather than the scientists themselves, with the result that the researchers lost control of their own research agenda. This is another reason for tension between researchers and the productive sector, a large majority of the former agreeing that "researchers are free to choose their own research topics" (mean value=4.0).

Several interviews confirmed that meetings between researchers and the productive sector are being organised. The three following excerpts from interviews illustrate the efforts made by IFS grantees, as well as the difficulties that they encountered, to strengthen their working relations with the private sector:

> *"The support received from the industry for research is extremely deficient. I have tried to involve local industry in my work but "they" tend to back off when it comes to investing money. I believe the problem is partly cultural and partly due to the fact that these are small and medium-sized industries that don't have much capital, especially with the present economic crisis of the country. Yet, links with local industry are vital for both parties, for the researchers to understand the problems that the producers have and for the producers to understand how research can help them. I always invite members of the industry to the meetings I organise."*

> *"I work closely with local co-operatives which is essential for my work. They provide transport and other local expenses for myself and my students as well as experimental species such as juvenile and adult abalone fishes. I believe that in general scientists in my field of marine biology are unaware of the needs of the producers. Food for abalone processed with some of the IFS equipment is being sold to a commercial enterprise, and the money used to support one of my students".*

Another grantee working in the area of parasitology in an agricultural technology institute has used a questionnaire to identify the most pressing problems facing local farmers. Regretting the lack of extension services in his institute, he deplored the fact that he had to do everything himself: "Every week, I make trips to visit farms in the region. They co-operate in my research by providing animals and I have the support of the local Farmers' Union for the publication of brochures disseminating some of my research findings in an attempt to reduce the level of pesticides in the region".

## 9.2 Science and State support

Most grantees interviewed recognise that the Mexican government has made an effort in the recent past to increase funding for research activities. Yet, they are also of the opinion that Mexico should invest a larger proportion of its GNP in R&D activities (at least 1% as compared to 0.4% today). They also deplore a lack of a clear national R&D policy and of an independent body advising the Mexican government on R&D issues. Thus, not surprisingly, Mexican grantees' perception of the Mexican government's attitude toward research is variable (see Figure 45).

Many grantees also believe that Mexican research is too geared towards world science, and would like to see more emphasis placed on projects directed towards solving problems of national importance. They accuse the SNI system of being responsible for this shift (see Box 13). Many would also like to see more research funding come from the industry and more joint research between public research institutions and the productive sector. This seems to be very much in line with what the newly appointed team at CONACYT is aiming to implement (Robles, 2001).

Many of the grantees interviewed describe their salaries as scientists as "competitive", taking into consideration not only their basic salary but also the various additional income schemes such as the SNI

and institutional productivity bonuses. Only a few (largely non-SNI members) consider salaries to be low compared to salaries in the US.

From the interviews carried out as part of the present impact study, it is clear that the income received by the members of the SNI is essential for sustaining a decent standard of living, in the absence of which the majority of scientists would be forced to look for other ways of supplementing their earnings. Scientific prestige is associated with a high level in the SNI and membership is often a requirement for applying for research funding from national bodies. The SNI is generally looked upon as a "necessary evil," although the pressure of having to maintain the required level of productivity, particularly in international journals, is influencing the scientists' research agendas and priorities.

## 9.3 Science and society

Many grantees taking part in the interviews think that not enough is done in Mexico to raise public awareness of science and recognition of the value of scientific research. They believe that the Mexican public understands little of what scientists do and that Mexican industry is not interested in sponsoring research carried out by Mexican scientists. The two statements below summarise what we heard during many interviews.

> *"The Mexican public does not understand what scientists do and for this reason scientists are not held in high public esteem and are considered a luxury… this is partly the fault of the Mexican scientific community which has made little effort to improve the situation."*

> *"I do not think that Mexican society holds scientists in great esteem, mainly because of ignorance of what a scientist does. The economic crisis also makes people want immediate solutions to problems."*

Despite these difficulties and problems of communication, many IFS grantees have been effective at disseminating their research results to potential

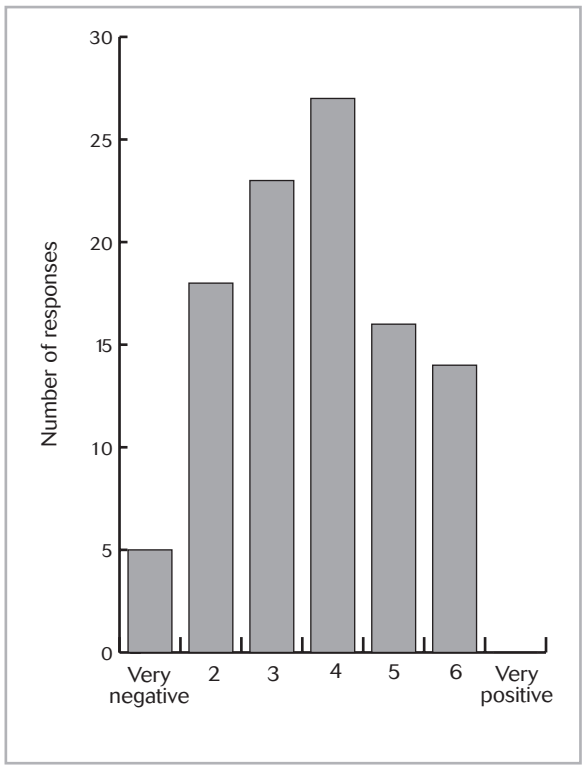


Figure 45
**Grantees' perception of the Mexican government's attitude toward research (Q42)**

Box 13
**What do IFS grantees think of the SNI system?**

While most grantees consider the SNI bonuses to be a fundamental part of the scientist's income, they are overwhelmingly critical of the SNI system. The main criticisms are summarised below:

> *"The SNI is a praiseworthy initiative but it needs to be evaluated as it has changed what scientists do and why they do it. The objectives of research are centred on staying in the SNI and no longer have much to do with scientific considerations."*

> *"A few years ago, the work of my Centre was more inclined towards applied aspects but because of the way research is presently evaluated both internally and externally (SNI), a change is occurring towards basic research."*

> *"By evaluating international publications only, they (the SNI) are prejudicing the development of applied projects focusing on the resolution of local and national problems. This is detrimental to the development and consolidation of national journals."*

> *"There should be a balance between basic and applied research in Mexican science policy. Thirty percent of a researcher's salary should not depend, as in my case, on the SNI. These kind of bonus schemes cause people to try to publish as much as possible regardless of the scientific quality."*

users. Dr Quezada's project is illustrative of this trend (see Box 14).

## 9.4 Career goals

The results of the questionnaire survey (see Figure 46) indicate clearly that the overwhelming majority (83%) of IFS grantees in Mexico want to pursue a national scientific career (the percentage for the same question in Africa is 43%). The career goal coming second, far behind a national scientific career, is a career within foreign or international organizations. The other career goals are much less attractive, and none are interested by a career in politics.

Grantees' intentions to pursue a national scientific career were confirmed in most interviews. Many of the IFS grantees interviewed find their work as a scientist intellectually stimulating and are motivated to train people "to think differently". A few also said that they considered their future bright in the public sector (SNI members).

In addition to contributing to scientific knowledge in their field of research (publishing scientific papers in internationally recognised journals), and training a new generation of researchers, many of them told us that they want "to offer a useful product to Mexican society", or, as another grantee put it, "transcend the scientific environment of publishing to produce new information of direct benefit to producers".

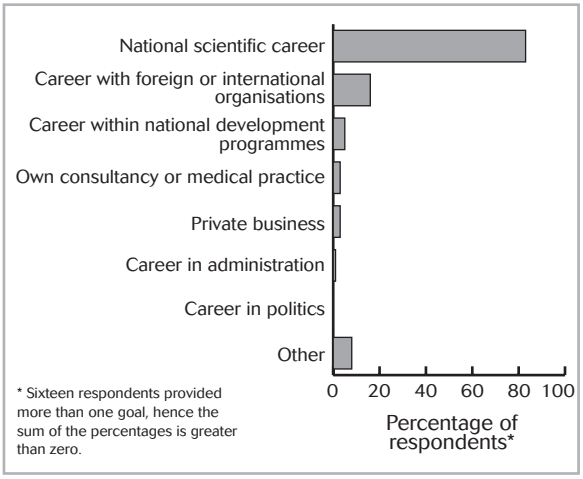


Figure 46
**Grantees' career goals (Q56)**

## 9.5 Conclusions

Grantees in Mexico are frustrated by their relationship with the Mexican public and Mexican industry. They feel that the public misunderstands the value of science to the welfare of society, and that the Mexican government through SNI encourages this misunderstanding by rewarding scientists for research and publications that are often irrelevant to the natural resource problems faced by Mexico. Meanwhile, grantees in Mexico strongly believe that science is a public good, and that the practice of science should have positive development outcomes and applications. However, the relationship between grantees in Mexico and private business is problematic. Grantees expect to be able to steer their own research independently, and they are unsatisfied with industry's short-term perspectives and desire to influence the research project.

Nevertheless, grantees in Mexico are positive about their work and their positions as scientists in Mexico. They generally look forward to a long national scientific career, and are optimistic that they can influence public opinion and find new ways in which to work co-operatively with private interests.

Box 14
**Dr Javier Quezada**

Dr Quezada's interest in bees began the moment he became involved in a small research project on a local breed of bees as an undergraduate student. Upon returning to Mérida in 1991 with a MSc, he successfully applied for an IFS grant and was appointed research assistant at the UADY. His IFS grant played, he says, a major role in the fact that he was granted the position. The first equipment in his research centre came from this IFS grant and is still in use. All of the papers published by Dr Quezada and his team on morphometrics derive from the work performed using this equipment. Part of the results had direct applications and allowed the Ministry of Agriculture of Yucatán to map the density of bees in the peninsula as well as to increase their surveillance of African-derived bees. As a practical result, beekeepers became more aware of and could better prevent the colonization of local breeds. Dr Quezada is pleased with the fact that the knowledge developed through his research had practical impacts on bee-keeping in the region.

# 10. Conclusion and recommendations

The history of scientific institutions in Mexico dates back to the middle of the 16th century when the National Autonomous University of Mexico (UNAM) was established. Many of the public universities located in the different states were also founded as colleges during the time when Mexico was a Spanish colony. More institutions, including universities and research institutes, were created during the 20th century. Attempts to decentralise research activities by establishing universities in the states and creating the SEP/CONACYT network of research centres were made in 1992, but scientific research in Mexico remains highly centralised within the Federal District of Mexico. As shown in this report (see in particular chapter 3), IFS grantees are concentrated in two regions (Yucatán and Mexico, DF) and in four institutions, but also dispersed in 22 of the 30 remaining states, with 17 institutions having one grantee only. Thus, IFS support for scientists in Mexico has also been a contribution to the decentralisation of research activities in Mexico.

Today, Mexico has a strong system of higher education and research institutions with a number of advanced research centres of excellence, some of which are highly visible in mainstream science. Furthermore, the higher education system is in a position to train an increasing number of graduate and postgraduate students, though the number is still much less in comparison to the total population size than for other OECD countries.

The federal government is the principal funding body for scientific research, as well as the principal executor of S&T activities in Mexico. Government support for S&T activities increased significantly during the last decade, but the level of investment (0.4% GDP for the period 1995-1999) remains well below that of other OECD countries. Although its size is difficult to estimate, Mexico has at its disposal an increasing number of S&T personnel, the elite of which is represented by the 6,742 researchers that are members of the Sistema Nacional de Investigadores[43] (SNI). A number of research funding schemes have also been created by CONACYT in the recent past, including a programme for the repatriation and retention of Mexican researchers, a programme for funding the research projects of young scientists, and a programme for the support of the decentralisation of scientific and technological activities.

Nevertheless, some important problems remain. One is the weak collaboration existing between researchers and the users/producers. Related to this is the weak demand for scientific research results in Mexican industry. The lack of a well-defined and continuous science policy for the country was mentioned by many of the scientists interviewed. Another problem is the important disparities existing between well supported institutions of excellence (some, but not all, being located within the federal district of Mexico) and weaker institutions with fewer resources. In particular, scientists from the weaker institutions find it both more difficult to access federal funding resources, and to become members of the SNI programme. As a consequence, their working conditions are far less favourable than for their colleagues who benefit from CONACYT support and complement their income with the SNI and other institutional productivity bonus programmes. Although IFS support had an impact on the development of the career of most grantees in Mexico, in both well supported institutions of excellence and in weaker institutions, IFS support is most needed in the latter category of institutions.

Although the present survey is based on a very specific and limited sample, we believe that many characteristics of the population surveyed are representative of the Mexican scientific community today. Thus, the results obtained should be of interest not only to IFS and CONACYT but also to a wider audience interested in strengthening science

43. National System of Researchers

capacity in the developing world. Some of the main characteristics of the population surveyed are summarised below:

- Although a significant number of the scientists have obtained their highest degree abroad (mainly in the US, UK, and France), the majority of all degrees are taken (and increasingly taken) in Mexico.
- The scientists are usually affiliated with a public institute of higher education or, but less frequently, with a public research institute.
- Although the scientists are young at the time they receive their first grant from IFS, at the time of the survey the population includes a wide range of ages.
- The scientists are partly concentrated in the capital city, and in particular at the UNAM, but to a much lesser extent than the overall Mexican scientific community.
- The majority of the scientists (but not all) are members of the SNI programme.

One important feature and bias of the sample is that it is limited to biological, agricultural and environmental sciences (with a further bias toward Animal Production science). A number of other research areas that are important in Mexican science are excluded from the survey (eg medicine, engineering and social sciences).

Before putting the main findings into perspective and discussing the extent to which they may call for an adaptation and revision of the IFS mode of work in Mexico, some of these are highlighted below.

## 10.1 Highlights of the main findings

### *1. Impact of IFS support.*

A number of potential impacts were analysed in this report. While changes can be ascertained, the key question is the extent to which they can be attributed to IFS support (the IFS support was often the first support that a grantee received in his or her career, but not necessarily). Ideally, to answer this question a control group should be identified and surveyed. However, the constitution of an appropriate control group proved to be too problematic, and the survey of such a control group would have been beyond the resources allocated for this study. Yet, SNI membership (and non-membership) can, in some contexts, be used as a yardstick to make comparisons. Different periods (before, during, and after the IFS support) were also used to make comparative analysis of the IFS impact. From these different impact analyses, we can conclude that IFS had a number of positive impacts. The publication trends show that IFS support led Mexican grantees to publish more frequently, more often in English, and more often in mainstream scientific journals. Answers to the interviews also confirmed that, in many instances, IFS also had a positive impact on the institutional promotion of grantees, on their progression in the SNI system, and on the award of national and international distinctions. IFS contributed to the internationalisation of the career of many grantees, was a catalyst for collaboration with other scientists, and opened doors to additional funding opportunities. Lastly, it is believed that the IFS grant contributed to the grantees' establishment as scientists in Mexico, thus contributing to reducing the likelihood of brain drain.

### *2. Mobility and brain drain.*

As shown in chapter 7, migration of Mexican postgraduate students, mainly to the United States, remains a stepping-stone to permanent migration. Mobility for research training and higher education abroad is also high in the population of IFS grantees, but most of them returned home immediately or very soon after they received their highest degrees. In most cases, they were also granted an IFS grant soon after receiving their highest degree. The decision to get established and remain in Mexico can of course not be attributed to one factor only. However, it is believed that the IFS support was a contributing factor explaining why most of the IFS grantees are still active in the Mexican scientific community today, 27 years after the first grant was given to a Mexican scientist. Out of 138 grantees, only two clear cases of brain drain to the US were found, and in one of the two cases the interview showed that the grantee had kept close professional ties with Mexico and was still contributing to the development of Mexican science. Low mobility of Mexican scientists can also be explained by a number of additional factors, including institutional constraints and overall satisfactory living conditions.

### *3. Basic salary, SNI and productivity bonuses.*

Although a large number are unsatisfied with their basic salary, many of the grantees interviewed described their salaries as competitive when taking into consideration not only their basic salary, but also the various additional income schemes, such as the SNI and productivity bonuses from their respective institutions. The SNI is essential for sustaining a decent standard of living, in the absence of which many scientists are forced to look for other ways of supplementing their earnings. One should also keep in mind that while for the scientists at the UNAM the SNI contribution is a complement to their main salary, in other institutions it could be the main source of income.

IFS has indirectly contributed to improving grantees' salary since one of the primary measurements used to judge SNI entry and promotion is publications. However, it appears to be easier to enter the SNI system as a candidate than to remain in the system. In 2001, more than one half of all SNI candidates were removed as they could not gather the five publications that are required to move to level 1. Here again, IFS, by contributing to increased publication output and, in particular, publication in mainstream scientific journals, plays a role in keeping IFS grantees in the SNI system during the early part of their career.

It may be expected that nearly all IFS grantees should become SNI members. However, many do not. Why? One possible explanation is that while grantees may enter the system as candidate with one or two publications, they may be excluded after a few years because they fail to continue to publish in mainstream journals after the IFS support is terminated. This is particularly likely for the grantees in the provincial universities with limited infrastructure and resources for research who may find it more difficult to raise funding for research once the IFS support is over.

### *4. The IFS grant and overall research funding.*

As shown in the questionnaire survey, the Mexican government and the grantees' home institutions are the primary source for research funding. Most of the respondents to the questionnaire also recognized that they would have been in a position to carry out their research work (in a substantially different form or on a reduced scale) without IFS funding. To the extent that it is given at the very beginning of their research careers, the IFS grant does constitute a valuable catalyst for the establishment of the IFS grantees' careers. But the monetary value of the IFS grant (USD 12,000) may not always be adequate for the Mexican grantees' research needs today, and may need to be readjusted for inflation or purchasing power. Yet, as many interviewed grantees pointed out, the IFS support cannot be judged solely in terms of the monetary value of the grant : the IFS grant is much more than USD 12,000.

### *5. The IFS grant and other support.*

Purchase, service and maintenance of research equipment are reported as being among the most important constraints to grantees' work, particularly at the beginning of their research career. Taking into account the relative development of scientific activities and the resources available in Mexico, it is believed that the responsibility for the purchase, service and maintenance of equipment should be delegated to the grantees' institutions. Recommendations on how to best implement such a change are proposed in section 10.2.

### *6. Communication / getting connected.*

Mexican scientists are well connected via the Internet and conferences to the international scientific community (mainly US and Canada), but to a much lesser extent to the rest of Latin America and the rest of the world. In particular South-South communication and collaboration are limited. While during the interviews many grantees stressed the importance and expressed their appreciation of the networking opportunities that their IFS grant provided, IFS networking activities received a less than satisfactory evaluation in the questionnaire survey. South-South collaboration and networking activities are two complementary areas where IFS could play a greater role and make a difference for the benefit of the Mexican grantees. This is further discussed below.

### *7. IFS in Mexico.*

IFS started its activities in the 1970s and soon afterward CONACYT was established. At that time, CONACYT was not as active in its support for Mex-

ican research as it is today. Given the establishment of many new research grant schemes at the federal and provincial levels, including grants to young scientists, is the IFS still needed in Mexico today? While conditions have changed, the results of this study provide enough evidence that the IFS grant continues to constitute an important catalyst for the establishment of the young Mexican scientists who have been awarded a grant at the very beginning of their research careers. However, the IFS mode of work in Mexico and the eligibility of Mexican scientists need to be revised.

## 10.2 Revisiting IFS work in Mexico

The results and discussion presented in this study suggest that a revision of the eligibility of Mexican scientists for IFS grants is necessary. In this section, a new role for Mexico in the IFS work in Latin America is also advocated.

### *1. Being established and not being established.*

Given the development of the higher education system and research activities in general, in Mexico a PhD should be a prerequisite for an IFS grant. In exceptional cases, MSc holders or PhD students could be considered, particularly when the applicant is working in one of the provincial universities. However, IFS should no longer consider a BSc to be a sufficient qualification. In a few cases it is clear that IFS grants given to Mexican researchers having only a BSc were not very successful, or even complete failures. At the other extreme, IFS should not support established scientists that are members of the SNI in the top categories. Candidates should be eligible, and in exceptional cases level I, but level II and III scientists should be disqualified.

### *2. Number and size of the grant.*

Based on the information gathered during the interviews, one can argue that in most cases (and in particular for the most recent grantees) one grant could have been enough. Very soon after the first grant was awarded, many grantees became rapidly established and were able to attract funding from other sources (mainly from national sources). In a limited number of cases, two grants may have been necessary, especially when the grantee was working in a weaker institution. If the general rule becomes to give one grant only, the recipient should be informed at the time that the first grant is awarded, not at the time of the renewal application. In the case where one grant only would be given, the size of the grant may need to be readjusted for purchasing power, particularly if IFS were to decide to reduce or stop the provision of supporting services, such as purchasing equipment, in Mexico (see below).

