

Development and Strengthening of Research Capacities in Madagascar: An impact study of IFS activities (1976-2008)

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Abstract

This paper examines the impact of the activities of the International Foundation for Science (IFS) in Madagascar. Between 1976 and 2008, 50 Malagasy scientists have received a total of 71 IFS grants. Before presenting the results of the impact study, it briefly reviews the development of science and technology in Madagascar as well as the present institutional framework and governance system. It also provides an estimate of S&T human and financial resources as well as an overview of Madagascar's scientific output measured in number of publications indexed in international databases.

Despite heterogeneous and sometimes unsatisfactory results, especially with regard to S&T outputs, it is concluded that the positive results obtained by IFS in many ways, e.g. academic advancement of the grantees, access to executive positions, avoiding the brain drain, stimulation, and high degree of satisfaction for the IFS granting programme and additional services indicate that IFS has, to a great extent,

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fulfilled its mission and that its strategy is sound. Madagascar needs IFS today even more than before.

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JEL Classification: O30, O31, O55.

1. Introduction

Since the mid 1970s, the International Foundation for Science (IFS) supports young scientists in developing countries in Africa, Asia and the Pacific, as well as Latin America and the Caribbean. It includes individual research grants and capacity enhancing activities. Between 1974 and 2008, IFS supported close to 5000 research scientists in some 100 developing countries; over one-third were in Africa. The first research grants in Madagascar date back to 1976. By December 2008, 50 Malagasy researchers had received a total of 71 IFS grants, making Madagascar 13th among the 40 countries of Sub-Saharan Africa where IFS awarded grants (Nigeria, Kenya and Cameroon being the top recipient countries). Among the 50 Malagasy recipients, three have died and four have retired. Several are still professionally active although they have reached retirement age. By early 2009, 27 young scientists were still being supported by IFS, including five new grantees from the December 2008 session. The grants, excluding travel and training subsidies, totalled some US\$720,000.

To assess the effects of IFS support on the grantees' academic and professional careers, the IFS Secretariat has adopted an impact assessment methodology called MESIA (Monitoring and Evaluation System for Impact Assessment) which includes interviews, questionnaire surveys, bibliometric studies of grantees' scientific publications, and national impact studies, such as this one for Madagascar. The impact studies are carried out within a defined conceptual framework and follow guidelines to meet the requirements of international comparisons (Gaillard, 2000: <http://www.ifs.se/Publications/Mesia/mesia.asp>). In so far as is possible, they involve the IFS staff and affiliated organisations.

The MESIA study in Madagascar combine seven complementary approaches:

- i. a historical, institutional, political and sociological study of the national research system;
- ii. a retrospective analysis (1976-2008) of grant applications, candidates, grantees, and results;

- iii. a bibliometric study of science in Madagascar (1987-2006);
- iv. a desk analysis of IFS grantees' files at the IFS Secretariat;
- v. a tracking study of grantees' personnel and professional life;
- vi. a questionnaire survey sent to IFS grantees in Madagascar and
- vii. in-depth interviews of 11 grantees.

The desk and field studies, as well as the interviews were carried out between May and December 2008. The impact study covers 45 scientists who received IFS support during the period between 1976 (when the first grants were awarded to Malagasy scientists) and August 2008. The present article summarizes some of the main findings (for greater details see Gaillard and Gaillard, 2010).

2. The context: a brief overview of science and scientific institutions in Madagascar

A brief history of science and technology in Madagascar

"Western" science was introduced into Madagascar before the colonial period¹. The discovery of the island's wealth (wildlife and flora) in the 16th century attracted scientific expeditions, mainly interested in assessing resources preliminary to studies on conditions for establishing colonisation. The 19th century, prior to the French occupation, saw the arrival of numerous adventurers, naturalists and missionaries who contributed to the emergence of several fields of research that marked the origins of most of the country's preferred disciplines of contemporary science: inventories of natural resources, the sciences of nature, medicine, marine environments, anthropology, historic linguistics, cartography and geography (Rasoamampianina, 2010). Between 1896 and 1960, the colonial administration laid the grounds for the first scientific institutions, including the Institut Pasteur de Madagascar, the Académie Malgache and several agricultural research institutes. But it wasn't until the last years of the colonial period that Madagascar got its first institution of higher education, the Institut français des hautes études. This was the institutional situation in 1960 when the newly born Malagasy Republic founded the Université d'Antananarivo.