### *3. What supporting activities in Mexico?*

As discussed above, it is recommended that the responsibility for the purchase, service and maintenance of research equipment should be delegated to the grantees and/or the grantees' institutions. These activities should be part of the learning process for grantees and their institutions. To that end, IFS may provide guidelines and organise training courses to transfer its accumulated knowledge. If the IFS grantees were to purchase their equipment directly or through their national institutions, the price charged by the firms (in particular local firms) might be significantly higher. To compensate for this price increase, the size of the grant should be adjusted. As shown in the questionnaire survey, Mexican scientists do receive support to attend conferences in Mexico and in the North (mainly US and Canada), but they do not seem to be as well connected to the rest of Latin America and the rest of the world. Hence, the award of IFS travel grants for participation in conferences in Latin America (outside Mexico) and the rest of the developing world should be given priority. South-South networking should also be strengthened by travel grants and other means.

### *4. Centres of excellence and weaker institutions.*

IFS has supported Mexican scientists working both at research centres of excellence and of international reputation as well as at more marginal research institutions with very little research tradition and where research activities do not receive much institutional support. While IFS had an important impact on the career development of most grantees at centres of excellence, the impact of IFS support proved to be even more important for those working at institutions with more modest resources. Similarly, it is important to keep in mind that it is easier for Mexican scientists working at centres of excellence or well established univer-

sities to get research funding. The same applies to entry into the SNI programme. It is therefore recommended to concentrate IFS support to Mexican scientists at institutions with limited infrastructure and resources for research. While doing so IFS should ensure that the necessary supervision is secured and that support for networking activities compensate for the lack of a critical mass of researchers within the grantees' institution. Former Mexican grantees working in centres of excellence could be used in this context.

### *5. National and mainstream science.*

As shown in chapter six, IFS has made a positive contribution to Mexican grantees' overall scientific production, as well as to their publication in English and in mainstream journals. This led to increased visibility of their work in mainstream science and to strengthening the internationalisation of Mexican science. While doing so, grantees in Mexico continued to publish in Spanish and in national journals. IFS should continue to encourage its grantees to publish in mainstream journals, while stressing the importance of also supporting good quality local journals.

### *6. A new role for IFS and Mexico in Central America.*

While Mexico has today developed a wide-ranging system of higher education and research institutions with a number of advanced research centres of excellence, many countries in the Central American region such as Nicaragua, Honduras and Guatemala are lagging behind. IFS, together with its member organisation in Mexico (CONACYT), and with former IFS grantees in Mexico acting as a resource-base, could contribute to strengthening science development in some of the weakest countries in the Central American region. Such a concerted effort could include research grants, networking activities and training courses, as well as scientific supervision and counselling.

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# Appendix 1: The questionnaire

## Questionnaire for IFS Grantees in Mexico N° .....

(leave blank)

This questionnaire is intended for all IFS grantees. Even those grant recipients no longer receiving support from the Foundation for their research work are invited to participate in this survey.
To answer, use the space provided, tick the box □, or circle the relevant number (1, 2, 3 ...).

**I Civil status, education and mobility**

| | |
|---|---|
| 1. Family name(s):<br>Name(s):<br>(underline the name under which you publish) | 2. Name and address of your home institution: |
| 3. E-mail address: | |
| 4. Citizenship: | 5. Sex: □ male □ female |
| 6. Year of birth: | 7. Civil status: □ single □ married □ widowed |
| 8. How many children do you have? | 9. If you are married, what is your spouse's principal occupation? |

10. Academic degrees obtained

| Degrees | Area of specialisation | Year degree awarded | Educational establishment | Fellowship/study grant obtained from |
|---|---|---|---|---|
| BSc/*Licenciatura* | | | | |
| MSc/*Maestría* | | | | |
| PhD/*Doctorado* | | | | |
| Post-Doc/*Estancia Posdoctoral* | | | | |

11. Membership of the SNI (*Sistema Nacional de Investigadores*)

| | |
|---|---|
| Are you currently a member of the SNI?<br>□ Yes □ No | Year of entry into the SNI<br>19 ____ |
| What is your current level?<br>Candidate I II III | Level of entry<br>Candidate I II III |

2

12. List your academic visits abroad (stay of at least 2 months) since you were awarded your highest degree

| Year | Institution | Country | Duration (x months) |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

13. How many years have you spent outside your country for higher education and training, including postdoctoral studies and academic visits abroad? _____ years

14. How many years in total have you spent abroad? _____ years

**II Career**

15. List all the positions you have held since the beginning of your career

| Position (*puesto*) | Employing institution | Country | Starting date | % of research time |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

16. How did you get your present position?

□ Promotion □ Advertised position □ Recommendation
□ Other (specify) ……..

3

17. In your present position give the approximate amount of time devoted to the different activities listed below and indicate in the second column what, according to you, it should ideally be.

| Activities | Present % | Ideal % |
|---|---|---|
| Teaching | | |
| Research | | |
| Administration | | |
| Extension | | |
| Consultancy | | |
| Other (specify) | | |

18. How many postgraduate theses have you supervised? None
Master's: _____ PhD: _____

19. Do you regularly (at least every other semester) give classes at postgraduate level?
□ Yes □ No

20. Do you consider that the salary you receive as a scientist is adequate to support you and, if applicable, your family? □ Adequate □ Inadequate

21. How many times higher than the minimum salary in your country is your salary as a scientist/teacher ?
_____ times more

22. In which institutional framework do you work today?

□ Public University □ Private University
□ Public Institute □ Private Institute
□ Non Governmental Organization (NGO)
□ Others (specify) _____

23. Given the institutional framework in which you work, would you consider the following elements as relative advantages or disadvantages ?

| | Advantage | Disadvantage |
|---|---|---|
| Salary scale | □ | □ |
| SNI | □ | □ |
| Institutional productivity bonus programmes (*estimulos*) | □ | □ |
| Career development | □ | □ |
| Job security | □ | □ |
| Social benefits | □ | □ |
| Retirement | □ | □ |
| Others (specify) _____ | □ | □ |

24. If you have extra jobs to supplement your income and, if applicable, your family, indicate how many additional hours you spend working per week. _____hours

25. If you have extra jobs, how many times more income do they provide you with in comparison to your basic salary as a scientist ? _____ times more

26. Specify the nature of your extra jobs

□ Teaching
□ Farming
□ Own consultancy or medical private practice
□ Somebody else's consultancy or medical private practice
□ Own private business
□ Somebody else's business
□ Other (specify) _____

27. Compare your total family income with your salary as a scientist/teacher or and, if applicable, indicate how many times more it corresponds to: _____ times more

28. Have you ever been offered employment abroad? □ Yes □ No

If yes, in which country (ies)? _____

Did you accept the offer(s)? □ Yes □ No

**III Research Choice and perception of research**

29. Since the beginning of your research career, have you substantially changed your scientific orientation/research subjects? Yes □ No □

30. What is your main field of science at present, e.g., agronomy, zoology, parasitology, etc.?
_____

31. To carry out your research activities, do you usually work alone or with other scientists? □ Alone
□ With other scientists

32. Whenever you work with other scientists do you usually work in monodisciplinary or multidisciplinary research teams ? □ monodisciplinary □ multidisciplinary

33. How often do you communicate with the following people regarding your research? (1 = never, 2 = rarely, 3 = annually, 4 = monthly, 5 = more often.)

1 2 3 4 5 Scientists in your department
1 2 3 4 5 Scientists from other institutions in your country
1 2 3 4 5 Scientists in other Latin American countries
1 2 3 4 5 Scientists in USA or Canada
1 2 3 4 5 Scientists in Europe
1 2 3 4 5 Scientists in Asia
1 2 3 4 5 Scientists in the rest of the World
1 2 3 4 5 Funding agencies
1 2 3 4 5 Non Governmental Organizations (NGOs)
1 2 3 4 5 Private clients
1 2 3 4 5 Consultancy groups
1 2 3 4 5 Extension staff
1 2 3 4 5 Others (specify) _____

5

34. Indicate whether you agree with the following assertions by circling a number from 1 = "disagree completely" to 5 = "agree completely".

1 2 3 4 5 Science is public knowledge
1 2 3 4 5 Scientific knowledge is universal
1 2 3 4 5 Science contributes to development
1 2 3 4 5 Science should firstly produce knowledge
1 2 3 4 5 Science should mainly lead to useful innovations
1 2 3 4 5 Researchers are free to choose their own research topics
1 2 3 4 5 Research topics are set by sponsors
1 2 3 4 5 Research topics are set by employers
1 2 3 4 5 Research problems are set by clients
1 2 3 4 5 Researchers should produce goods for a competitive market
1 2 3 4 5 Researchers should have entrepreneurial and managerial skills

**IV Access to scientific literature and attendance at conferences**

35. Do you have easy access to the Internet ? □Yes □No

36. Do you have access to bibliographic databases? □Yes □No
If yes, which one(s)? _____

37. How many scientific conferences have you attended since the beginning of your research career?

| Conferences | With national support | With IFS support | With foreign support** | Without support |
|---|---|---|---|---|
| In Mexico | | | | |
| In Latin America & Caribbean* | | | | |
| In USA and Canada | | | | |
| In Europe | | | | |
| In Asia | | | | |
| In the rest of the World | | | | |

*Except Mexico **Except IFS

38. How many scientific conferences have you attended outside your country during the last five years?
_____ conferences

**V Main research constraints and research evaluation procedures**

39. What are, according to you, the three main factors holding back your research work in order of importance?
1. _____
2. _____
3. _____

6

40. What were the main difficulties you experienced as a young scientist starting on a research career? Indicate by circling the relevant number (1, 2, 3, 4) whether they are 1 = insignificant, 2 = tolerable, 3 = serious, or 4 = obstructive, according to you, in your research work.

| | | | |
|---|---|---|---|
| 1 2 3 4 | Access to equipment | Lack of technician(s) | 1 2 3 4 |
| 1 2 3 4 | Purchasing equipment | Field work difficulties | 1 2 3 4 |
| 1 2 3 4 | Equipment repairs | Access to vehicle | 1 2 3 4 |
| 1 2 3 4 | Access to supplies | Access to scientific documentation | 1 2 3 4 |
| 1 2 3 4 | Lack of time | Data processing | 1 2 3 4 |
| 1 2 3 4 | Others (specify) _____ | | |

41. What are your recurring difficulties today (if different from above)?

| | | | |
|---|---|---|---|
| 1 2 3 4 | Access to equipment | Lack of technician(s) | 1 2 3 4 |
| 1 2 3 4 | Purchasing equipment | Field work difficulties | 1 2 3 4 |
| 1 2 3 4 | Equipment repairs | Access to vehicle | 1 2 3 4 |
| 1 2 3 4 | Access to supplies | Access to scientific documentation | 1 2 3 4 |
| 1 2 3 4 | Lack of time | Data processing | 1 2 3 4 |
| 1 2 3 4 | Others (specify) _____ | | |

42. How do you perceive your government's attitude toward research? Indicate the attitude by circling one number between "very negative" (1) and "very positive" (7).

1 2 3 4 5 6 7

43. Which criteria are the most important for the promotion of scientists in your country? Circle one number from 1 = not important at all to 5 = very important

| | | | |
|---|---|---|---|
| 1 2 3 4 5 | Seniority | Contribution to teaching | 1 2 3 4 5 |
| 1 2 3 4 5 | Contribution to development | Contribution to the institution | 1 2 3 4 5 |
| 1 2 3 4 5 | Publications in local journals | Publications in international journals | 1 2 3 4 5 |
| 1 2 3 4 5 | Award of research grants | Strategic social relations | 1 2 3 4 5 |
| 1 2 3 4 5 | Others (specify) Citation to their papers | | |

44. Is your research work evaluated regularly? ☐Yes ☐No

45. If yes, by whom? _____

**VI Research Funding and Academic Distinctions**

46. What was your annual research budget (excluding salaries) last year, to the nearest U.S. $1,000 ?
U.S. $ _____

7

47. What were your sources of research funds as percentages (excluding salaries) last year ?

| Sources | % |
|---|---|
| Home institution | |
| Federal funds | |
| Industry or private foundation (national) | |
| Industry or private foundation (foreign) | |
| International organization | |
| Other (specify) | |
| Total | 100 |

48. List the different funding institutions from which you have received financial support for your research activities since the beginning of your research career, excluding IFS and your own institution. Indicate your degree of satisfaction (1 = very bad, 2 = bad, 3 = average, 4 = good and 5 = excellent)

| Years | Name of funding organizations | Country | Amount in US $ | Degree of satisfaction |
|---|---|---|---|---|
| | | | | 1 2 3 4 5 |
| | | | | 1 2 3 4 5 |
| | | | | 1 2 3 4 5 |
| | | | | 1 2 3 4 5 |
| | | | | 1 2 3 4 5 |
| | | | | 1 2 3 4 5 |
| | | | | 1 2 3 4 5 |
| | | | | 1 2 3 4 5 |
| | | | | 1 2 3 4 5 |
| | | | | 1 2 3 4 5 |

49. Have you received any national or international scientific prizes or distinctions?

. □ Yes □ No

If yes, which one(s)?

□ Premio Nacional de la Ciencia □ Premio Universidad Nacional □ Premio AIC/AMC
□ Premio OEA □ Miembro Electo Colegio Nacional □ Miembro US Nat Acad Sci
□ IFS Sven Brohult Award □ IFS Silver Jubilee Award □ IFS King Baudouin Award
□ Others (specify) _____

**VII Relative importance of IFS support and future research goal**

50. Would you have pursued your research if IFS funding had not been made available?

□ Yes, other support would have been available □ Yes, but on a reduced scale
□ Yes, but in a substantially different form □ No
□ Yes, even without other support □ Other (specify) _____

8

51. Since becoming an IFS grantee, has it become easier for you to obtain:

| | Yes | No |
|---|---|---|
| 1. Additional funding from your institution | ☐ | ☐ |
| 2. Additional funding from a national funding institution | ☐ | ☐ |
| 3. Additional funding from an international institution | ☐ | ☐ |

If yes to 3, give name _____

52. After receiving support from IFS, did it become easier for you to obtain scientific and technical assistance from your institution?

☐ Yes ☐ No

53. Has the IFS support provided opportunities to collaborate with new partners ?

☐ Yes ☐ No

54. Whenever applicable, did you continue to collaborate with them once the support was terminated ?

☐ Yes ☐ No ☐ Not applicable

55. How would you assess the IFS mode of work and support to your research work ? (1 = unacceptable, 2 = poor, 3 = satisfactory , 4 = good and 5 = excellent)

1 2 3 4 5 Selection process
1 2 3 4 5 Grant administration (including transfer of funds)
1 2 3 4 5 Monitoring and follow-up of projects
1 2 3 4 5 Contacts with IFS staff
1 2 3 4 5 Purchase of research equipment
1 2 3 4 5 Maintenance of research equipment
1 2 3 4 5 Access to literature
1 2 3 4 5 Research training
1 2 3 4 5 Scientific counselling
1 2 3 4 5 IFS organized workshops
1 2 3 4 5 Networking activities
1 2 3 4 5 Assistance in the publication of your research results
1 2 3 4 5 Follow up activities once the supported project is terminated
1 2 3 4 5 Other (specify) _____

56. What is your future career goal?

| | | | |
|---|---|---|---|
| ☐ National scientific career | ☐ Career in administration | ☐ Career in politics | ☐ Private business |
| ☐ Own consultancy or medical practice | ☐ Career within national development programs | ☐ Career within foreign or international organisations | ☐ Other (specify) _____ _____ |

Thank you for your co-operation. Please return the completed questionnaire together with a complete list of publications (articles, books, papers in proceedings, reports, etc.) in the original language of publication (names of co-authors, full titles of articles, books, papers, scientific journals, volume(s), first and last pages, date of publication, etc.), and **mark with an asterisk in the margin the ones which are directly derived from IFS support**.

# Appendix 2: Response rate to the questionnaire

The questionnaire was sent to all 138 IFS grantees in Mexico. 105 were returned duly filled in giving an overall response rate of 76%.

Of present grantees (still benefiting from IFS support), 91.3% responded (63 of 69) to the questionnaire. Of former grantees, 60.9% (42 of 68) responded.

Response rates by scientific areas are overall satisfactory even if grantees in Food Science (E), Animal Production (B) and Forestry (D) tended to respond less than the average.

| Area | Total | received | response rate |
|---|---|---|---|
| A | 18 | 15 | 83.3 |
| B | 47 | 33 | 70.2 |
| C | 21 | 18 | 85.7 |
| D | 19 | 14 | 73.7 |
| E | 24 | 16 | 66.7 |
| F | 7 | 7 | 100.0 |
| G | 2 | 2 | 100.0 |

**Response rates by research area**

| Grants | Total | received | response rate |
|---|---|---|---|
| 1 | 81 | 65 | 80.2 |
| 2 | 42 | 30 | 71.4 |
| 3 | 15 | 10 | 66.7 |

**Response rates by number of grants**

### *Explanation for the grantees not considered in the statistics*

In Mexico, there have been three "not started" grants, and they will not be considered.

There have been two "shared" grants in Mexico. In both cases (grants B/242-X and B/416-1X), only the second holder of the grant[44] is considered.

The first holder of grant B/242-2X is now deceased; he is the only deceased grantee in Mexico during the period 1974-1999.

Two of the grantees in Mexico are of non-Mexican nationality: grantee holding grant D/2617-2 is from Costa Rica and C/2864-1 from Brazil. They have been considered when appropriate

One grantee, A/845-3X, got her 3 grants when she was working in Cuba. As of 1998, she was working in Mexico. She was not considered in the statistics.

44. In the case of the first holder of the grant B/242-2X, after having moved to a second institution, he applied for and got a second grant, B/512-2X. This grant will not be considered in the statistics. The grantee is now deceased.

# Appendix 3: List of IFS grantees interviewed

| STATE<br>Institution<br>Grantee | SNI | Grant no. | No. of grants | Year of grant | Active Y/N | Area | Sex | Interviewer |
|---|---|---|---|---|---|---|---|---|
| **AGUASCALIENTES** | | | | | | | | |
| INST. AGROPECUARIO | | | | | | | | |
| Cruz Vázquez, Carlos | Y | 2588 | 1 | 4 | Y | B | M | JR |
| UNIV AUT AGS | | | | | | | | |
| Rico Martínez, Roberto | Y | 2648 | 1 | 4 | Y | A | M | JR |
| **BAJA CALIFORNIA NORTE** | | | | | | | | |
| UNIVAUTBC | | | | | | | | |
| Viana, Ma. Teresa | Y | 2205 | 2 | 3 | N | A | F | JR |
| **BAJA CALIFORNIA SUR** | | | | | | | | |
| CIBNOR | | | | | | | | |
| Civera, Roberto | N | 1900 | 1 | 3 | N | A | M | JR |
| Zenteno Savin, Tania | Y | 2968 | 1 | 4 | Y | A | F | JR |
| Racotta, Ilie | Y | 2711 | 2 | 4 | Y | A | M | JR |
| Perez Enriquez, Ricardo | N | 2971 | 1 | 4 | Y | A | M | JR |
| UNIVAUTBC | | | | | | | | |
| Caceres Martinez, Carlos | Y | 1739 | 1 | 2 | N | A | M | JR |
| CUERNAVACA IBT-UNAM | | | | | | | | |
| Galindo, Enrique | Y | 1395 | 3 | 2 | N | E | M | JG |
| **GUANAJAUTO** | | | | | | | | |
| INIFAP | | | | | | | | |
| Castellanos, Javier | Y | 2234 | 1 | 3 | Y | C | M | JR |
| Inst Tecnol Celaya | | | | | | | | |
| Guevara Gonzalez, Ramon G. | N* | 2955 | 1 | 4 | Y | C | M | JR |
| CINVESTAV | | | | | | | | |
| Gomez-Lim, Miguel Angel | Y | 1881 | 3 | 3 | Y | E | M | JR |
| Lozoya-Gloria, Edmundo | Y | 1929 | 2 | 3 | N | C | M | JR |
| Herrera-Estrella, Alfredo | Y | 2446 | 1 | 3 | Y | C | M | JR |
| Silva-Rosales, Laura | Y | 2464 | 2 | 3 | Y | D | F | JR |
| Olmedo-Alvarez, Gabriela | Y | 2604 | 2 | 4 | Y | C | F | JR |
| Guevara Lara, Fidel | Y | 2598 | 1 | 4 | N | C | M | JR |

## IFS grantees interviewed (cont.)

| STATE<br>Institution<br>Grantee | SNI | Grant no. | No. of grants | Year of grant | Active Y/N | Area | Sex | Interviewer |
|---|---|---|---|---|---|---|---|---|
| **MÉXICO DF** | | | | | | | | |
| IPN | | | | | | | | |
| Valdés, Maria | Y | 39 | 3 | 1 | N | D | F | JG/AM |
| UNAM | | | | | | | | |
| Jimenez-Cisneros, Blanca | Y | 1180 | 2 | 2 | N | G | F | JR |
| Zarco, Luis | Y | 1217 | 2 | 2 | N | B | M | JR |
| Bárzana, Eduardo | Y | 1581 | 1 | 2 | N | F | M | JR |
| Rincon, Emmanuel | Y | 1876 | 2 | 3 | N | D | M | JR |
| UAM-Ixtapalapa | | | | | | | | |
| Escamilla-Hurtado, Ma.de L. | N | 738 | 2 | 1 | N | E | F | JR |
| Soriano-Santos, Jorge | N | 2185 | 1 | 2 | N | E | M | JR |
| **MÉXICO (ESTADO DE)** | | | | | | | | |
| UNAM | | | | | | | | |
| Shimada, Armando | Y | 240 | 2 | 1 | N | B | M | JR |
| COLPOS | | | | | | | | |
| Becerril, Carlos M. | Y | 2490 | 1 | 3 | Y | B | M | JR |
| Cobos-Peralta, Mario A. | Y | 2518 | 1 | 4 | Y | B | M | JR |
| **MORELOS** | | | | | | | | |
| CINVESTAV-IPN | | | | | | | | |
| Velazquez, Miguel | N* | 966 | 1 | 2 | N | D | M | JR |
| UNIV AUT MORELOS | | | | | | | | |
| Orihuela, José A. | Y | 2346 | 1 | 3 | N | B | M | JR |
| **QUERETARO** | | | | | | | | |
| UAQ | | | | | | | | |
| Suzan Azpiri, Humberto | Y | 2816 | 1 | 4 | Y | D | M | JR |
| ITESM | | | | | | | | |
| Escamilla Héctor | N | 963 | 1 | 2 | N | C | M | JR |
| **USA** | | | | | | | | |
| T.C.JACOBY & CO. | | | | | | | | |
| Garcia-Winder, Miguel | N | 1415 | 1 | 2 | N | B | M | JR |
| **XALAPA** | | | | | | | | |
| INSTECOL | | | | | | | | |
| Aluja, Martin | Y | 1741 | 1 | 2 | N | C | M | JG |

## IFS grantees interviewed (cont.)

| STATE<br>Institution<br>Grantee | SNI | Grant no. | No. of grants | Year of grant | Active Y/N | Area | Sex | Interviewer |
|---|---|---|---|---|---|---|---|---|
| **YUCATAN** | | | | | | | | |
| UNIV. A. YUCATAN | | | | | | | | |
| Belmar, Roberto | N | 669 | 2 | 1 | N | B | M | JG |
| Castro P, Manuel | N | 302 | 2 | 1 | N | B | M | JG |
| Godoy, Raul | N | 303 | 1 | 1 | N | B | M | JG |
| Aguayo, Ana Maria | N | 1634 | 1 | 2 | N | B | F | AM |
| Chel G., Luis | N | 1402 | 2 | 2 | N | E | M | JG |
| Delgado, Roger | N | 1610 | 2 | 2 | Y | B | M | AM |
| Dominguez A., Jose Luis | N | 1035 | 1 | 2 | N | B | M | JG |
| Pereira P., Fabiola | N | 1376 | 3 | 2 | N | E | F | JG |
| Quezada E., Jose JG | N | 1911 | 2 | 3 | Y | B | M | AM |
| Betancur A., David | N | 2760 | 1 | 4 | Y | E | M | JG |
| CICY | | | | | | | | |
| Pena Rodriguez, Luis Manuel | Y | 1744 | 3 | 2 | Y | F | M | AM |
| Santamaria, Jorge Manuel | Y | 2949 | 1 | 4 | Y | D | M | AM |
| CINVESTAV | | | | | | | | |
| Aldana Aranda, Dalila | Y | 1523 | 1 | 2 | N | A | F | JG |
| ITM | | | | | | | | |
| Rodriguez-Gil, Luis Alfonso | N | 1740 | 1 | 2 | N | A | M | JG |
| ITAGRO | | | | | | | | |
| Rivera-Lorca, Juan Antonio | Y | 2586 | 1 | 4 | Y | B | M | JG |

* Candidate

Interviewers:
AM = Anne-Marie Gaillard
JG = Jacques Gaillard
JR = Jane Russell

Partial interviews were also conducted with Carlos Manuel Echazarreta at Mérida Airport, and Jaime Sosa at Kuntunilkin.

# Appendix 4: Selection of 15 transcribed interviews

Interviews included in this appendix:



## Carlos Caceres Martinez

Centro de Investigaciones Biológicas del Noreste (CIBNOR), La Paz, Baja California Sur, México

Project title: Experimental extensive culture of the Catarina scallop (*Argopecten circularis*)

Dr Caceres Martinez graduated in oceanology from the Universidad Autónoma de Baja California Sur (UABCS), Ensenada, in 1978. He then went to the Université de Bretagne Occidentale in France to do his Master´s (1982) and his doctorate (de Tercer Ciclo) (1984). He returned to the same university and in 1999 graduated in the new doctoral system as he needed the equivalent level to a US or British PhD to further his research career in Mexico. Part of the results that were presented in his doctoral thesis came from the IFS-supported project.

Since 1985 he has been a researcher/lecturer at Universidad Autónoma de Baja California Sur, La Paz. He was the first IFS grantee in this institution, which gave him a certain prestige. Since then there have been others. He was granted IFS funding from 1994 -1996 for a project on the experimental extensive culture of the Catarina scallop. Scallops are normally reared in cages, which is expensive, and he was hoping to develop a method for their extensive cultivation at the bottom of the sea by liberating them in a protected area. However, the presence of predators reduced the population of scallops and the experiment failed. The renewal of his grant was refused on the grounds that the project produced negative results. He was disappointed by the decision which forced him to change his research focus. If he had been granted a renewal he considers he would still be working on his original topic. A paper in a local journal was forthcoming from the first stage of the IFS-supported project on the spatial dispersion of the scallops, as well as an international conference proceedings paper. Two theses - one at undergraduate level and the other at Master´s level were related to the IFS-funded project.

In the proposal for the extension of the project he abandoned the concept of extensive cultivation putting forward the idea of trying to reduce costs of the intensive culture of the scallops in cages. He considers that the IFS projects should be evaluated from two different viewpoints - firstly, their

scientific contribution and secondly, their "social" impact on the training of students and the development of infrastructure. He believes that the refusal to renew his grant was biased towards the first and did not take sufficiently into consideration the second aspect. He also maintains that negative results make a contribution to science.

He found out about the IFS grants by chance from a colleague. He used the money to buy diving and computer equipment without having to deal with the "usual university bureaucracy". Through the IFS-funded project he was able to consolidate his relationship with other researchers in his field.

Prior to the IFS grant he received funding in 1988, in 1989 and again in 1990 from the Education Ministry (SEP). This was prior to the incorporation of CONACYT into the SEP and the creation of the SEP-CONACYT scientific system of research centres. The sums were small but allowed him to carry out fieldwork. The IFS grant of $12,000 US was his first significant money for research which was followed by a bigger grant from CONACYT in 1997 for $800,000 Mexican pesos (probably about $10,000 US at that time) which was for buying scientific equipment to establish an experimental aquaculture laboratory in the UABC which is now equipped and functioning.

This year he has applied for a CONACYT grant involving researchers from CIBNOR and from Université de Bretagne Occidentale which he is hoping will be approved, on the biology of reproduction of two species of molluscs. Though it is not a continuation of the IFS project, it is related. He also has funding via an academic exchange programme between the UABC and the Université de Bretagne Occidentale for research visits for both Mexican and French scientists and for Mexican postgraduate students to do their theses in France which will help implement the project submitted to CONACYT.

He mentioned recent policy changes in the UABC which are detrimental to his research activity. The new administration is only interested in promoting activities that are politically beneficial and research is not properly evaluated. These types of occurrences are not uncommon in Mexico. During the 14 years he has been at the UABC he has created the infrastructure he needs so do research but the new political climate has forced him to take his sabbatical. He would very much like to move permanently to CIBNOR but because pension schemes, bonus payments, etc., are not transferable it is not convenient from the salary point of view. In the CIBNOR they "understand research". He defined his research future as decidedly uncertain and several of his colleges at UABC are in the same position. He mentioned that his own institution has never given him money for research. He has always had to procure his own research money from external funding. CONACYT gave him the grant to study in France. He even got money from CONACYT when he was doing his undergraduate thesis project. "I owe my research career to CONACYT" he said. He mentioned university policy as the main constraint for the evolution of his research. He is not in agreement with the policy of CONACYT to evaluate highly only papers published in indexed journals and considers this to be detrimental to the development and consolidation of national journals. He also believes that there is prejudice against papers coming from developing country institutions during the review process. When a foreign co-author is included it is much more likely that the paper will be accepted.

He described himself as an adventurer with an innate curiosity. He was brought up in Mexico City but was attracted to the field of Oceanology because of the adventure element. Being a scientist in Mexico gives some prestige but social groups tend to be very jealous of each other. He has had small contracts from the private sector mainly for providing some kind of service like supplying juvenile forms. This money he has used to fund thesis projects. He does not have any other jobs and believes that the SNI grant is a fundamental part of the scientist's income. He has just been given membership of the SNI level 1 for another three years. He has been level 1 since 1989. He was a candidate from 1986-1989.

## Maria Teresa Viana Castrillon

Instituto De Investigaciones Oceanológicas, Universidad Autónoma De Baja California (UABC), Ensenada

Project title: Effect of cooked fish silage as a protein source on purified diets for abalone (*Haliotis fulgens*)

Maria Teresa received her undergraduate degree in Biology from the UNAM in Mexico City in 1982 and a NORAD grant from the Norwegians from 1982-1983. The NORAD grant did not allow her to work as recipients were expected to return to their native countries following their research stay. However, she was able to get a work permit if she was accepted for a PhD programme at a Norwegian university. During this time she worked as part-time university researcher and, for one year, for a Norwegian biotechnology company while reading for her doctorate at the Norwegian College of Fishery Science at the University of Tromso in northern Norway. She stayed on another year following completion of the PhD and returned to Mexico in 1990. Her reason for returning was to make a professional name for herself who was proving difficult in Norway "as a woman and as a foreigner". In Mexico she was offered jobs both at UABC (University of Baja California) and at CIQRO (Centro de Investigaciones de Quintana Roo, now part of the Colegio de la Frontera Sur [EcoSur], a SEP/CONACYT institute in Tapachula) in Chetumal, Quintana Roo. The salary was more in CIQRO but the infrastructure was non-existent. She also had family living in Ensenada so opted for the job at the Institute for Research in Oceanology at UABC. She did a year's postdoc in 1996 at the Aquatic Resources Research Institute, Chulalongkorn University, Bangkok.

She considers that in Mexico her field of aquaculture suffers from a lack of adequate undergraduate training as well as a shortage of researchers specialised in this field. Her training in Norway, where the field is more interdisciplinary, was important for her development in this area. She feels she has learnt from researchers in related fields with which she has had close contact as she has been able "to take something from each of these fields". No single discipline in Mexico is wholly equipped to work in this field due to its interdisciplinary nature. Her present funding from CONACYT is a collaborative project involving national and international researchers with expertise in different fields; veterinary science, biology, statistics, etc. In this way she has been able to resolve her problem of the absence of national peers. Of the 45 researchers in her institution only 18 are members of the SNI. The productivity of the majority could be improved. This is partly due to the fact that many are older researchers who started work when productivity was not an important issue.

Her research interest is the utilisation of fish waste, a line of research that she pioneered in the UABC and for which no equipment was available except a spectrometer. For this reason her first projects were relatively simple experiments and her first grants used to buy essential equipment. She received her first research grant from the SEP (Mexican Ministry of Education) in 1991 just after her return to Mexico for a research project on the commercialisation of fish viscera and then her first CONACYT grant from 1992-1994 prior to the IFS grant in 1994. She was the first person in the UABC to be awarded an IFS grant and her institution gave some additional money to allow her to buy the equipment she needed for the IFS project. Since then she has received two further CONACYT grants and one from her own institution. Her present CONACYT funding of approximately $360,000 US (1999-2002) is for a group project on the digestive physiology and nutritional metabolism of cultivated abalone. She has never applied for regional (SIMAC) CONACYT funding.

Maria Teresa had several things to say about the reviewing procedure at IFS. She would like to see more congruity in the reviewing of applications by the IFS committees. She feels that their judgements are not necessarily based on scientific criteria. Her original project was accepted without comment. When she submitted her renewal application it was suggested that she had not yet solved the problem of the instability in water of the fish silage making it appropriate for her continue her research as she proposed. She did not really agree but conformed to the suggestions proposed to continue the project. Her second renewal was refused on the grounds that her project was rather elementary and that the work had been done before. She knew that this particular work had not been done in the abalone. From there followed a series of correspondence with the IFS. By this time she had access to other funding sources so she was not really affected by the refusal of the renewal application.

She mentioned that several young researchers from her institution have applied unsuccessfully for IFS grants. She thinks the reason might be that IFS does not give specific enough indications as to the type of projects that are eligible for funding. On the other hand it could be the fault of the Mexican researchers misinterpreting the IFS information. When she spent the year's postdoc in Thailand she was surprised to find that the IFS was funding the building of a laboratory so obviously IFS "has its priorities". During the time she had the IFS funding she had little contact with IFS staff and advisers and suggests that a network should be set up to stimulate and facilitate communication. Although the IFS grants are small compared to those from CONACYT, which are around $170,000 US, this does not make them any less important. She considers both the IFS application and report forms concise and specific. She specifically mentioned the lack of bureaucracy compared to Mexican funding agencies. The IFS grant gave her prestige within her institution because of its international status. As regards to contacts made with other scientists or groups of scientists, she commented that she was asked by the IFS to name experts with whom she wanted to establish contact but she received no follow-up on this.

She has one article published and two under review forthcoming from the IFS supported project. One undergraduate and one master's student were associated with this research. As far as practical applications are concerned food for abalone processed with part of the IFS equipment is being sold to a commercial enterprise, money that is used as a grant for two of her students. She works closely with local co-operatives, which is essential for her work. They provide transport and other local expenses for herself and her students as well as providing experimental species such as "juvenile" and adult abalone. She believes that in general scientists in her field of marine biology are unaware of the needs of the producers.

She had always wanted to study biology. During her first semester in 1978 she started to help with research at the INIFAP in Mexico City and her present CONACYT group project involves a researcher she got to know at that time. She loves doing research even though the pay is far less than she could get by working in industry, especially outside Mexico City. She believes that Mexican society assigns a certain prestige to scientific work especially in biotechnology, in spite of not understanding what researchers do. She has tenure so her research future is assured but this is not the case with young researchers whose future is much less certain. Not all those finishing their PhDs abroad are offered repatriation through the CONACYT programme due to a lack of research positions in many institutions.

Maria Teresa does not have other jobs except now and then she acts as a paid consultant. At present she is Level II in the SNI. She is especially interested in the collaboration of an associate researcher. In summary she commented that she has trained many young students (17 both under and postgraduate students) and has received a lot of support from her institution. After her interview, she moved into a new laboratory that is the largest in her institution (200 m2). She mentioned a lack of maturity in the Mexican S & T system. Research training is more than the acquiring scientific knowledge. Many young people take on further education because of a lack of jobs. Many do not appreciate the educational opportunities they are given and start postgraduate education without adequate preparation. She also believes that the Mexican government should provide more funding for research. About 70% of research proposals submitted to CONACYT are rejected. A big limitation for Mexican research is that many scientists do not know how to write research protocols.

## Miguel Gerardo Velazquez Del Valle

Centro de Desarrollo de Productos Bioticos (CEPROBI), Instituto Politecnico Nacional (IPN), Yautepec, Estado de Morelos

Project title: Ecological studies of some native and introduced strains of Rhizobium loti (*Leucaena esculenta*) in Oaxaca

Dr. Velázquez del Valle's undergraduate degree (1976-1981) in Bacteriological and Parasitological Chemistry, his MSc (1983-1985) specialising in Microbiology, and his PhD (1985-1993) were all from the ENCB-IPN (Escuela Nacional de Ciencias Biológicas, Instituto Politécnico Nacional). He received only one research grant from IFS approved in 1986 (report finished in 1991) as he was completing his MSc thesis on competition for nodulation of Rhizobium strains. He was working at the ENCB-IPN in the laboratory of his supervisor, Dr. María Valdés, who had already received IFS support. The IFS funded project on ecological studies of some native and introduced strains of *Rhizobium loti* (*Leucaena esculenta*) in Oaxaca was directly related to his MSc work. He mentioned that Dr. Valdés encouraged him to focus his research on microbiology applied to agriculture rather than on clinical aspects which was more usual at that time in his institute. He was given a CONACYT grant for both his master's and part of his doctoral studies. He reports no other funding except for visits and exchanges of less than a month.

He used the IFS funding mainly for the purchase of reagents although he also bought equipment and financed some trips to Oaxaca to carry out field work. He described the IFS funding as facilitating his research rather than being essential. He would still have been able to do the research without IFS support but it would have taken him much longer. He could have got funding from the IPN but he might have got in six years what IFS gave him in two. Without a PhD it is more difficult to get research support from CONACYT or from institutional sources. The main impacts of the research funded by IFS were an undergraduate thesis and an international research report paper which was co-authored by a researcher from Oaxaca who later went on to do his PhD in Spain. The IFS funded research was carried out in collaboration with one of the IPN's research centres in Oaxaca. Practical application of the project was reforestation on a small scale that is still being carried out today by the local IPN centre. He found that having international funding gave him certain prestige in his institute and helped him obtain other benefits. He recognised the agility and flexibility of IFS funding. In his case the money was deposited in an account in Mexico in pesos. He gave in his final report to IFS representative who visited the IPN.

For his doctoral thesis he wanted to go deeper into the subject of nitrogen fixation. For this reason his PhD research was carried out at the Biotechnology Institute of the Universidad Nacional Autónoma de México (UNAM) in Cuernavaca where there were better facilities for this type of research. His thesis on the mutagenesis and cloning of *Azospirillum brasilense* involved in nitrogen fixation represented a change of organism but not the type of research carried out.

Since completion of his doctorate Dr. Velázquez del Valle has had several administrative posts with the IPN. He has been the Director of the CEPROBI (Centro de Desarrollo de Productos Bioticos), of the Instituto Politecnico Nacional (IPN) since October 1997. A requirement for this post was that the candidate should have a PhD. The CEPROBI is situated in Yautepec, Morelos, just over an hour's drive from Mexico City and 30 minutes or so from Cuernavaca. Previous to this he was deputy head of the Microbiology Department at the ENCB-IPN (1996-1997); associate director of the undergraduate course on environmental systems engineering (1997); and private secretary to the Director of Undergraduate Studies in Medical and Biological Sciences of the IPN in 1997. He believes that it is important for scientists to be involved in academic planning and decision-making.

The CEPROBI has 75 academic staff of which 53 are involved in scientific research. 25 of these have a Master's degree and 14 are PhDs of which 9 are members of the SNI. The number of scientific papers published by his Centre has doubled in the 3 years since he became director. This year over twenty papers in international journal will be published.

He is coming to the end of his first three-year term as director and is eligible for another three-year term. He mentioned the importance of forming a good support team for a scientist with administrative functions who also wishes to continue with his/her research career. He forms part of an active research group at the CEPROBI with funding from

CONACYT and from a state government foundation called "PRODUCE" which supports rural projects providing about $70,000 pesos (about $7,000 US) annually. His main research limitation is time as he considers the research infrastructure adequate even though the library services could be improved. His immediate career goals are to carry on with his twin duties as an administrator and as a researcher, to publish two more papers in the international literature, continue teaching classes at Master's level, and to supervisor postgraduate theses.

He has also been heavily involved in teaching. From 1982 to 1997 he gave classes at undergraduate level at the Escuela Nacional de Ciencias Biológicas (ENCB) of the IPN in Mexico City and since August is a senior lecturer at postgraduate level in the IPN. From 1986 onwards he has supervised 5 undergraduate theses, 1 master's thesis at the University of Puebla and at present has one doctoral student at the ENCB-IPN.

He was admitted as a candidate member of the SNI in July 2000. He reports 9 scientific contributions from 1984 to 1999; five papers in national and regional journals; a paper in English in an international research reports publication in 1991 derived from the IFS project; one paper in regional proceedings; and two chapters on professional education in Mexico in a book published by a national association in 1996.

Born in Chiapas he came to Mexico City for his undergraduate studies as the best courses in Biology at that time were available in the capital city. He had always been interested in Biology and was encouraged by a teacher at High School to make this subject his career. There is good job stability for scientists in Mexico although the downside is that some scientists do not bother to publish much once they get tenure. They still receive their basic salary but do not benefit from institutional incentive schemes or SNI payments. He considers that the Mexican government has carried out certain actions, although rather disperse, toward strengthening scientific research but that more needs to be done such as increasing the percentage of GNP dedicated to research. The 1999 law on S & T was a positive step but we have yet to see if it bears fruit. What is needed are more resources, more transparent criteria for appointing key people, and a clearer science policy.

## Laura Silva Rosales

Centro de Investigaciones y de Estudios Avanzados del Instituto Politecnico Nacional, Unidad de Biotecnologia y Ingenieria Genetica de Plantas, Irapuato, State of Guanajuato.

Project title: Construction of infectious genomic clones of papaya ringspot virus and papaya mosaic virus

Dr Silva Rosales got her undergraduate degree at the Universidad Autónoma Metropolitana-Iztapalapa, Mexico City in 1980, her M.Sc. from the University of Cambridge, UK in 1984, and her PhD from the CINVESTAV in Irapuato in 1995. The experimental work for her PhD was carried out during a two and a half year stay at the University of Oregon in the US. She was given a grant from the British Council to do her Master's and received both institutional support and a grant from CONACYT for her PhD. She was one of the founding members of CINVESTAV's Unit for Biotechnology and Genetic Engineering of Plants in Irapuato.

She told me that since adolescence she had wanted to be a researcher and had not considered any other career options. In preparatory school the interaction with one of her teachers and attendance at a biophysics class confirmed her career choice. She believes that the work of scientists in Mexico is underestimated by the general public mainly due to ignorance. Job security of researchers in Mexico is very good in spite of having to sign contracts every few years. As long as you remain productive there is little chance that you will lose your job.

Dr Silva Rosales was given her first IFS grant in November 1995 and started in February 1996. Her second grant was approved in December 1998 and started in April 1999. She learned about IFS through the web page and also through her colleague, Edmundo Lozoya-Gloria. Her first grant was approved as she was finishing her PhD and it proved to be vital in her quest to become an independent researcher. When she applied she had not yet gained her doctorate so few options were open

to her. Soon after she became an IFS grantee she received her first CONACYT grant which she had also applied for while finishing her doctoral thesis. She mentioned how grateful she is to IFS especially for the speed with which requests were followed up and the flexibility in the administration of resources (ease of moving resources from one budget heading to another, for instance). She also praised the fact that the applicants are sent details of the reviewer's opinions, something that CONACYT has now started to do. Nonetheless, IFS support is small compared to other funding agencies so she would like to see an increase in the amount assigned. She was pleased also with the bibliographical support from IFS and wanted to know if it is possible for IFS to provide online journal subscriptions. She finds it difficult to get hold of copies of papers as her library subscribes to only two of the four important virology titles. A third subscription is bought jointly by herself and another researcher which means she is still without access to the fourth important journal. She mentioned that it is quite common for researchers in her institute to pay for some journal subscriptions but the problem is that new titles are being published which are very costly.

Other funding she applied for following her IFS grant was to the Third World Academy of Sciences (TWAS) which was refused and no reason given, and to the Rockefeller Foundation which was refused on the grounds that they did not support the type of project she solicited. She has an application pending with TWAS at the moment. The efficiency and ease of applying for CONACYT funding has improved considerably since 1995, she was pleased to point out. Although IFS forms are simple she still finds filling in application forms a chore.

The IFS grant was important to her research as she was between two grants and IFS money nicely filled the gap. She did not have money to pay a technician and IFS agreed to cover this need considering that this person filled the role of an assistant researcher. CONACYT has strict conditions about paying "labour" costs which can only be considered for specific periods. IFS stresses that the money cannot be used to hire help as this involves establishing a formal agreement between the two parties involved. She mentioned the speed with which the IFS staff answer her requests.

With the IFS money she bought everyday equipment that previously she had to share, and reagents. As the result of the work sponsored by IFS she published a short article in a Mexican journal and another in an international journal. She is writing another article in a high impact journal from the projects supported by IFS and CONACYT. Two undergraduate students are involved in the IFS-supported research and a PhD student is collaborating with the project funded by CONACYT and INIFAP (Instituto Nacional de Investigaciones Forestales y Agropecuarias). This latter support is focussed on applied projects and provided her with funds to collect papaya from different parts of the country. CONACYT is in the process of reviewing the usefulness of this programme. She has been awarded a total of three CONACYT grants.

Other sources of support she has been given are from the Fundación Tabasco. This she described as an attractive proposition which was to provide her with a five year funding from federal, state and private sector funds for projects of strategic importance for regional development. A requirement is that the research results are directly applicable. She has signed the contract providing her with $190,000 Mexican pesos (approx. $19,000 US) every six months for first three years. Nonetheless, she has not yet received even half this amount and she is following-up with those concerned for not keeping the agreement. However, there has been a change in the people in charge and they want to make it a joint programme CONACYT/ Fundación Tabasco programme. She described it as a "real headache".

She does not believe that having an IFS grant gave her prestige in her institute as she is one of a group of grantees and ex-grantees. She cannot remember if this information is required for the CONACYT application but she always notes the fact that she is an IFS grantee. She is in the process of developing a practical application of her work: the determination of the amino acid sequence of a viral protein that could have implications for its geographic distribution.

As for the situation of science education and support in Mexico she believes that more needs to be done in the high schools to encourage young people to become scientists. Also she would like to see increased funding for ambitious projects of young scientists, especially in the State of Guanajuato.

She considers that the relationship between researchers and producers is complicated. Produc-

ers tend not to be organised into associations making it difficult for them to approach the scientists although there are many problems that require answers. However private industry wants immediate solutions to problems, something the scientists cannot always supply. In general, producers have little risk capital and are not willing to tie up money in research activities. This fact she considers a serious problem for research in Mexico.

She describes her research limitations at the present time as, firstly, the lack of support for certain projects such as one she has now on a bean virus; secondly, the time taken away from research by classes and paper work; and, thirdly, a lack of laboratory space. At the moment she is working in borrowed facilities but is hoping to be allocated space in a new building under construction.

Nonetheless, she sees a bright future for herself as a scientist in Mexico even though it took time to get her research career off the ground due to particular personal and institutional circumstances. She finds her chosen career very intellectually stimulating, especially training young scientists and rates her working environment as very good. Her professional goals are to train more PhD students and to strengthen her research group to be among the best in Latin America.

## Armando Shimada Miyasaka

Facultad de Estudios Superiores-Cuautitlán, Universidad Nacional Autonoma de México, Querétaro, México

Project title: Improvement of the nutritive value of cassava by feed technology methods

Armando Shimada was one of the first Mexican IFS grantees, his first grant being assigned in 1977. At that time he worked for the Mexican government's institute on forestry, agriculture and animal research (INIFAP) in Mexico City. In 1985 he was appointed Director of the INIFAP's Centro Nacional de Investigación en Fisiología y Mejoramiento Animal (National Centre for Research in Animal Physiology and Breeding) in Ajuchitlán, near Querétaro, about a three-hour drive to the north of Mexico City. In 1995 he took on a full-time appointment as a professor at the Facultad de Estudios Superiores-Cuautitlán (FES-Cuautitlán) belonging to the Universidad Nacional Autónoma de México (UNAM) to the north of Mexico City.

He received two grants, the first for a project on the improvement of the nutritive value of cassava by feed technology methods. His second grant was for a project on the preparation of ensilages. He does not recall the reason for not applying for a second renewal. He thinks, perhaps, it coincided with a change in research interests due to his move to Querétaro. He has received several grants from international organisations during the course of his research career, including IDRC (in association with CONACYT) from Canada, the International Atomic Energy Agency in Vienna (IAEA), NSF and the FAO. At the national level he has received support from CONACYT's national and regional programmes and from the UNAM's special research funding programmes. Comparing the different funding sources he remarked that the IAEA gives modest sums of money and they are attached to a specific topic (which is good). He also mentioned the fact that the research must use nuclear techniques. The FAO is somehow bureaucratic and complicated by the fact that applications are sent via the Mexican government. There is no problem with NSF except that a US counterpart is obligatory. He also had no problem with either the UNAM or the CONACYT funding and found them very flexible. He especially mentioned the CONACYT regional system as excellent. IDRC/CONACYT support he considered good experience, providing large sums of money and flexibility in the handling of the money.

He suggested that IFS could consider adopting a similar scheme as IAEA by inviting scientists to apply for funding to carry out specific projects.

He has also benefited from support provided by private companies such as the American Soya Association, Purina, Elanco, and Roche. He continues

to receive this kind of support but feels it brings only small sums of money for research and has too many strings attached. Researchers who rely on this type of funding are merely validators. He mentioned that his group is close to taking out a patent on their work the owner of which will be the UNAM. He believes that it is highly important that the private sector "buys" the results of research carried out by the academic sector by paying patent rights.

Dr Shimada is one of the most successful researchers in the country in veterinary and animal science. He is one of the few scientists in this field who have attained the highest category, level III, in the Mexican's National Researcher's System (SNI). He has also reached the highest level in the lecturer's scale at the UNAM. He mentioned three turning points in his scientific career. Firstly, when he gained access to international groups through funding from organisations such as IDRC and IFS. Secondly, being designated level III in the SNI in 1990 and his incorporation the following year as a member of the SNI's review committee. Thirdly, his being appointed to full professor at the UNAM, while being able to continue his research at INIFAP's animal facilities in Ajuchitlán, Querétaro. He presently divides his time between his undergraduate teaching duties at the FES-Cuautitlán campus and his graduate teaching and research activities in Ajuchitlan. He also has an agreement with the UNAM's Centre for Neurobiology, also in Querétaro, where he is given laboratory facilities.

Dr Shimada has more than 100 papers in 3 national journals and 14 international journals to his credit. As he pointed out to me, much of his production is published in the INIFAP's primary journal Técnica Pecuaria en México as this is institutional policy. Being a public institution research results are considered government property. His move to the UNAM has given him the freedom to publish wherever he considers the information would be available to a wider (ie international) audience.

## Jose Agustin Orihuela Trujillo

Universidad Autonoma del Estado de Morelos (UAEM), Cuernavaca

Project title: Applied animal ethology in the shortening of the interval from calving to first oestrus in Zebu type cattle

Dr Orihuela is a graduate in Agricultural Engineering from the Universidad Autónoma de Chapingo (UACh) (1979) with a Master's (1982) and PhD (1986) in Animal Production (specialising in Animal Reproduction) from the Faculty of Veterinary Medicine and Zootechnics (FMVZ) from the UNAM in Mexico City. He has close ties with the Animal Science Department of the University of California, Davis where he spent his postdoctoral year in 1989 and where from 1996-7 he was a visiting researcher. He has a number of international papers published both with his Master's and PhD supervisor, Dr Carlos Galina, and with his colleagues in Davis. It was Dr Galina who informed him about the IFS grants about five years after receiving his PhD.

At the present time, Dr Orihuela is a full-time teacher/researcher at the Faculty of Agrosciences at the Autonomous University of the State of Morelos (UAEM) in Cuernavaca. Previously, he was a full-time teacher/professor at the UACh from 1980-1981 and then went to the Instituto Tecnológico Agropecuario No. 9 (ITa 9) belonging to the Mexican Ministry of Education (SEP) in Cuernavaca, Morelos where he was sub-director for operations from 1986-1987 and Director between 1990 and 1991. The discontinuation of the undergraduate programme in 1995 prompted his change from the ITa 9 to the UEAM. This was also a suggestion of the evaluation committee of the SNI that he change to an institution offering postgraduate studies in his field.

He received a grant from the SEP for his master's studies and from CONACYT for his doctorate and postdoctoral studies. Support from the Organisation of American States (OAS) was also forthcoming for his postdoc in Davis as well as for his subsequent stay there.

Dr Orihuela's speciality is in animal ethology and he used his IFS money to buy closed circuit camera equipment for continuous observation of animals. His previous experiments had been carried out using students as observers. He purchased the equipment directly in Mexico rather than have IFS buy it and have it sent to Mexico. The reason he gave was that companies such as Sony, had the equipment readily available for purchase in Mexico. He had previously received a CONACYT grant which was used to buy basic equipment such as a computer and scanner. The IFS money allowed him to buy more specialised equipment that he is still using today and which he took with him during his move from the ITa 9 to the UAEM. He mentioned that it would have taken him much longer to acquire the equipment had he not received the IFS money and this in turn would have affected his research productivity. He felt it would have been difficult to get local money for his field which is little understood in Mexico but is much better known in Europe. He did not make any important contacts as the result of his role as an IFS grantee nor did he receive any other benefits or feel that it gave him prestige within his institution. He was very happy with the way IFS worked and expressly mentioned the lack of bureaucratic hurdles and demands characteristic of his dealings with Mexican institutions.

Dr Orihuela has published the results of many projects using the IFS-supported equipment. Students have been involved in almost all of these projects. He has supervised 6 MSc and 2 PhD theses in three different Mexican institutions. His supervision of undergraduate theses was mainly during his time at the ITa 9. He believes that his work has practical applications but this is an aspect he has not yet exploited. He has been too busy writing original articles for publication highly prized in institutional evaluation exercises. He mentioned his professional goal is to reach level III (the highest level) in the SNI. He was a Candidate in the National Researchers' System (SNI) from 1987-1990, Member at Level 1 from 1990-1999 and was promoted to Level II for the period 2000-2002. Being Level III would allow him to have 2 or 3 paid assistants, the lack of which he mentioned as the biggest constraint to his research work today. He finds his students unreliable when they work on a voluntary basis. Earlier on in his research career he was not so productive and could do everything himself. Now he needs assistants for information searching and for getting estimates of equipment, etc. With regard to the differences between the availability of funding a few years ago compared to the present day, before everybody looked only to CONACYT for support, now there are more possibilities both nationally and internationally. He presently has two grants, one from his own institution for about $3,000 US and the other from a SEP programme for the improvement of higher education for the equivalent of some $30,000 US.

Unfortunately Dr Orihuela's IFS renewal application was not approved. The reason given was that he presented an article published prior to the approval of the IFS grant thanking IFS for their support. He explained that this particular study had been started using alternative methods of observation (human observation). He felt that IFS should have taken account of the fact that he had successfully completed the research project approved for the first grant. He appealed but without success. He has already sent in his final report.

Dr Orihuela is a member of various professional and learned societies including the American Association for the Advancement of Science since 1995 and the New York Academy of Sciences since 1996. He did not originally consider research as a possible career alternative. His ambition was to do work in a ranch but decided first to do a Master's in Animal Production to get some clinical experience. It was during his master's studies that he first got interested in research mainly due to the influence of his supervisor. He believes that research activities are actively encouraged in Mexico but that more emphasis should be placed on projects directed towards solving problems of national importance. At the moment Mexican research is geared towards world science. He feels that industry in Mexico has little interest in supporting research activity, more particularly that focussed on national problems, as most of the big companies here are subsidiaries of US industry. It should be possible for him to get a certain amount of money from the private sector but he has never attempted it. His job security is good at the moment as institutions are looking to employ researchers who are members of the SNI. He feels that Mexican society looks up to people who "continue to study".

## Maria Valdés

Instituto Politecnico Nacional (IPN), México, D.F.

Project title: Mycorrhizal inoculation and the afforestation of the deep valley of Mexico City

Maria Valdés grew up in a city close to the United States border. Her parents were school teachers and all of their children have a higher education in the sciences.

She entered university (UNAM) at the age of 16. As she lived in a desert region during childhood, she says she has always been interested in problems caused by aridity, erosion and the lack of trees. These were the subjects that she would have liked to have studied at a higher level, but the School of Agronomy was, at that time, not open to women. Therefore she chose the faculty of biology where she finally discovered a field which corresponded to her aspirations: soil microbiology.

At the age of 22, with a B.Sc. in biology, she looked to Europe for further studies. "I grew up in admiration of the Mexican liberalism and the French revolution. So when my elder sister left to study at American universities, my wish was to go to France." She applied for scholarships from CONACYT and from UNAM (which she was granted) and set off to continue her studies in France.

Between 1962 and 1964 she studied soil sciences (and symbiotic nitrogen fixation) at ORSTOM (now IRD), a French public research institute for development. Just before graduating, she went back to Mexico where she was appointed as a teacher to the Instituto Politecnico Nacional (IPN) where she is still employed. At that point, being simultaneously engaged in a doctoral program at a French university, she started to carry out research activities as well. In 1968 she went back to France in order to defend her doctoral thesis in the city of Caen. Back in Mexico, she was promoted to Professor at IPN, Mexico City.

After being advised by her former professor of Mycology (Dr Teofilo Herrera) that she ought to work on mycorrhizae, Dr Valdés, who did not know anything about these symbiotic fungal associations but didn't dare to tell it, contacted an American professor (Dr Bratislav Zak), applied for Mexican funding, and launched her research... This was both the origin of her research career and the source of her first contact with the International Foundation for Science. This happened in 1974 when she met, at an international symposium on Mycorrhizae held in the U.S., Dr Peitsa Mikola, one of the first IFS advisers, who encouraged her to apply for an IFS grant. Later in that same year Dr Valdés became one of the first IFS grantees when she was awarded grant number 39. She was also the first IFS grantee in Mexico.

Dr Valdés' grant application was based on a research project entitled: Mycorrhizal inoculation and the afforestation of the deep Valley of Mexico. The aim of the project was to compare hardiness and growth of Pinus small plants inoculated with mycorrhizae strains in severely eroded soils in the deep Valley of Mexico City. The final purpose was to contribute to the reforestation of the valley.

Difficult international money transfers that challenged the carrying out of the research disrupted the first collaboration with IFS. However, the start of the project was made possible thanks to the support of her institution. "This was," in Dr Valdés' words, "the first positive effect of the grant at a time when no institutional funding was available for research in Mexican teaching institutions." Despite difficulties the Vice-Rector of the university made it possible to arrange temporary funding for Dr Valdés' project. At that point, she says, "the IFS grant is not only ten thousand dollars. Receiving money from an international funding institution gave rise to the interest of professors and the administration towards me. Until that moment I was considered only as a teacher and received only my basic salary".

However, the interest aroused by the IFS grant would not have been sufficient to strengthen her young reputation if her work had not been of good quality. "While I had not been publishing much after my thesis, I really began to publish after the IFS grant." She continues: "The Foundation money also had secondary effects, stimulating other funding from my institution and from other local sources. This funding contributed to my research activities and complemented my salary." Her publications from the time of the IFS grant, far from being solely connected to the research financed by the Foundation, confirm the development of her scientific activities.

Her grant was renewed twice, in 1976 and 1981, for the continuation of the same project. Thanks to

this support, she could also increase the number of her international scientific contacts: In 1977, 1979, 1984 and 1986 she obtained travel grants which enabled her to participate in several international conferences and workshops. The scientific relationships established at these meetings gave her the opportunity to visit American universities for educational purposes as well as for collaborative ones. These visits helped her to remain at the cutting edge of her specialty. Between 1983 (she was still a grantee) and 1995 she completed four stays of from one to six months each in American universities (Texas A&M University, Michigan State University, Yale and UCLA). These training periods were successively financed by BOSTID, USAID, CONACYT and the University of California. In 1992-1993 she also spent three months at the French ORSTOM/CIRAD laboratory for tropical forestry symbiosis (Laboratoire de symbioses forestières tropicales) at Nogent sur Marne in France (with French funding from the Ministère des Affaires Etrangères).

After having been awarded three grants, Dr Valdés applied for a fourth one in 1985, which was not approved on the grounds of her scientific recognition ("too established", she was told). Much like a confirmation of the validity of this decision, she became at that very moment a member of the recently founded SNI (Sistema Nacional de Investigadores). This recognition by the most important Mexican scientific institution gave her a real local "quality-label" as a scientist.

In 1986 Valdés published an article in the Canadian Journal of Botany presenting the results of her Foundation-funded research. This article (which is still quoted today) boosted her international recognition: she was, for example, invited to Harvard to present her findings. Following an invitation to an international forestry congress she obtained financing from the National Academy of Science, and later received USD 300.000 from BOSTID. Her laboratory was henceforth well equipped. She subsequently received some small grants from US institutions.

The recognition that Valdés was receiving also had positive effects on a national level. A national policy for research support being progressively drawn up in Mexico gave Dr Valdés the opportunity to receive successive grants from CONACYT. The first one, approved for 1981 to 1984, overlapped her last IFS grant. Ever since, her research has been supported by CONACYT. She received successive funding for 1990-1991, 1992-1995, 1996-1997 and 1998-2001. With this financial recognition came academic recognition, Dr Valdés has twice been elected president of national academic societies, in 1983-1984 and 1996-1998. She received six national awards, the first, from the Mexican Academy of Sciences rewarding the results of her IFS supported research supported. Since 1984 she has continually been a "member" of the SNI, progressively moving up in grades. She is currently a member at level 3, which represents the highest degree of scientific recognition. She is a member of the Editorial Board of the international journal "Mycorrhiza". During the international women's day (March 7, 2001) the National College of Agriculture at Chapingo, Mexico publicly recognised the scientific career of Maria Valdés.

This scientific and academic recognition went together with a financial recognition. Dr Valdés' current basic monthly salary of 17 000 pesos[1] is topped-up with a bonus from her institution, and supplemented with various other bonuses, e.g. one from the SNI (which doubles the basic salary). The monthly income of Dr Valdés is in the range of 50.000 pesos. "This is an excellent salary compared to the salary of many of my colleagues", she says. It is obvious that under these circumstances she can devote herself to teaching and research.

The international recognition of Dr Valdés, including the approval of the IFS grant which was the beginning, appear clearly in her publication list numbering more than 65 items. Until 1973 she appeared as the sole author of her work, but since 1974, the year of her first grant, her publications are almost always co-signed (with four exceptions). This is obvious evidence that the IFS grant is the starting point, not only of her scientific career, but also of her teamwork[2] (the two points can probably not be separated). The article which she signed on her own in 1986 on the findings of her IFS research was her first article as sole author to be published in English. It was to be followed by 14 articles published in English, all co-signed by colleagues from the South as well as from the North, strong proof of her international scientific recognition.

1. 9.5 Mexican Pesos are approximately equal to USD1.
2. In one of her letters to IFS she explains that the trip to the US of one of her colleagues was made on the Foundation grant.

Dr Valdés is still a teacher-researcher at IPN. In addition to her teaching she is running a laboratory where she supervises student theses. Today, she continues to work on mycorrhizae and nitrogen-fixing plants.

Dr Valdés never tried to patent her findings. She has always believed that she should work for the common good, in a public institution, and promote the spread of knowledge (these are the reasons for her continuous interest in teaching). In addition, her research is applicable to reforestation practices. The National Forestry Institute (INIFAP) is currently developing applications of her research that will benefit farmers. Dr Valdés has been a consultant in this program for one year.

Moreover, Dr Valdés continues to work with a great many people in France, the US and Latin America, whom she met partly thanks to the Foundation. She also feels that the IFS grants were stimulants for her to produce good quality work.

In retrospective Dr Valdés considers the IFS grant to have been the real beginning of her career. She repeats, "the grant is much more than US$ 10,000,

1 It stimulates to make quality work
2 It leads to recognition from people working in the same institution (inclusive colleagues and the administration)
3 It gives the possibility to contact scientists of good standard in one's field of research and gives the opportunity of getting assistance
4 It offers the chance to participate in training workshops and to meet one's peers
5 It brings a cultural and relational opening, pushing to master English, which for a scientist is essential in order to publish in good scientific journals."

"It is a formative grant, small, but giving courage and above all giving the possibility to find other supports elsewhere in order to continue", she concludes.

Since 1990 Dr Valdés has been a Scientific Adviser for IFS, anxious, by virtue of scientific interest but also out of gratitude, to contribute to the continuation of the activities of the Foundation.

General comments on the need for research support in Mexico

It is, according to Dr Valdés, getting harder and harder to become a researcher in Mexico. The competition has become fierce among the too many students and scientists. Nowadays it is no longer possible to have one's viva unless one has published in English in a "mainstream" journal. This condition is very difficult to fulfil for the Mexican scientists who are not working in one of the few institutions recognized as centres of excellence.

These centres receive considerable financing from Mexico as well as from abroad. "For the scientists working there, a small grant of USD 10,000 does not have a great financial impact. Furthermore, they do not need IFS to give them international recognition, their own institutions, well known abroad, place them in the mainstream science". She continues: "as far as I'm concerned, the money from IFS should go to public state-owned universities, that's where it can fulfil its function. Those centres of excellence belonging to the two best known public institutions in Mexico constitute by themselves a very good calling card for their students and give a very good visibility for the scientists working there. The IFS calling card should be spared for good students in the public universities who are in great need of both money and recognition".

## Luis Manuel Peña Rodriguez

Centro de Investigación Científica de Yucatán, Merida

Project title: Detection, isolation, and identification of bioactive metabolites produced by medicinal plants in the Yucatán

When Luis first arrived in Edmonton to start his PhD, he had to first supplement his academic background to compensate for some gaps in chemistry. This was despite the fact that he had gotten quite a good level of education in his home country.

During his post-doctoral fellowship in North Carolina, Luis matured as a scientist when he was given the opportunity to start a new research project on fungal metabolites, a work that was funded by the Agrochemical Company Novartis.

In January 1989 Luis was hired as a Senior Researcher by the Departamento de Química Orgánica of the Centro de Investigación Científica de Yucatán (CICY) in Mérida, Yucatán, México; this is the institution where he still works today. Initially Luis participated in a project on steroidal chemistry, where the main objective was to produce steroidal hormones using sapogenins, triterpenoids obtained from waste generated during the production of Henequen (Sisal) fibre, as starting material. Luis considered that although the idea was a good one, the project was out-of-date[3]. On the side, he started to explore the possibility of establishing his own research project on natural product chemistry; however, since launching a project on fungal metabolites, his main area of expertise, was difficult because of the lack of infrastructure for this line of work at CICY, Luis decided to start working on the phytochemical analysis of a limited number of Yucatecan medicinal plants.

In 1989 (during his first year at CICY) Luis attended a Pharmacognosy conference in Puerto Rico, which included a workshop on the use of simple assays for the isolation of bioactive natural products. He didn't know at that time that this workshop would have a great impact in his future research interests.

It was at this point that the impact of the IFS grant made "the difference". Luis had heard about the existence of IFS through a friend who was already a grantee. He decided to submit a grant application to work on the identification of bioactive metabolites from Yucatecan medicinal plants and soon after, in 1990, got his first grant. Despite the amount of money awarded (USD 6,200), which many might consider small, this first grant launched the project at all levels, allowing the purchase of equipment and the recruitment of the first members of his research group (two undergraduate students). None of them had significant experience in working with plants or with the bioassay procedures; they all learned together.

Two years later, despite this good start, Luis entered a professional crisis: the progress of the research project was slow, the institution was facing big changes, and several of his colleagues were leaving for institutional policy reasons. Moreover, he had the feeling that he was dying professionally. He felt isolated being the only PhD in Chemistry in the southeast. He looked north again and went back to Canada (New Brunswick) where he was offered a post-doctoral position to work on a very interesting project dealing with fungal metabolites. However, soon after his arrival in New Brunswick Luis realized that his place was back in Mexico; being back in Canada and away from Mexico made him realize that all difficulties and problems could be overcome by hard work, through collaborations with other researchers, and by just being patient.

In the fall of 1993 Luis returned to his Senior Researcher position at CICY and continued building his research group. In 1995 he received a second IFS grant (USD 8,330) to continue working on the detection, isolation and identification of bioactive metabolites produced by Yucatecan medicinal plants[4]. Luis' third funding proposal to IFS was granted in 1997 (USD 12,000).

A year later (1994) Luis was invited by the IFS to attend a Natural Products Chemistry Conference in Chile, giving him the opportunity to meet, for the

3. The steroid project was mainly based on a national interest aimed to promote the use of local plants for the development of commercially-competitive products. However, the results obtained at CICY showed that the process of transforming sapogenins to steroidal-hormone intermediates was not economically profitable. Luis considered that the project had limited future and thus was of little impact. The chemical process had been developed in the 1940´s and in the 1960´s and 1970´s Glaxo, the pharmaceutical group, had used the technology extensively to produce cortisone and its derivatives using sapogenins from Henequen (Sisal) fibre waste as starting materials.

4. A year before, in 1994 the research team received an important grant from CONACyT to formally start a project on fungal metabolites.

first time, scientists from different Latin-American countries working on similar subjects. This conference came to him as a revelation; he had no idea, before this meeting, of all the work that was being done in Latin America. Personal contacts made at this time opened tremendous opportunities for collaboration with colleagues in Argentina and Bolivia, among other countries. In 1998 he was invited to the same meeting as a lecturer (still supported by IFS).

Luis does not see his role as that of a top class scientist, but more as that of a builder of a scientific research group. Still, this role requires an internationalisation of his scientific activities in order to keep in contact with mainstream science (both for staff members and students). Towards that end, in 1995 he organized an international workshop on the importance of natural products in pharmacy and agriculture. A number of national and international experts (all paying their way to the meeting), from both academic institutions and private companies, were invited and attended.

Also in 1995, collaborations were initiated with a Cuban Research Centre and with Prof. Peter Waterman, an IFS Scientific Adviser. Luis and Prof. Waterman are the research directors of a student working towards her Ph.D. degree in phytochemistry. Both collaborations are still going on today, continuing the exchange of students and information.

Early in 1996 the IFS invited Luis to participate in both a phytochemistry workshop in Peru and a Natural Products Chemistry meeting in Panama. It was at this time that Luis started to participate more actively in CYTED (Programa Iberoamericano de Ciencia y Tecnologia para el Desarrollo) and started to develop professional ties with other countries in Latin America. Nowadays, these links are much stronger than the ones he still develops with colleagues in the north. In 1999 CICY and CYTED organized in Merida the same Phytochemistry workshop that Luis had attended in Peru; the workshop was attended by 20 Mexican researchers and 15 colleagues from various Latin American countries. Lectures and training were given by Prof. K. Hostettmann and his group from the University of Lausanne, Switzerland.

IFS has had an important impact not only in on Luis' scientific career but also in that of other scientists in his group. For a long time, his laboratory had no support other than the IFS money and the team used the funds, according to the global policy of the institution, to face the general needs of their research. As natural product chemistry research can be either very expensive (e.g. having a laboratory with full spectroscopy facilities) or reasonably cheap (i.e. meeting the basic needs in terms of solvents and chromatographic supplies), Luis and his group made the cost of the research match the limits of their financial support.

It is a fact that without IFS support Luis' team would not exist today. All students in his research group are officially grateful to both IFS and CICY, always making sure that this is written in their thesis acknowledgements. For this young unit, research and teaching are closely linked since there cannot be any scientific recognition without developing postgraduate programs (and hosting postgraduate students). Thus far, members of the group have managed to participate in undergraduate programs by both lecturing and supervising theses. Luis has had the opportunity to teach at both MSc and PhD levels and he has also had the opportunity to direct postgraduate theses. Luis and his group hope to start a postgraduate degree in Natural Products Chemistry in the not too distant future.

Developing scientific activities in a region remote from the capital (Mexico City) and its administration seems to be very challenging. On the one hand it is difficult to attract new researchers (holding a PhD) from Mexico and abroad to work in what they consider as an isolated scientific area. On the other hand, it is difficult to fight for the money allocated by federal scientific institutions[5]. Despite that, Luis and his colleagues are convinced that they are contributing to the development of the region through their efforts to build and strengthen science in Yucatan.

5. While on sabbatical at UNAM, in 1999 Luis was asked by CONACyT to review funding applications made by some of his colleagues from various academic institutions in Mexico City. Although he favoured a project on scientific basis he recommended limited funding since the applicant's laboratory was already equipped with the required facilities. Despite his warning, the application was funded. In the meantime, Luis´ application, also considered as scientifically good, was not approved despite the striking need of equipment. It is common knowledge that CONACyT favours academic institutions in Mexico City since they are the ones having research teams that are already well established. At the same time, including postgraduate training for students is a very important criteria for CONACyT to consider funding a project. However, this strong educational component is hard to fulfil by groups working in institutions that do not have postgraduate programs.

In view of the difficulties to attract new researchers to Yucatan, Luis and his group started to prepare their own personnel. Both undergraduate students that first joined the group in 1990 are now working towards their Ph.D. degrees. One is in Switzerland working on polymer chemistry, while the other, a phytochemist, is on a split program between CICY and the University of Southern Cross in Australia (under the direction of Prof. Peter G. Waterman, formerly of Strathclyde University, Glasgow, Scotland). Among the others, two students also working on phytochemistry are doing their PhDs; one in Canada, the other in Chicago (finished his degree in December 2000 and joined the group as a researcher in January 2001). Another PhD student (IFS grantee since 1997) is enrolled at UNAM in Mexico City for the academic part of her PhD while she remains in Merida to perform her experimental work on fungal metabolites (graduated in November 2000 and joined the group as a researcher in December 2000). Finally, one student is due to start his PhD in Pharmacology next year at The University of Greenwich, London, UK (worked in the group as a technician until September 2001, left to start his program on October 2001).

The IFS support received by Luis was very timely in the development of his research career. He had not received any support from CONACYT before he got his first IFS grant. He also acknowledges that the survival of his research team couldn't have been possible without the IFS grants.

Luis summarizes the strengths of the IFS as:

- having high levels of expectation stimulates students and researchers to perform well,
- promoting and enhancing collaboration with other scientists,
- helping in making the research more visible and better known,
- opening new opportunities for additional funding (for the grantee and for the other members of the team).

## Jorge Manuel Santamaria

Centro de Investigación Científica de Yucatán, Merida

Project title: Effects of light intensity, media sugar type and concentration on the development of photoautotrophy in coconut vitroplants

Dr Santamaria's basic training is in plant biology and physiology with a specialization in drought resistance. He has been working as a scientist since he got his MSc from the University of Queensland (Australia) and an appointment at the CICY in 1987. This appointment and the responsibilities to students and administrative duties that it entails made it difficult for him to leave the country in order to finish his PhD. "It took me three years to convince everybody that I really had to leave". Nevertheless, in 1995 he left for the University of Lancaster (United Kingdom) where he completed his PhD. Afterwards, he spent four months in post-doc training in France, and in 1998 he got his new appointment as the head of the biotechnology department at CICY. This job entails a heavy administrative component, since 15 researchers are working under his leadership. However, as one of the scientists working in the unit, he dedicates a large part of his time to science.

Upon returning from his post-doc, Dr Santamaria rapidly built a research group consisting of another researcher, technicians, and Masters and PhD students studying the physiology of plants cultured in vitro. Yet, lack of money made it difficult to carryout the work. The team was mainly using the remainder of a CONACYT grant (230,000 Mexican Pesos allocated between 1995 and 1998 to Dr. Santamaria's previous research) and a part of a European grant obtained with a European partner . Despite a CONACYT regional grant obtained in 1998, the IFS support was received enthusiasti-

6. This grant was managed exclusively by the European partner. The Mexican laboratory had less control over the use of the money or its distribution, and the funding was often delayed by administration processes.

cally by Dr Santamaria and his students, who had hoped to find more flexible and fast research funding. However, due to a new agreement between CONACYT and IFS, the funding for the grant would come from CONACYT, the IFS Member Organization in Mexico, rather than from the IFS Secretariat.

This arrangement caused some confusion that resulted in the payments being split-up and delayed. Consequently, the team could not start its work. Being responsible for the students involved in the project whose progression towards their degrees was being delayed by the bureaucracy, Dr Santamaria decided not to wait any longer and used other funding to purchase the equipment for which he had received the IFS grant.

The financing of the IFS grant by CONACYT brought on another series of inconveniences: the grant was less prestigious than other IFS grants. A criterion for ranking scientists in Mexico is the degree of success that a scientist has had in winning non-national funding for his/her research. This funding, called "own funding", is rewarded financially with productivity bonuses. The IFS grant funded by CONACYT was not regarded as "own funding" and did not bring any financial reward. Furthermore, the prestige accorded for receiving money from a selective international institution disappears if a national institution grants the money. These distinctions are very important because "for the internal board and committees in Mexico, it is important that a scientist received this type of international recognition."

When Dr. Santamaria was interviewed, he was wondering if under the new scheme of IFS-CONACYT grants, a grantee would also have access to additional funding to attend meetings or workshops as had other IFS grantees in the past . During the interview he was assured that he was eligible for IFS supporting services, including travel grants (see section 5.5 for a discussion of grantee travel, and section 8.4 for a discussion of grantee use of travel grants).

As Director of the Biotechnology Unit, Dr Santamaria strongly appreciates the research support that IFS has extended to himself and the other researchers in his Unit, and to CICY in general. He hopes that IFS continues to support young scientists from countries like Mexico where scientists' success during the early stages of their careers is strongly dependent upon international funding.

## Blanca Jiménez Cisneros

Instituto de Ingeniería, Universidad Nacional Autónoma de México, México City.

Project title: Fluidized bed denitrification of sewage using an internal source of organic carbon

Dr. Jiménez is presently deputy director of the UNAM's Engineering Institute (II) in the areas of hydraulic and environmental engineering, environmental bioprocesses and process engineering. She has an undergraduate degree in environmental engineering from the UAM (Universidad Autónoma Metropolitana) in Mexico City (1976-1980), with a master's (1981-1982), doctorate (1982-1985) and postdoctoral studies (1989) in water treatment and reuse from the INSA (Institut National des Sciences Appliquées) in Toulouse. There are few specialists world wide in her subject field. Dr. Jiménez has followed two parallel interests in her work: research, and technological development and transfer. In the latter the economic realities of Mexico have always been at the forefront of her work which aims to ensure that the country has sufficient water of acceptable quality. Her research has focussed mainly on the improvement of three unit operations: filtration, secondary sedimentation and reactors. She has received several important national awards for her work including the UNAM distinc-

7. In CICY, the experience of Dr Peña Rodriguez had a very strong impact: When he received his second grant, Dr Peña was invited by IFS to an international workshop in Chile where he came in contact with all the Latin American scientists working on his subject. This meeting was for him the beginning of a rich international scientific co-operation within Latin America.

tion for young academics in the area of technological innovation and industrial design in 1996 and the Mexican Academy of Sciences prize in the area of technological research in 1997.

She does not consider engineering a scientific career but wanted to implement solutions to fight water pollution and to combat the "government effect" - changes in policy every six years. The work of the II where she has been employed as a researcher since 1985 is very applied. She had the option to work in government or in industry but the university was a better choice for what she wanted to do. There is good job security in the UNAM. However, in provincial universities the pay is so bad that job security is a not really a consideration. She sees good prospects in her scientific career and definitively finds her research intellectually stimulating. Notwithstanding, engineers come out badly under the present system of rewarding international publication. The present evaluation system has been "imposed" by researchers from the basic sciences. With respect to society's view of research she believes that scientists think well of themselves but the general public does not have a good opinion of their worth.

The II receives only a small budget from the UNAM and is the research institute within the UNAM that receives the most money from government industry. She receives funding for short-term applied projects mainly from the public sector (state governments, Comisión Nacional del Agua; Dirección General de Construcción y Operación Hidráulica). She also receives some money from industry. However, funding is lacking for long term projects that would allow her to do research on the more fundamental aspects of the problems.

The IFS grant was the first she received and was the only international support open to her at the time. She does not remember if CONACYT financing was available. By 1989 she had other funding possibilities with a sabbatical supported by the Instituto Mexicano de Tecnología del Agua (IMTA - Comisión. Nacional del Agua). She calculates that approx. 600,000 pesos ($60,000 US) are required to produce a publication from a project. CONACYT grants give only 200,000 pesos.

She sees IFS support as seed money without strings attached. The IFS grant was critical for her research and for the development of her group and she is very grateful for the support given by IFS. The IFS funding came at a crucial time, in 1987/88, 2 years after returning from the PhD in Toulouse when she was trying to adapt what she had learnt in France to the needs of her country. Her PhD research was on the treatment of nitrogen in residual water. In Mexico sewage is normally used for irrigation for its nitrogen content. Her work (which was started with the IFS grant) has produced a patented system for the extraction of nitrogen and carbon in residual water that has been installed in several residential blocks and in industrial plants.

She learned of the IFS grant through a colleague in the UAM. The grant was used to buy equipment to set up a laboratory and to establish her research team. This allowed her the opportunity to keep up her publication output. Dr. Jiménez is a prolific author with more than 30 papers in international journals, 45 in international congresses, 31 in national proceedings, and 16 in national journals. She also has over 100 internal research reports to her name, over 80 of which were written for sponsors. She has also written a chapter on pollution in Mexico City for a UNESCO children's book, an educational package for postgraduates on water treatment as well as several manuals and books on sanitary and environmental engineering. She has also been active in the training of young engineers both with respect to teaching and thesis supervision.

She did not establish any new international contacts due to the IFS grant but it gave her prestige within the institution and opened the door for complementary financing. Her international contacts have been established through meetings. She did not attend any IFS seminars or other events. The IFS is not very well known in Mexico and is therefore not linked to increase in national prestige. Consequently, it does not help to win prizes but does help to produce a better CV. She considers that it probably does help in some way to get promoted within the institution. National schemes exist today to give support to young scientists but only to those who have already published. This, she believes, rather defeats the object.

Dr. Jiménez's suggests that IFS should extend its grants to include chemical and physical aspects of environmental engineering. She only got in "through the door" as her research was concerned with biological aspects. The reporting scheme for IFS is fine especially as it makes the grantees put their research findings in writing thus forming the basis for a paper. She also found the reporting scheme for European Union equally agile. Not so

the reporting systems for the national schemes, the difference being that IFS and EU trust the scientists whereas CONACYT and the UNAM do not. The national funding bodies are afraid that the grant recipients "might go off to Acapulco to spend the money". They also provide only small sums of money and suffer from an excess of bureaucracy making everything unnecessarily complicated. She mentioned that one way to beat the CONACYT system is to ask for money for research that has already been carried out so that results from the previous year can be reported.

She administered the IFS grants from Sweden leaving the money in the Swedish bank account until she needed it thus protecting against loss of value of the peso against the dollar.

Dr. Jiménez is highly critical of science policy (or lack of it) in Mexico. Neither CONACYT nor SNI actively encourage practical research in Mexico in the long term due to a lack of clear policies and long term planning. By evaluating highly publications in the international literature they are prejudicing the development of applied projects focussed on the resolution of local and national problems.

She believes there is more international support now than there was in her area of research. However certain restrictions apply such as the fact that the US support demands the collaboration of a US institution and they like to set the research agenda. The Americans are particularly interested in problems in the US/Mexico border region. The EU gives only a few contracts to Mexico and as she has already had one, she believes her chances of being granted another one are slight.

Dr. Jiménez wishes to continue as a scientist to consolidate her work. She has a good research group respected both nationally and internationally. She stressed the importance of sabbaticals which she believes have allowed her to extend her horizons. She spent her last sabbatical at the IMTA en Cuernavaca.

## Javier Quezada

Universidad Autónoma de Yucatán, Mérida

Project title: Genetic variability of native bees from the Yucatán peninsula

Dr. Quezada's interest in bees began the moment he became involved in a small research project on a stingless bee species native to the Yucatan peninsula as an undergraduate student. In 1987, after he had completed the theoretical part of his BSc, he received a grant from the Ministry of Education to work as research assistant in the Bee Department of the University of Agriculture of Yucatan. When the grant was concluded, he was encouraged by the university staff to continue his academic work and studies on bees. However, since no MSc training on bees was offered in Mexico, he had to leave the country.

Knowing people at the British Council in Mexico, and having developed links with scholars at the University of Wales in Cardiff, Dr Quezada enrolled in this university in 1989 (at the age of 25) with a scholarship from the British Council. He remained in Wales for two years.

When he came back to Merida in 1991, Dr Quezada was appointed to a research assistant position. His application for this position had been in competition with several colleagues, and he feels that the fact that his application to IFS had recently been approved played a major role in the fact that he was granted the position .

The first equipment in the Dr Quezada's research centre was purchased with the IFS grant, and it is still in use. All papers published by Dr. Quezada and his team on morphometrics derive from the work performed on this equipment. Furthermore, the first published paper derived from Dr Quezada's research (1994) had direct applications and allowed the Ministry of Agriculture of Yucatan to map the density of bees in the peninsula, as well as to increase the monitoring of African-derived bees. As a practical result, the beekeepers became more

aware and could better prevent the colonization of the local breeds.

During Dr Quezada's grant period, IFS supported his participation in two scientific meetings. In 1992 he attended a conference in Costa Rica and in 1993 he participated in a training course in Texas. This training was very successful: not only did it help Dr. Quezada to progress in using new programs, but it also contributed to the broadening of his scientific networks. Today, he still collaborates with the four colleagues from abroad (Australia and Germany) that he met during this course. In 2000 his first co-authored paper with one of these scientists was published.

After the exhaustion of the IFS grant, Dr Quezada continued his research on African-derived bees and started to work on enzymes using a new grant from CONACYT. The grant amount was twice as large as the IFS funding (USD 20,000), but using the money was not as easy: it lacked flexibility and involved a great deal of bureaucracy. Nevertheless, the CONACYT grant allowed the purchase of further equipment and the continuation of the research. Dr Quezada has since participated in a sandwich training programme between Cardiff, where he had his academic work for his PhD, and Merida, where he had his field research. Dr Quezada's last year of training was in Cardiff, and in 1997 he received his Ph.D.

Prior to completing his PhD, however, Dr Quezada applied for a renewal of his IFS grant. His renewal was approved in 1997 and in 1998 he began a project that was expected to conclude late in 2000. At the same time (early 1998), his previous CONACYT grant came to an end, and he requested a renewal. The renewal application to CONACYT was approved with a budget of USD 70,000. With this money he was able to purchase much equipment. Yet, at the time of his interview in spring, 2000, it had not yet been possible to fully use the CONACYT grant. Long administrative processes and other problems had hindered the assembly of staff for the project, and at least one key component of the equipment had not been delivered. Dr Quezada explained that this demonstrated the difference in administrative efficiency of the IFS grant, which is easy to use, and the CONACYT grant, which is public money and is characterised by bureaucratic management that restricts the effectiveness of the resources. Dr Quezada's only criticism of the IFS grant is that the size of the award is rather small.

At the time that I visited him, he was working on his IFS project and anticipated its conclusion in December 2000, and he planned to apply for another renewal. Given that his career was becoming well established, I asked if a refusal would change anything in his scientific work. He honestly answered that it would not play a major role at this point (Dr Quezada's second renewal application was granted in spring, 2001).

Dr Quezada is convinced that he would never have received the CONACYT grants if IFS had not provided him with the opportunity to become a recognized scientist. IFS gave him his first equipment and the means collaborate internationally. The rest came afterwards.

Curiously enough, Dr Quezada did not begin to collaborate with his national peers until 1999. This was due mainly, he says, to the fact that there are so few bee scientists in Mexico. However, despite a great deal of research on bees being conducted in other Latin-American countries, especially Brazil, he does not cooperate with other Latin-American scientists. "It would be like to start again from zero," he says.

Dr Quezada is now the coordinator of the Master School of Tropical Agriculture. However, he wants to remain mainly a teacher and researcher, though his position requires a significant amount of administrative tasks. He supervises three M.Sc. students' theses, teaches many undergraduates and works with his students on his research. He is pleased with the fact that his research had practical impacts on bee keeping in the region, and sees his role as developing knowledge through research and teaching.

## Ramon Gerardo Guevara González

Instituto Tecnológico de Celaya, Celaya

Project title: Study on gemini virus replication as a strategy to design resistant transgenic plants

Dr Guevara has only recently received the deposit of his first grant assigned in 1999 from IFS. He has spent the last 18 months trying to arrange the transfer of funds from Stockholm to an institutional account in Mexico. It seems that the Stockholm bank had no knowledge of the existence of this particular Mexican bank, Bancrecer. The rules of his institution are such that the total amount of the grant had to be transferred to Mexico although he would have preferred to manage the money from Stockholm. Consequently he has not yet had access to the funds.

Dr Guevara is a young researcher who since secondary school days has been interested in chemistry and biology. He developed an inclination for research during his undergraduate studies in chemistry, bacteriology and parasitology at the Faculty of Biological Sciences at the University of Nuevo León in the city of Monterrey in the North of Mexico. This undergraduate course is very much geared to teaching students research skills and about 60% of his graduating class embarked on a scientific career. He attributes his love of research to the fact that he accompanied an uncle of his, an agricultural engineer with a Master´s degree in agriculture, when he did field research.

He worked for a year at Campbells canned foods before doing postgraduate studies but found the work very routine and uninspiring. He earned more or less what he is earning now but had much better chances of promotion within the company and of going on to earn higher salaries than he has as a researcher in the public sector.

He received CONACYT grants for both his Master´s and PhD and during the last three months of his doctorate received a grant from a state source - Consejo de Ciencia y Tecnología de Guanajuato (CONCITEC).

He does not consider that Mexican society holds scientists in great esteem, mainly because of ignorance of what a scientist does. He also mentioned that perhaps the economic crisis makes people want immediate solutions to problems. He considers that employment as a scientist in the public sector is secure while in the private sector very few people are employed to do biotechnology research as most of the transnational companies have their research laboratories in the industrialised countries and the technological packages developed there are transferred to Mexico. He considers his future bright as a researcher in the public sector but in no way can it compare to what it might be in the US, for instance. During a stay in the US while studying for his PhD he was able to appreciate that students there are taught to think and to solve their country's problems.

He definitely finds his work as a scientist intellectually stimulating and is especially motivated to train people to have a different mentality and everything follows on from there. He does not have extra jobs and is a member of the SNI in the candidate category. He considers his future goal is to consolidate a line of research of use to his country by improving chile crops using traditional and transgenic strategies.

He learnt of the IFS funding from a colleague at CINVESTAV, Irapuato, about a year before finishing his PhD there. He then applied for IFS funding about 3 months after graduating. He believes that the IFS support was important for him to start on his research career as it was his first source of money. This first project would not have been eligible for funding by CONACYT as it was too basic[8]. Soon after he got the IFS support he was also successful in obtaining funding from CONACYT through their programme to support "proyectos de instalación" for recent PhDs. Other funding sources secured around the same time were from the regional CONACYT funds (in Guanajuato, SIHGO-Sistema Miguel Hidalgo)[9] and some funds from CONCITEC. From these sources he received about 10 times the amount he received from IFS for a project that was predominantly applied with some basic science elements. When he applied for CONACYT funding he already had his PhD and had published papers from his PhD work .in the international literature.

8. In a later conversation with Javier Castellaños he explained to me that about two years ago CONACYT initiated a programme to support applied research through funding channelled to the Mexican states which involved 15% participation from the private sector.

9. He mentioned the involvement of the Foundation of Chile Producers of Guanajuato in this project at least in the beginning.

Although the IFS grant is small compared to his research funding from other sources, it is more flexible. SIHGO, for instance, is rigid in that you are allowed to spend the budget only in ways that were stipulated in the proposal. Also decreasing exchange rates means that you have less money than you originally budgeted for.

He plans to spend the IFS money on equipment for a new laboratory, 90% of which will be new. More equipment and reagents will be bought with money from another project. He considers lack of equipment as the main constraint to his work at the present time. Within three months he hopes to have the basic equipment he needs. The fact that INIFAP in Celaya and CINVESTAV in Irapuato, about an hour away, presented him with the possibility of sharing certain resources while remaining independent were important considerations for him to decide to take the job at the Instituto Tecnológico de Celaya. His institute is well equipped in Chemical Engineering but not in Biological Engineering. The outcomes of the IFS funded project will be scientific papers and also he has two undergraduate students whose theses are related to the IFS funded project. He hopes his research will lead towards the production of transgenic chile plants resistant to virus plagues.

The fact that he was the first researcher at his institute to get an IFS grant helped him secure other support as one of the questions CONACYT always ask on their application forms is if the applicant has received other funding, especially important at international level. He also mentioned that he has left a precedent in his institution for others to follow.

He believes not enough is done in Mexico towards public awareness of science and recognition of the worth of scientific research. To most people all doctors are medics. He recognises that CONACYT is making an effort to increase research funding. He would like to see more research funding coming from industry and more joint research between public and private sectors. They are the ones who have to tell us the problems that need to be solved.

## Miguel Jorge Garcia Winder

T.C.Jacoby & Company, Inc, Saint Louis, USA

Project title: Effect of time and intensity of suckling on post-partum reproduction, milk production and calf performance in cattle in the humid tropics

IFS grant was given to Dr Garcia Winder in 1987-88 about 1 year or 18 months after his return to Mexico from USA where he did his Master´s degree in Animal Sciences (1981-1983) at the University of Nebraska and his PhD in Reproductive Physiology (1983-1986) at the West Virginia University. At that time he was a researcher and lecturer at Centro de Ganadería of COLPOST in the State of Mexico, about a 30 minute drive from Mexico City. In 1989 he was promoted to director, a position he held until 1991. His undergraduate degree in Agricultural Engineering specialising in Animal Husbandry in 1979 was from the nearby Escuela Nacional de Agricultura in Chapingo, State of Mexico. From 1988 to 1991 he continued to work with Dr James Kinder of the University of Nebraska on different research projects (with support from the NIH, USDA and CONACYT) and supervising students. From 1991 to 1995 he held a government position as National Director of Production and Technical Services in LICONSA (Leche Industrializada CONASUPO). In 1995 he left Mexico to work as Vice President of International Marketing of T.C. Jacoby & Co. Inc., Dairy Product Merchants in Saint Louis, Missouri. He pointed out to me that he was not looking for a job in the USA. However after 5 years working for the Mexican government straddling the two six-years presidential terms, he was about to leave to set up his own consulting firm when he came into contact with T.C. Jacoby who offered him a job to work with them in the States.

During his research career he authored more than 30 papers in the national and international literature. By the age of 30 (in 1987) he was already level II in the SNI. He gave his reason for leaving the research environment as economical. He never had two jobs so he found the money insufficient. His directorships gave him extra income but he found it impossible to keep up with his research. For two years he continued to teach but gave it up for lack

of time. He still misses the research environment but continues to be associated with researchers and enjoys taking part in courses from time to time. He is thinking of returning to part-time teaching at Ohio State University.

Dr Garcia Winder heard about IFS through the previous director of the Centro de Ganadería, Dr Manuel Cuca who was in touch with Dr Carlos Galina who knows how "to sell the idea of international funding to national institutions". After discovering the potential that IFS represented for him to start his career as independent researcher he applied for funding. He was awarded just one IFS grant. His renewal application was rejected as he already had access to other funds. He was then forced to give his project a more applied focus than he had originally intended, which turned out to be a blessing as he got consistent results over a six-year period.

Dr Garcia Winder's IFS money was used to develop his laboratory (purchase of equipment, reagents) and to graduate a Master´s student. He knows that one of these pieces of equipment is still being used but the other is not due to an internal issue. Most of the IFS money was used to conduct experiments on suckling. At the time he applied to IFS he did not know of any other funding sources. IFS were quick to approve his grant.

Dr Garcia Winder was subsequently granted money from CONACYT (after having a basic research project turned down by them), but this funding was not immediately available. He mentioned CONACYT as providing him money for basic research and other sources for more applied projects (including the private sector).

Although IFS funding is small, it comes at a critical point and is also restricted with respect to what type of research project can be considered for support. In his case the impact of the IFS funding was to provide him with a "tranquil state of mind", releasing him from the pressure of having to look elsewhere for money. It got him started on a line of enquiry which he continued for six years and which was taken up by a colleague, Jaime Gallego - delayed sucking in double purpose cattle in the tropics - and which has modified traditional suckling systems in these regions. The calf is no longer kept continuously with the mother thus allowing her to also produce milk for human consumption and to return more promptly to oestrus. An improvement is also found in calf growth. Through his contact with IFS he met a few scientists from Latin America but he had already established his network of international contacts. He did have access to bibliographic material through IFS. He had no complaints about IFS but does not consider it gave him prestige within his institution to be an IFS grantee. The only problem he experienced was with Mexican customs. However, he would like to see more continuity in IFS support and more flexibility so that support can continue for two or three more years. He considers that the funding is "understandably low".

Dr Garcia Winder believes that the SNI is a praiseworthy initiative, but it needs to be evaluated as it has changed what scientists do and why they do it. The objectives of research are centred on staying in the SNI and no longer have much to do with scientific considerations.

He mentioned several other constraints to research in Mexico such as the fact that there is only one principal source of funding (CONACYT), the lack of well-defined research priorities, poor salaries compared to other countries such that many researchers have other jobs to compensate thus limiting the time they are able to spend on research, and the concentration of research in and around Mexico City. Compared to his time as a researcher in Mexico he believes that the situation is more complicated now with more people competing for resources and under severe pressure to publish and to train a large group of Master´s students and PhDs. He mentioned scientists with up to 20 students. He has no answer for this and certainly does not think that sending them abroad is the solution. He referred to the "cheapening" of scientific work. He has no recent experience to know if it is easier to get funding than before or to comment on present day national science policy. He believes that international standards should be followed.

## Carlos Cruz Vazquez

Instituto Tecnológico Agropecuario De Aguascalientes (Itaa), El Llano, Aguascalientes

Project title: Epidemiology of *Stomoxys calcitrans* (L.) and *Haematobia irritans* (L.) in dairy cattle in Aguascalientes, Mexico

Carlos received his IFS grant one year after getting his PhD from the Faculty of Veterinary Medicine and Zootechnics (FMVZ) at the UNAM in Mexico City in 1995. Both his Master's (1989) and his PhD from this university are in the area of Parasitology. He has submitted an IFS renewal application and is waiting to hear the result. He transferred from the Instituto Tecnológico Agropecuario No. 9 in Cuernavaca, Morelos where he had worked since 1983 to the Instituto Tecnológico Agropecuario 20 (Itaa) in Aguascalientes in 1996 due to the closure of the undergraduate programme in his former institute. He had got to know about the IFS grants through a colleague. He mentioned that the IFS grant was approved at a vitally important moment in his research career when he was just arriving at an institute "in crisis" where he knew nobody. The money allowed him sufficient resources with which to "start work", to begin publishing in journals and to put him in contact with national peers. He also got to spend some time with an important researcher in Texas who has now retired. Furthermore, he asked to be put in touch with a group in Nebraska. He receives the IFS information bulletins but has very little other contact with IFS.

He described the IFS grant as very flexible allowing money to be moved between different budgetary items. As the Itaa did not have facilities for importing material he asked for the money to be transferred to Mexico. The bank (BANRURAL) used by the Itaa did not have a swift code so he had to open a special account in another bank. At that time there was no email access in his institute. That coupled with the fact that the fax was not left on automatic at night, made communication with IFS difficult. In 1996 he was also given a three-year grant from the Mexican Education Ministry (COSNET) for the purchase of items such as reagents, petrol, travelling expenses, telephone calls, but the money is invariably late coming. COSNET financing does not contemplate the purchase of equipment. He has not applied for money from CONACYT as they support large budget projects and his type of field research does not require large sums of money. Notwithstanding, he hopes to put together a project with other researchers and a PhD student to apply for money from the Regional CONACYT programme.

He thinks that the IFS policy of supporting researchers <40 years' old is the right one and goes hand-in-hand with the programmes that exist in Mexico to promote postgraduate study. He mentioned CONACYT's support for people who have recently got their PhD to help them get started in research. He thinks that not many people know about this programme.

As far as the application of his research results, he mentioned the lack of extension services in his institute which means he has to do everything himself. Every week he makes trips to visit farms in the region. Previously he had applied a questionnaire to identify the most pressing problems facing local farmers. They co-operate in his research by providing animals and he has had the support of the local Farmers' Union for the publication of brochures announcing some of his research findings in an attempt to reduce the level of pesticides used in the region. The fly he works with is not well publicised in Mexico. He hopes for a bigger impact of his research on local customs once the three-year project is complete. He is already advising a couple of producers on the control of flies using lower doses of pesticides.

He has published the first results of his research in Veterinaria-México, the journal edited by the FMVZ of the UNAM, and has another paper in process to be published in the other Mexican research journal in his field, Técnica Pecuaria en México. When he has the final results he hopes to publish these in an international journal. He has participated in many national meetings and has presented results in the last two or three Latin American Congresses of Parasitology. Two undergraduate students have been associated with the project but he has not yet managed to get any Master's students interested. Again he mentioned his desire to form a research group.

He thinks that perhaps, his only "mistake" is to be presently working with large farmers. However, as he pointed out, these are the ones who have programmes for the intensive use of insecticides. He is confident that the results will eventually filter down to the smaller farmers. He also has an experimental unit in the Itaa.

He described various constraints on his research activity. Firstly, a lack of technical support in the laboratory and secondly, the lack of vehicles for field work. In third place, he referred to the limited number of journal subscriptions in his institutional library and fourthly, limited funding to attend meetings. Although COSNET does provide money for this, the decision often takes so long that by the time it has been made the meeting is over. Lastly he commented on a perpetual lack of money for research. He does have a number of students helping him who receive a small sum of money from his COSNET grant. He thinks there is more money around for research than there was 6-10 years ago and more impetus towards postgraduate programmes, but the support is still insufficient. Searching through INTERNET he has found many different options for funding for research on sustainable development of natural resources but does not know about other areas. With regard to national science policy much is being done towards encouraging research but it is not enough. Some positive actions he mentioned were National Science and Technology Week, the creation of the SEP/CONACYT system of research institutes, and efforts towards the decentralisation of research institutes.

He has always enjoyed teaching of which he had his first taste when he was a teacher's assistant at the FMVZ, UNAM while he was a student there. He worked first in the Bank of Mexico and then was appointed assistant director of the ITa No. 9 in Cuernavaca when José Agustin Orihuela Trujillo (IFS ex-grantee, see separate interview) was the director. During his Master's studies he came into closer contact with research directed towards the solution of real-life problems and this provided the incentive for him to continue and do his PhD. He named his thesis supervisor as an important influence in his decision to follow a research career. He became an independent researcher on his arrival at the Itaa helped by the IFS funding. There is no group structure in the system of ITa research institutions making each researcher his own leader and the possibilities for growth unlimited.

While he was studying for his Master's and PhD he continued to receive his salary supplemented by a grant from the COSNET of the SEP. He entered the SNI as a candidate in 1992 and is now Level 1. The research positions at his institute are unionised making it possible for researchers to ask for unpaid leaves of absence for indefinite periods. He is positive about his future and describes his salary as "competitive" taking into consideration not only his basic salary but also the various additional income schemes such as the SNI and institutional productivity bonuses.

Carlos believes that the Mexican public understands little of what scientists do and that Mexican industry is not interested in financing research. They would rather import technology. He describes his research goals as making an important impact in many scenarios, training new researchers, and transcending the scientific environment of publishing to produce new information of direct benefit to producers.

## Roberto Civera Cerecedo

Centro de Investigaciones Biológicas del Noreste (CIBNOR), La Paz

Project title: Digestive enzyme activity of Penaeus californiensis fed diets containing red crab (*Pleuroncodes planipes*) meal as a protein

Roberto had only one IFS grant from 1991-1995, closed in 1997. His reason for not reapplying was that he was very tied up at the time with administrative duties. From March 1994 to August 1998 he was head of the Division of Experimental Biology at CIBNOR. He did not realise when he accepted the position that it was going to take up so much of his time forcing him to put on hold to some extent his research career. He took the position as he felt he could contribute to certain organisational changes that were being proposed at that time such as a change from a vertical departmental structure to a horizontal one via an organisation by programmes. He had intended to resign from the headship about a year before he did but a directorial change delayed his resignation. He had previously been head of the Biochemistry Department from 1990 to 1995. When he arrived at CIBNOR the head of his department did not have a post-

graduate degree and it was suggested that he took over. His involvement with administrative duties has taken its toll on his number of publications. He has a backlog of 13 potential papers that he has not yet had the time to write up. He has 5 papers published in international journals, 2 in press, and 5 reported as in process in his CV.

He did his first degree in Biology at the Universidad Autónoma Metropolitana in Mexico City from 1977-1982. He did not have a clear idea of what he wanted to do as he believes is the case of many Biology graduates who are taught "a little about lots of things" but nothing in depth. He believes that this is not the case of other professions such as doctors, vets, etc, whose career path is clearer. So the obvious choice for him was to continue and do a Master's degree. He got a place at Stirling in Scotland and had been given a British Council scholarship and was just waiting to leave when he was informed that a severe budget cut had forced them to cancel his scholarship and that of another group of Mexicans. He started taking courses at Plymouth but soon realised that it was not what he wanted and went to visit some friends who were already studying at the Université de Bretagne in Brest, France. The courses there interested him. He had a COSNET grant for the doctorate at the same institution.

On his return to Mexico in 1989, before the CONACYT repatriation programme started, he was looking for work for sometime until he went to a meeting on aquaculture where he made contact with people from CIBNOR. He applied for the IFS grant a few months after starting work in CIBNOR in October 1990. The previous director of the Division of Experimental Biology at CIBNOR who had done his PhD in Sweden told him about IFS. He is grateful to IFS for the opportunity to attend a meeting on aquaculture in Ecuador, Latin America's largest producer of shrimp. He also got to meet other IFS grantees and researchers from different places. His only complaint is that IFS asked all the participants with IFS support for permission to print their extended abstracts in a special edition which never materialised. He has deleted the event from his CV as he has nothing to prove his participation. He could have applied for a grant from CONACYT at the time he was thinking about trying for the IFS one. In the end he opted for IFS. After that he was associated with four CONACYT projects and one from SIMAC but was not the main researcher. The IFS money gave him independence and the opportunity to make his own decisions.

He presently has a project funded by SIMAC where he is the main researcher, total amount of $20,000 US for the period Feb 1999-Jan 2001 and participation in another two projects funded by CONACYT. These projects have similar applied aims to his IFS-funded research. The SIMAC project is partially supported by the Mexican Fishing Industry Chamber of Commerce and also involves a consortium of local fisherman and a local plant producing feed for shrimps. The private sector participants provide resources and facilities rather than money. In this case the local shrimp boats collect the red crab which is then processed into shrimp feed by the food processing plant. He believes that this kind of collaboration between the researchers and the producers is very important for both parties but that it is always a difficult partnership. Changes in some of the people in key positions have affected the development of this project and he now has to renegotiate arrangements with the new people.

He has a patent pending on the extraction process of red crab meal which is related to the IFS-funded project. Other outputs are a paper in the proceedings of an international meeting and another which has been submitted. One Master's student was associated with the project who has now gone on to do his PhD. There were also several undergraduate students involved in the project at one time but only one continues. The fact that he had international funding made him stand out from his colleagues and opened the way for him to obtain more money from institutional funding. It also allowed him to set up an area of research into aquatic nutrition.

The support received from industry for research is extremely deficient. He has tried to involve local industry in his work but they tend to back off when it comes to investing money so he has been looking further afield. He believes the problem is partially cultural and partly due to the fact that these are small and medium-sized industries that don't have much capital especially with the present economic crisis of the country. Links with local industry are vital for both parties, for the researchers to understand the problems that the producers have and for the producers to understand how research can help them. He always invites members of industry to the meetings he organises. A few years ago the work of the Centre was more inclined towards applied aspects but because of the way research is presently evaluated both internally and externally (SNI) a change is occurring towards basic research. In some areas analytical services

are provided which serve as a bridge between the Centre and industry. He considers that many of these present situations are due to the fact that the Centre is undergoing a "maturing" process.

With respect to the future of his research he is concerned that the "humid" laboratory facilities (experimental fish tanks and facilities) are increasingly in demand. He is also concerned that the institutional budget has not kept up with inflation levels so there are more people and less money. Not many options are open to him at national level for external funding other than the "usual" SIMAC and CONACYT. There is increasing competition all around. On the positive side is the that over the last 10 years he has been able to build the research infrastructure which has allowed him to attract students to his research. Getting students is always a bottleneck.

He believes that Mexican society sees scientists as demented human beings unable to respond to the reality of the country.

# Appendix 5: List of acronyms and abbreviations

| | |
|---|---|
| Area A | Aquatic Resources |
| Area B | Animal Production |
| Area C | Crop Science |
| Area D | Forestry/Agroforestry |
| Area E | Food Science |
| Area F | Natural Products |
| Area G | Rural Development (discontinued) |
| Area H | Environmental Sciences (discontinued) |
| CEPROBI | Centro de Desarrollo de Productos Bióticos |
| CICY | Centro de Investigación Científica de Yucatán |
| CINVESTAV del IPN | Centro de Investigación Y de Estudios Avanzados del IPN (The Centre for Research and Advanced Studies) |
| COLPOS | Colegio De Postgraduados |
| CONACYT | Consejo Nacional de Ciencia y Tecnología (The National Council for Science and Technology) |
| GDP | Gross domestic product |
| IFS | International Foundation for Science |
| IPN | Instituto Politécnico Nacional (National Polytechnic Institute) |
| ISI | Institute for Scientific Information |
| ITESM | Instituto Tecnológico y de Estudios Superiores De Monterrey |
| MESIA | Monitoring and Evaluation System for Impact Assessment |
| OECD | Organisation for Economic Co-operation and Development |
| PCI | Programa de Conocimiento e Innovación (Programme of Knowledge and Innovation) |
| RICYT | Red Interamericana de Indicadores de Ciencia y Tecnología |
| S&T | Science and Technology |
| SAGARPA | Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación (Ministry for Agriculture, Livestock, Rural Development, Fisheries and Food) |
| SCI | Science Citation Index |
| SEP | Secretaría de Educación Pública (Ministry for Education) |
| SNI | Sistema Nacional de Investigadores |
| UADY | Universidad Autónoma de Yucatán (Autonomous University of Yucatan) |
| UAM | Universidad Autónoma Metropolitana (Autonomous Metropolitan University) |
| UNAM | Universidad Nacional Autónoma de México (National Autonomous University of Mexico) |

# Appendix 6:

## Directory of all Tables, Figures and Boxes in this report

*Tables in the main report*

*Tables in the Appendices*



*Figures in the main report*

*Figures in the main report (cont.)*



*Figures in the Appendices*

*Boxes in the report*

# Appendix 7: Additional Tables

| City | Region | Institution | No. of grantees |
|---|---|---|---|
| Acapulco | Guerrero | Instituto Tecnológico Agropecuario (ITA) (Acapulco) | 1 |
| Aguascalientes | Aguascalientes | Instituto Tecnológico Agropecuario (ITA) # 20 | 1 |
| | | Universidad Autónoma de Aguascalientes (UAA) | 1 |
| Calera | Zacatecas | Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias (INIFAP) | 2 |
| Cárdenas | Michoacán | Colegio Superior de Agricultura Tropical | 1 |
| Celaya | Guanajuato | Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias (INIFAP) | 1 |
| | | Instituto Tecnológico de Celaya (ITC) | 1 |
| Cerro de las Campanas | Querétaro | Universidad Autónoma de Querétaro (UAQ) | 1 |
| Colima | Colima | Universidad de Colima | 1 |
| Colonia San Rafael | Mexico, DF | Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias (INIFAP) | 2 |
| Cuautlán Izcalli | Mexico | Universidad Nacional Autónoma de México (UNAM) | 1 |
| Cuernavaca | Morelos | Universidad Autónoma del Estado de Morelos (UAEM) (formerly Universidad de Ciencias Agropecuarias, Cuernavaca) | 1 |
| | | Universidad Nacional Autónoma de México (UNAM) | 3 |
| Durango | Durango | Instituto Politécnico Nacional (IPN) - Centro Interdisciplinario de Investigación para el Desarrollo Integral Regional (CIIDIR) | 1 |
| | | Universidad Juárez del Estado de Durango (UJED) | 1 |
| Ensenada | Baja California Norte | Universidad Autónoma de Baja California (UABC) | 1 |
| Guadalajara | Jalisco | Centro de Investigación y Asistencia en Tecnología y Diseño del Estado de Jalisco (CIATEJ) | 1 |
| Guaymas | Sonora | Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM) | 1 |
| Hermosillo | Sonora | Centro de Investigación en Alimentación y Desarrollo (CIAD) | 2 |
| Irapuato | Guanajuato | Centro de Investigación y de Estudios Avanzados (CINVESTAV) del IPN | 11 |
| | | Universidad de Guanajuato (UGTO) | 1 |
| Iztapalapa | Mexico, DF | Universidad Autónoma Metropolitana (UAM) | 1 |
| La Paz | Baja California Sur | Centro de Investigaciones Biológicas del Noroeste (CIBNOR) | 6 |
| | | Universidad Autónoma de Baja California (UABC) | 1 |

Table A1
**Distribution of grantees by city, region and institution at the time of the first grant (1974-1999)**

| City | Region | Institution | No. of grantees |
|---|---|---|---|
| Linares | Nuevo León | Universidad Autónoma de Nuevo León (UANL) | 5 |
| Martinez de la Torre | Veracruz | Universidad Nacional Autónoma de México (UNAM) - Centro de Enseñanza, Investigación y Extensión en Ganadería Tropical | 1 |
| Mazatlán | Sinaloa | Centro de Investigación en Alimentación y Desarrollo (CIAD) | 2 |
| **Mérida** | **Yucatán** | Centro de Investigación Científica de Yucatán (CICY) | 5 |
| | | Centro de Investigación y de Estudios Avanzados (CINVESTAV) del IPN | 3 |
| | | Instituto Tecnológico Agropecuario (ITA) # 2 | 3 |
| | | Instituto Tecnológico de Mérida (ITM) | 2 |
| | | Universidad Autónoma de Yucatán (UADY) | 26 |
| **Mexico City** | **Mexico, DF** | Instituto Politécnico Nacional (IPN) - Escuela Nacional de Ciencias Biológicas (ENCB) | 2 |
| | | Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias (INIFAP) | 4 |
| | | Universidad Autónoma Metropolitana (UAM) | 7 |
| | | Universidad Nacional Autónoma de México (UNAM) | 14 |
| Montecillo, Texcoco | Mexico | Colegio de Postgraduados en Ciencias Agrícolas (COLPOS) | 5 |
| Monterrey | Nuevo León | Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM) | 1 |
| **Morelia** | **Michoacán** | Universidad Michoacana de San Nicolas de Hidalgo | 1 |
| | | Universidad Nacional Autónoma de México (UNAM) | 1 |
| Nuevo León | Nuevo León | Universidad Autónoma de Nuevo León (UANL) | 1 |
| **Puebla** | **Puebla** | Benemérita Universidad Autónoma de Puebla (BUAP) | 1 |
| | | Colegio de Postgraduados en Ciencias Agrícolas (COLPOS) | 1 |
| Querétaro | Querétaro | Instituto Tecnológico y de Estudios Superiores | 1 |
| San Luis Potosí | San Luis Potosí | Universidad Autónoma de San Luis Potosí (UASLP) | 1 |
| Tapachula | Chiapas | El Colegio de la Frontera Sur (ECOSUR) | 1 |
| Torreón | Coahuila | Universidad Autónoma Agraria "Antonio Narro" (UAAAN) | 1 |
| Los Tuxtlas | Veracruz | Universidad Nacional Autónoma de México (UNAM) | 1 |
| Xalapa | | Instituto de Ecología (INECOL) | 3 |
| | | **Total** | **137** |

Table A1 (continued)
**Distribution of grantees by city, region and institution at the time of the first grant (1974-1999)**

| Institution | City | No. of grantees in the city | No. of grantees at the institution |
|---|---|---|---|
| Universidad Autónoma de Yucatán (UADY) | Mérida | 26 | 26 |
| **Universidad Nacional Autónoma de México (UNAM)** | Cuautlán Izcalli | 1 | **21** |
| | Cuernavaca | 3 | |
| Universidad Nacional Autónoma de México (UNAM) - Centro de Enseñanza, Investigación y Extensión en Ganadería Tropical | Martinez de la Torre | 1 | |
| **Universidad Nacional Autónoma de México (UNAM)** | Mexico City | 14 | |
| | Veracruz (Los Tuxtlas) | 1 | |
| | Morelia | 1 | |
| **Centro de Investigación y de Estudios Avanzados (CINVESTAV) del IPN** | Irapuato | 11 | **14** |
| | Mérida | 3 | |
| **Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias (INIFAP)** | Calera | 2 | **9** |
| | Celaya | 1 | |
| | Colonia San Rafael | 2 | |
| | Mexico City | 4 | |
| **Universidad Autónoma Metropolitana (UAM)** | Iztapalapa | 1 | **8** |
| | Mexico City | 7 | |
| Centro de Investigaciones Biológicas del Noroeste (CIBNOR) | La Paz | 6 | 6 |
| **Universidad Autónoma de Nuevo León (UANL)** | Linares | 5 | **6** |
| | Nuevo León | 1 | |
| **Colegio de Postgraduados en Ciencias Agrícolas (COLPOS)** | Montecillo, Texcoco | 5 | **6** |
| | Puebla | 1 | |
| Centro de Investigación Científica de Yucatán (CICY) | Mérida | 5 | 5 |
| **Centro de Investigación en Alimentación y Desarrollo (CIAD)** | Hermosillo | 2 | **4** |
| | Mazatlán | 2 | |
| Instituto de Ecología (INECOL) | Xalapa | 3 | 3 |
| Instituto Politécnico Nacional (IPN) - Escuela Nacional de Ciencias Biológicas (ENCB) | Mexico City | 2 | 3 |
| Instituto Politécnico Nacional (IPN) - Centro Interdisciplinario de Investigación para el Desarrollo Integral Regional (CIIDIR) | Durango | 1 | |
| Instituto Tecnológico Agropecuario (ITA) # 2 | Mérida | 3 | 3 |
| Instituto Tecnológico de Mérida (ITM) | Mérida | 2 | 2 |
| **Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM)** | Guaymas | 1 | **2** |
| | Monterrey | 1 | |
| **Universidad Autónoma de Baja California (UABC)** | Ensenada | 1 | **2** |
| | La Paz | 1 | |
| Benemérita Universidad Autónoma de Puebla (BUAP) | Puebla | 1 | 1 |
| Centro de Investigación y Asistencia en Tecnología y Diseño del Estado de Jalisco (CIATEJ) | Guadalajara | 1 | 1 |

Table A2
**Distribution of grantees by institution at the time of the first grant (1974-1999)**

| Institution | City | No. of grantees in the city | No. of grantees at the institution |
|---|---|---|---|
| Colegio Superior de Agricultura Tropical | Cárdenas | 1 | 1 |
| El Colegio de la Frontera Sur (ECOSUR) | Tapachula | 1 | 1 |
| Instituto Tecnológico Agropecuario (ITA) # 20 | Aguascalientes | 1 | 1 |
| Instituto Tecnológico Agropecuario (ITA) (Acapulco) | Acapulco | 1 | 1 |
| Instituto Tecnológico de Celaya (ITC) | Celaya | 1 | 1 |
| Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM) | Querétaro | 1 | 1 |
| Universidad Autónoma Agraria "Antonio Narro" (UAAAN) | Torreón | 1 | 1 |
| Universidad Autónoma de Aguascalientes (UAA) | Aguascalientes | 1 | 1 |
| Universidad Autónoma de Querétaro (UAQ) | Cerro de las Campanas | 1 | 1 |
| Universidad Autónoma de San Luis Potosí (UASLP) | San Luis Potosí | 1 | 1 |
| Universidad Autónoma del Estado de Morelos (UAEM) (formerly Universidad de Ciencias Agropecuarias, Cuernavaca) | Cuernavaca | 1 | 1 |
| Universidad de Colima | Colima | 1 | 1 |
| Universidad de Guanajuato (UGTO) | Irapuato | 1 | 1 |
| Universidad Juárez del Estado de Durango (UJED) | Durango | 1 | 1 |
| Universidad Michoacana de San Nicolas de Hidalgo | Morelia | 1 | 1 |

Table A2 (continued)
**Distribution of grantees by institution at the time of the first grant (1974-1999)**

| Area | BSc | MSc | PhD | Total |
|---|---|---|---|---|
| A | 1 | 3 | 1 | 5 |
| B | 5 | 12 | 4 | 21 |
| C | 0 | 5 | 7 | 12 |
| D | 0 | 3 | 3 | 6 |
| E | 0 | 4 | 2 | 6 |
| F | 0 | 1 | 3 | 4 |
| **All grantees** | **6** | **28** | **20** | **54** |
| **% of all grantees** | **11.1** | **51.9** | **37.0** | **100.0** |

Table A3
**Distribution by Research Area of degrees obtained in Mexico and held at the time of the first grant**

| Area | BSc | MSc | PhD | Total |
|---|---|---|---|---|
| A | 0 | 0 | 13 | 13 |
| B | 0 | 9 | 13 | 22 |
| C | 0 | 1 | 8 | 9 |
| D | 0 | 2 | 11 | 13 |
| E | 0 | 7 | 10 | 17 |
| F | 0 | 0 | 3 | 3 |
| G | 0 | 0 | 2 | 2 |
| **All grantees** | **0** | **19** | **60** | **79** |
| **% of all grantees** | **0.0** | **24.1** | **75.9** | **100.0** |

Table A4
**Distribution by Research Area of degrees obtained abroad and held at the time of the first grant**

| Institutions | Grantee participation | SNI member? | | Publications | |
|---|---|---|---|---|---|
| | | Yes | No | Total | IFS supported |
| Benemérita Universidad Autónoma de Puebla (BUAP) | 1 | 0 | 1 | 5 | 2 |
| Centro de Investigación Científica de Yucatan (CICY) | 4 | 4 | 0 | 109 | 12 |
| Centro de Investigación en Alimentación y Desarrollo (CIAD) | 3 | 2 | 1 | 49 | 12 |
| Centro de Investigación y de Estudios Avanzados (CINVESTAV) del IPN | 12 | 11 | 1 | 556 | 35 |
| Centro de Investigaciones Biológicas del Noroeste (CIBNOR) | 6 | 4 | 2 | 194 | 52 |
| Colegio de Postgraduados en Ciencias Agricolas (COLPOS) | 5 | 4 | 1 | 322 | 15 |
| El Colegio de la Frontera Sur (ECOSUR) | 1 | 1 | 0 | 43 | 0 |
| Instituto de Ecología (INECOL) | 3 | 1 | 2 | 89 | 19 |
| Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias (INIFAP) | 9 | 7 | 2 | 639 | 52 |
| Instituto Politécnico Nacional (IPN) | 2 | 1 | 1 | 77 | 6 |
| Instituto Tecnológico Agropecuario (ITA) | 4 | 4 | 0 | 98 | 28 |
| Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM) | 2 | 2 | 0 | 32 | 6 |
| Universidad Autónoma Agraria ""Antonio Narro""(UAAAN) | 1 | 1 | 0 | 82 | 11 |
| Universidad Autónoma de Aguascalientes (UAA) | 1 | 1 | 0 | 23 | 1 |
| Universidad Autónoma de Baja California (UABC) | 2 | 2 | 0 | 59 | 3 |
| Universidad Autónoma de Nuevo León (UANL) | 4 | 4 | 0 | 132 | 13 |
| Universidad Autónoma de Nuevo León (UANL) | 4 | 4 | 0 | 132 | 13 |
| Universidad Autónoma de Querétaro (UAQ) | 1 | 1 | 0 | 35 | 0 |
| Universidad Autónoma de San Luis Potosí (UASLP) | 1 | 1 | 0 | 37 | 1 |
| Universidad Autonóma de Yucatán (UADY) | 17 | 1 | 16 | 347 | 63 |
| Universidad Autónoma del Estado de Morelos (UAEM) | 1 | 1 | 0 | 33 | 3 |
| Universidad Autónoma Metropolitana (UAM) | 5 | 4 | 1 | 151 | 19 |
| Universidad de Guanajuato (UGTO) | 1 | 1 | 0 | 20 | 1 |
| Universidad Juárez del Estado de Durango (UJED) | 1 | 1 | 0 | 6 | 0 |
| Universidad Nacional Autónoma de México (UNAM) | 18 | 15 | 3 | 1096 | 87 |
| **Total** | **105** | **74** | **31** | **4234** | **441** |

Table A5
**Institutional affiliation and SNI status of respondents to the bibliometric survey**

| Journal Title | Number of articles |
|---|---|
| Técnica Pecuaria en México | 109 |
| Veterinaria México | 90 |
| Revista Latinoamericana de Microbiología | 28 |
| Revista Mexicana de Fitopatología | 28 |
| Micología Neotropical Aplicada | 26 |
| Agrociencia | 25 |
| Biotecnología | 24 |
| Revista Biomédica de Yucatán | 22 |
| Revista de la Facultad de Química (UADY) | 21 |
| Aquaculture | 20 |
| Proceedings Gulf | 20 |
| Revista Mexicana de Micología | 19 |
| Theriogenology | 17 |
| Biochimica et Biophysica Acta | 16 |
| Biotechnology Letters | 16 |
| Fitopatología | 16 |
| Tecnología de Alimentos | 16 |
| Avances en Ingeniería Química | 15 |
| Ciencia y Desarrollo (CONACYT) | 15 |
| Ciencia (Academia de la Investigación Científica) | 15 |
| Applied Animal Behaviour | 14 |
| Hydrobiología | 14 |
| Turrialba | 14 |
| Water Science and Technology | 14 |
| Journal of Shellfish Research | 13 |
| Agricultura Técnica en México | 12 |
| Applied and Environmental Microbiology | 12 |
| Avance y Perspectiva | 12 |
| Terra | 12 |
| American Oil Chemists' Society Journal | 11 |
| Biotechnology Techniques | 11 |
| Boletín de Educación Bioquímica | 11 |
| Comparative Biochemistry & Physiology | 11 |
| Environmental Technology | 11 |
| Journal of Animal Science | 11 |
| Process Biochemistry | 11 |
| World Journal of Microbiology & Biotechnology | 11 |
| Florida Entomologist | 10 |
| Journal of Bacteriology | 10 |

Table A6
**Journals with five or more publications by IFS grantees**

| Journal Title | Number of articles |
|---|---|
| Journal of Dairy Science | 10 |
| Plant Physiology | 10 |
| Acta Horticulturae | 9 |
| Applied Microbiology & Biotechnology | 9 |
| BIOTAM | 9 |
| Biotechnology and Bioengineering | 9 |
| Biotechnology Progress | 9 |
| Journal of Agricultural and Food Chemistry | 9 |
| Journal of Natural Products | 9 |
| Proceedings National Academy of Science | 9 |
| Revista de Biología Tropical | 9 |
| Small Ruminant Research | 9 |
| Avances en Investigaciones Agropecuarias | 8 |
| Boletin Sociedad Mexicana de Micología | 8 |
| Journal of the Science of Food and Agriculture | 8 |
| Molecular and General Genetics | 8 |
| Phytopathology | 8 |
| Starch/Starck | 8 |
| Bioprocess Engineering | 7 |
| Journal of Apicultural Research | 7 |
| Journal of Fermentation and Bioengineering | 7 |
| Journal of Plant Physiology | 7 |
| Molecular Microbiology | 7 |
| Animal Reproduction Science | 6 |
| Annals Entomological Society of America | 6 |
| Aquaculture Research | 6 |
| Archivos Latinoamericanos de Nutrición | 6 |
| Enzyme and Microbial Technology | 6 |
| Food Chemistry | 6 |
| Infection and Immunity | 6 |
| Journal of Applied Microbiology | 6 |
| Journal of Chromatography | 6 |
| Journal of Food Science | 6 |
| Revista Cubana de Ciencias Agricolas | 6 |
| Revista de Investigación Científica (UABCS) | 6 |
| Revista Federalismo y Desarrollo (BANOBRAS) | 6 |
| Water Research | 6 |
| Advances in Agricultural Research | 5 |

Table A6 (continued)
**Journals with five or more publications by IFS grantees**

| Journal Title | Number of articles |
|---|---|
| Animal Feed Science and Technology | 5 |
| Applied Biochemistry and Biotechnology | 5 |
| Archivos Latinoamericanos de Producción Animal | 5 |
| Biotechnology Advances | 5 |
| Botánica Marina | 5 |
| Current Topics in Plant Physiology | 5 |
| Educación Química | 5 |
| Elevage Insemination | 5 |
| Entomologia Experimentalis et Applicata | 5 |
| Environmental Entomology | 5 |
| FEBS Letters | 5 |
| Folia Entomologica | 5 |
| Gene | 5 |
| Horticultural Science | 5 |
| Información Técnica Económica Agraria | 5 |
| Interface | 5 |
| Journal of Agricultural Science | 5 |
| Journal of Applied Phycology | 5 |
| Journal of Biological Chemistry | 5 |
| Journal of Chemical Ecology | 5 |
| Journal of the World Aquaculture Society | 5 |
| Letters in Applied Microbiology | 5 |
| Life Sciences | 5 |
| Microbiology | 5 |
| Mushroom Newsletter for the Tropics | 5 |
| Mushroom Science | 5 |
| Mycorrhiza | 5 |
| Nematropica | 5 |
| Nucleic Acids Research | 5 |
| PANAGFA | 5 |
| Physiology & Behavior | 5 |
| Physiologia Plantarum | 5 |
| Plant and Soil | 5 |
| Revista Fitotecnia Mexicana | 5 |
| Tecnología Alimentaria | 5 |
| **Total** | **1240** |

Table A6 (continued)
**Journals with five or more publications by IFS grantees**

| Area | Average duration of: | | | Number of grantees with: | | |
|---|---|---|---|---|---|---|
| | One grant | Two grants | Three grants | One grant | Two grants | Three grants |
| A | 6 | 7 | - | 5 | 3 | 3 |
| B | 6 | 8 | 12 | 14 | 9 | 9 |
| C | 5 | 5 | - | 5 | 2 | 2 |
| D | 5 | 7 | 12 | 7 | 2 | 2 |
| E | 4 | 8 | 9 | 7 | 5 | 5 |
| F | 6 | - | - | 3 | - | - |
| G | 11 | 11 | - | 1 | 1 | 1 |

Table A7
**Average duration of grants by Research Area and granting period**

| Quality | No. of reports | % |
|---|---|---|
| Unsatisfactory | 3 | 5.0 |
| Poor | 7 | 11.7 |
| Satisfactory | 25 | 41.7 |
| Good | 16 | 26.7 |
| Excellent | 7 | 11.7 |
| Unknown | 2 | 3.3 |
| **Total** | **60*** | **100.0** |

* This number is smaller than the total number of closed grantee files because some grants were closed without a final report.

Table A8
**Quality of final report**

| Area | Granting period(s) | BSc | MSc | PhD | Total |
|---|---|---|---|---|---|
| A | 1X | - | 1 | 4 | 5 |
| | 2X | - | 1 | 2 | 3 |
| B | 1X | 1 | 6 | 6 | 13 |
| | 2X | 1 | 4 | 3 | 8 |
| | 3X | - | 1 | - | 1 |
| C | 1X | - | 2 | 3 | 5 |
| | 2X | - | - | 2 | 2 |
| D | 1X | - | 2 | 5 | 7 |
| | 2X | - | 1 | 1 | 2 |
| | 3X | - | - | 1 | 1 |
| E | 1X | - | 2 | 5 | 7 |
| | 2X | - | 4 | 1 | 5 |
| | 3X | | 1 | 2 | 3 |
| F | 1X | - | - | 3 | 3 |
| G | 1X | - | - | 2 | 2 |
| | **Total** | **2** | **25** | **40** | **67** |

Table A9
**Degree at the time of the first grant by Research Area and granting period**

| Country | Institution | Number |
|---|---|---|
| France | Institut National de la Recherche Agronomique (INRA) | 1 |
| | Institut Pasteur | 1 |
| | Institut de Recherche pour le Développement (IRD) | 1 |
| United Kingdom | University of Birmingham | 1 |
| Thailand | Chulalongkorn University | 1 |
| USA | Cornell University | 1 |
| | University of Oregon | 1 |
| | North Carolina State University | 1 |
| | University of California, Los Angeles | 1 |
| | University of Pennsylvania | 2 |
| | University of Missouri-Columbia | 1 |
| | Vanderbilt University | 1 |
| | University of California, Davis | 1 |
| | University of Kentucky | 1 |
| | University of Arizona | 1 |
| | Colorado State University | 1 |
| | **Total** | **17** |

Table A11
**Country and institution of grantees' post-docs**

| Area | Granting period(s) | Number of grantees | Number of grantees with a highest degree from Mexico | Number of grantees with a highest degree from outside Mexico |
|---|---|---|---|---|
| A | 1X | 5 | 1 | 4 |
| | 2X | 3 | - | 3 |
| B | 1X | 13 | 5 | 8 |
| | 2X | 8 | 3 | 5 |
| | 3X | 1 | 1 | - |
| C | 1X | 5 | 3 | 2 |
| | 2X | 2 | - | 2 |
| D | 1X | 7 | 3 | 4 |
| | 2X | 2 | - | 2 |
| | 3X | 1 | - | 1 |
| E | 1X | 7 | 3 | 4 |
| | 2X | 5 | 1 | 4 |
| | 3X | 3 | 1 | 2 |
| F | 1X | 3 | 2 | 1 |
| G | 1X | 2 | - | 2 |

Table A10
**Origin of the degree held at the time of the first grant by Research Area and granting period**

| Statements | Frequency of response | | | | | Total response | Mean |
|---|---|---|---|---|---|---|---|
| | 1 Disagree completely | 2 | 3 | 4 | 5 Agree completely | | |
| Research topics are set by employers | 33 | 24 | 28 | 15 | 2 | 102 | 2,3 |
| Research topics are set by sponsors | 18 | 21 | 43 | 16 | 5 | 103 | 2,7 |
| Researchers should produce goods for a competitive market | 12 | 21 | 38 | 15 | 15 | 101 | 3,0 |
| Research problems are set by clients | 14 | 18 | 31 | 26 | 13 | 102 | 3,1 |
| Researchers should have entrepreneurial and managerial skills | 10 | 19 | 28 | 31 | 13 | 101 | 3,2 |
| Science should mainly lead to useful innovations | 7 | 15 | 28 | 25 | 28 | 103 | 3,5 |
| Researchers are free to choose their own research topics | 3 | 5 | 25 | 29 | 40 | 102 | 4,0 |
| Science is public knowledge | 1 | 4 | 18 | 20 | 58 | 101 | 4,3 |
| Scientific knowledge is universal | 2 | 2 | 5 | 16 | 77 | 102 | 4,6 |
| Science should firsly produce knowledge | 0 | 7 | 18 | 28 | 49 | 102 | 4,7 |
| Science contributes to development | 0 | 0 | 5 | 8 | 90 | 103 | 4,8 |

Table A 12
**All responses to value statements provided in the questionnaire (Q34)**

| Degree at the time of the first grant | Country | Institution | No. of degrees |
|---|---|---|---|
| Diplôme d'Etudes Supérieures Spécialisées (DESS) | France | Université de Paris VI (Pierre et Marie Curie) | 1 |
| **Docteur** | **France** | Université de Bourgogne | 1 |
| | | Université de Bretagne Occidentale | 3 |
| | | Université de Montpellier I (Université des Sciences et Techniques du Languedoc) | 1 |
| | | Université de Nancy I | 1 |
| | | Université de Perpignan | 1 |
| **Docteur de 3e cycle** | **France** | Université de Bretagne Occidentale | 1 |
| | | Université de Caen | 1 |
| | | Université de Paris VI (Pierre et Marie Curie) | 1 |
| **Docteur Ingénieur** | **France** | Institut National des Sciences Appliquées | 2 |
| | | Université de Technologie de Compiègne | 1 |
| Doctor en medicina veterinaria (doctorado) | Mexico | Universidad Autónoma Metropolitana (UAM) | 1 |

Table A 13
**Grantee degrees at the time of the first grant: institution awarding the degree**

| Degree at the time of the first grant | Country | Institution | No. of degrees |
|---|---|---|---|
| Doctor en Medicina Veterinaria (licenciatura) | Mexico | Universidad Autónoma de Yucatán (UADY) | 5 |
| **Doctor of Philosophy (PhD)** | **Australia** | James Cook University | 1 |
| | | MacQuarie University | 1 |
| | Belgium | Universiteit Gent (University of Ghent) | 1 |
| | **Canada** | Université Laval | 1 |
| | | University of Alberta | 1 |
| | | University of Guelph | 1 |
| | **Germany** | Georg-August-Universität Göttingen | 1 |
| | | Max-Planck-Institut für Züchtungsforschung | 1 |
| | **United Kingdom** | University of Birmingham | 1 |
| | | University of Edinburgh | 1 |
| | | University of Lancaster | 1 |
| | | University of Leeds | 1 |
| | | University of London | 2 |
| | | University of London, Wye College | 1 |
| | | University of Oxford | 1 |
| | | University of Sheffield | 1 |
| | | University of Wales, Bangor | 1 |
| | **Japan** | Ehime University | 1 |
| | | Tohoku University | 1 |
| | | Tottori University | 1 |
| | The Netherlands | University of Amsterdam | 1 |
| | Norway | University of Tromsö | 1 |
| | Sweden | University of Lund | 1 |
| | **USA** | Arizona State University | 1 |
| | | Cornell University | 1 |
| | | Georgia Institute of Technology | 1 |
| | | Iowa State University | 1 |

Table A 13 (continued)
**Grantee degrees at the time of the first grant: institution awarding the degree**

| Degree at the time of the first grant | Country | Institution | No. of degrees |
|---|---|---|---|
| **Doctor of Philosophy (PhD)** | **USA** | Massachusetts Institute of Technology | 1 |
| | | Michigan State University | 1 |
| | | Montana State University | 1 |
| | | Purdue University | 1 |
| | | State University of New York | 1 |
| | | Texas A & M University | 2 |
| | | University of Alaska Fairbanks | 1 |
| | | University of Arizona | 1 |
| | | University of California, Davis | 2 |
| | | University of California, Riverside | 1 |
| | | University of Florida | 1 |
| | | University of Massachusetts at Amherst | 1 |
| | | University of Minnesota | 1 |
| | | University of Pennsylvania | 2 |
| | | West Virginia University | 1 |
| **Doctorado** | Spain | Universidad de Las Palmas de Gran Canaria | 1 |
| | **Mexico** | Centro de Investigación y de Estudios Avanzados (CINVESTAV) del IPN | 8 |
| | | Escuela Nacional de Ciencias Biológicas del Instituto Politécnico Nacional (IPN) | 2 |
| | | Universidad Nacional Autónoma de México (UNAM) | 9 |
| Ingeniero | Mexico | Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM) | 1 |
| **Maestría** | **Mexico** | Centro de Investigación y de Estudios Avanzados (CINVESTAV) del IPN | 4 |
| | | Centro Interdisciplinario de Ciencias Marinas | 1 |
| | | Colegio de Postgraduados en Ciencias Agrícolas (CP) | 3 |
| | | Escuela Nacional de Ciencias Biológicas del Instituto Politécnico Nacional (IPN) | 2 |
| | | Instituto de Ecología (INECOL) | 2 |
| | | Universidad Autónoma de Yucatán (UADY) | 10 |
| | | Universidad Nacional Autónoma de México (UNAM) | 6 |

Table A 13 (continued)
**Grantee degrees at the time of the first grant: institution awarding the degree**

| Degree at the time of the first grant | Country | Institution | No. of degrees |
|---|---|---|---|
| Maîtrise | France | Ecole Nationale Vétérinaire d'Alfort | 1 |
| Master of Science (MSc) | Australia | University of Queensland | 1 |
| | Canada | University of Toronto | 1 |
| | The Czech Republic | University of Veterinary and Pharmaceutical Sciences, Brno | 1 |
| | United Kingdom | University of Bristol | 1 |
| | | University of Liverpool | 1 |
| | | University of Reading | 5 |
| | | University of Strathclyde | 1 |
| | | University of Wales Institute, Cardiff | 1 |
| | Japan | Hiroshima University | 1 |
| | USA | Massachusetts Institute of Technology (MIT) | 1 |
| | | Michigan State University | 1 |
| | | Pennsylvania State University | 1 |
| | | University of California, Davis | 1 |
| | | **Total** | **133** |

Table A 13 (continued)
**Grantee degrees at the time of the first grant: institution awarding the degree**

# Appendix 8: Additional Figures

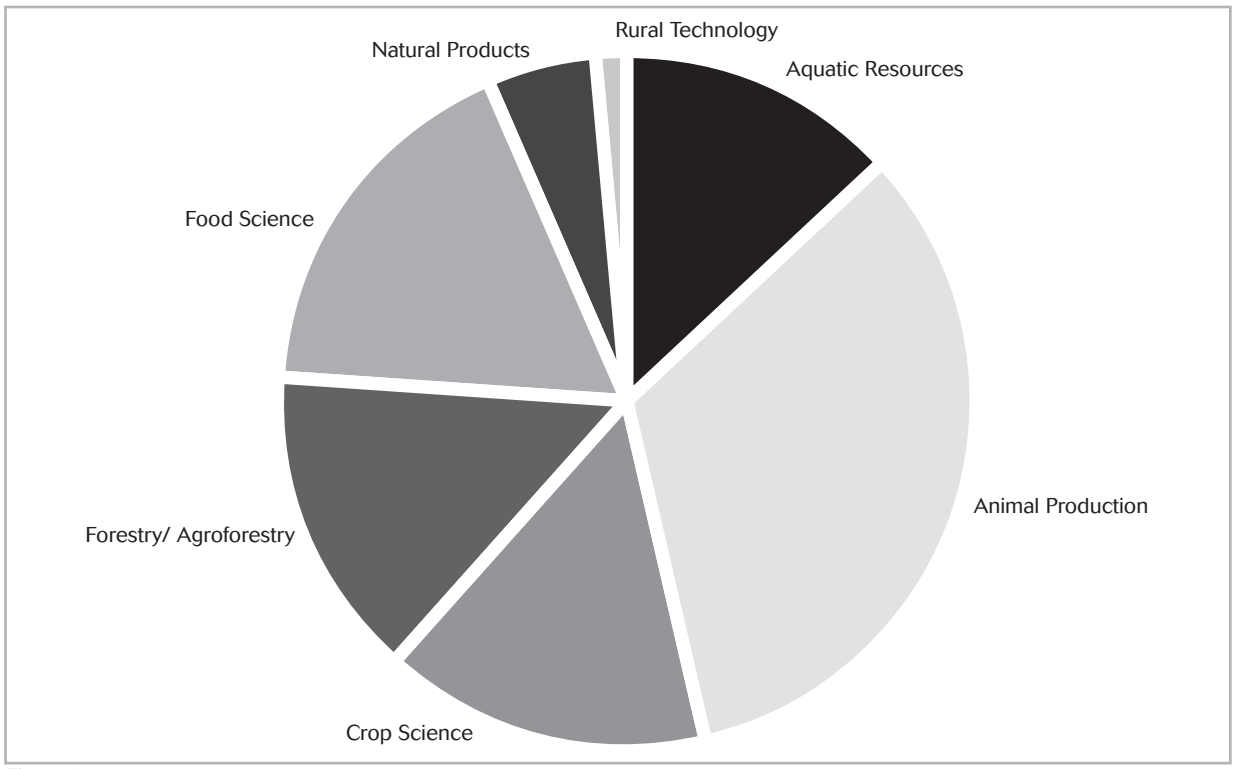


Figure A1

**Grants by Research Area**

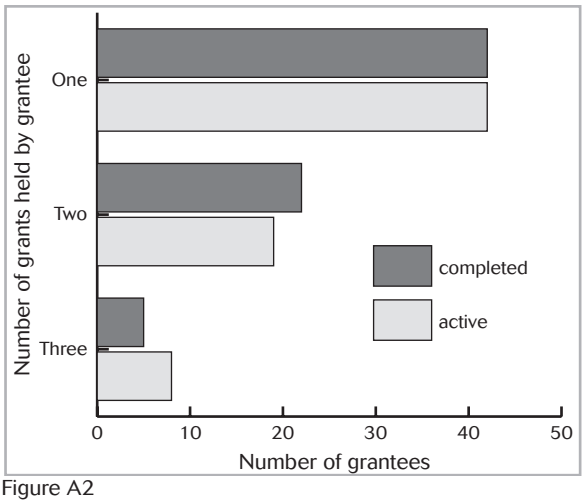


Figure A2

**Active and completed grants by number of grants**

IFS MESIA Impact Studies

| | |
|---|---|
| Report No. 1 | *Monitoring and Evaluation System for Impact Assessment (MESIA), Conceptual Framework and Guidelines*<br>Gaillard J.<br>Stockholm: IFS, 2000. 38 pages. |
| Report No. 2 | *Questionnaire Survey of African Scientists*<br>Gaillard J. and A. Furó Tullberg<br>Stockholm: IFS, 2001. 92 pages. |
| Report No. 3 | *IFS Impact in Mexico: 25 years of support to scientists*<br>(this document)<br>Gaillard J., J.M. Russell, A. Furó Tullberg,<br>N. Narvaez-Berthelemot and E. Zink<br>Stockholm: IFS, 2001. 152 pages. |


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