Despite independence, research remained "French" until 1972, the year when authority was transferred from the former colonial power to Madagascar and the year when institutions were nationalised and the institutional landscape was redesigned. Today, Madagascar has six public universities, with a combined enrolment of 40,000 students. Over half (60%) attend the Université d'Antananarivo. Private institutes of higher education have become very popular in the last few years. Some 50 private higher education

institutions were created since 1992. Most of these private institutions essentially offer curricula that prepare students for professional life and invest very little in academia per se. In the public universities, the teacher/student ratio has reached a critical level as a result of insufficient recruitment of teachers over the last 20+ years and a 100% increase in the student body over the last 6 years. Aging of teachers-researchers (with an average age of 56 years in 2008 reported by the University of Antananarivo) is another great cause for concern. Seven of the ten national research centres (Centres Nationaux de Recherche, CNR), are very small (between 5 and 17 researchers) and combine teaching, support services and expertise. There are three exceptions: The National Research Center for Rural Development (FOFIFA) and, to a lesser extent the National Research Center for Industrial and Technological Research (CNRIT) and The National Research Center for Environment (CNRE).

Table 1: Main Research Centers and Institutes in Madagascar (public and private)

Public Research Centers
Centre National de Recherche Appliquée au Développement Rural (FOFIFA)
Centre National d'Application de la Recherche Pharmaceutique (CNARP)
Centre National de Recherche Océanographique (CNRO)
Centre National de Recherche Industrielle et Technologique (CNRIT)
Centre National de Recherche sur l'Environnement (CNRE)
Parc Botanique et Zoologique de Tsimbasaza (PBZT)
Institut National des Sciences et Techniques Nucléaires (INSTN)
Institut Malgache des Vaccins Vétérinaires (IMVAVET)
Private Research Centers
Institut Pasteur de Madagascar (IPM)
Institut Malgache de Recherches Appliquées (IMRA)

Madagascar also has several private research centres. The Institut Pasteur de Madagascar (IPM) and the Institut Malgache de Recherches Appliquées (IMRA) rank among the most dynamic private centers and produce a tangible share of Madagascar scientific publications. Other research centres include institutes under the ministries of health, water resources, mines, economic affairs, finance, etc. and the Non-Governmental Organisations (NGOs). The growing importance of the NGOs including WWF, WCS, but also the Bibikely Biodiversity Center, Magasikara Voakajy and Vahatra, of most recent origin, is tangible in the institutional landscape. The latter group focuses essentially on environmental issues and biodiversity protection.

Most of the IFS grantees work in the Université d'Antananarivo, the CNRs (FOFIFA, CNRE, CNRP, INSTN) and at IMRA. Two Malagasy researchers who work for the NGO Magasikara Voakajy have also received support from IFS over the last few years.

Research policy and governance

The research governance system has evolved using various models, whose history and chronology are described elsewhere in greater details (Gaillard and Gaillard, 2010; Randimbimahenina, 2010). A look at the ministerial reform of April 2008 shows an unprecedented situation that caused anxiety among Madagascar's scientists and supporters of scientific activities interviewed for this study: the words "research", "science" and "scientific" were totally missing from the ministerial titles. The only "survivor" was the term "higher education" but it has been demoted to the level of a "vice ministry" within the Ministry of National Education. The researchers, the teachers-scientists and the institution directors interviewed for this study were very worried. The most pessimistic ones said that, at best, the national research centres would be attached to the university, and, at worst, they would be closed down. The organisational chart of the Vice Ministry in charge of Higher Education, Technical and Professional Training, within the Ministry of National Education confirmed the role of the Department of Research in formulating and implementing the ministry's research policy.

Since the early 2009, Madagascar went through a new political crisis leading to the creation of a government of transition (Haute Autorité de Transition -HAT). One of the first decisions of this government was to create a Ministry of Higher Education and Research (MESUPRES). However, one short-term drawback is that some of the main donors and funding institutions (including the World Bank and the European Union), decided to stop funding ongoing projects. It includes projects supporting research and higher education activities. As a consequence, research activities within universities and public research institutes stand often idle.

Human and financial resources

The number of teaching staff in Higher Education public institutions has remained more or less unchanged over the last ten years (slightly more than 1,000), while the number of students doubled. Due to structural adjustment programmes, no recruitments took place between 1996 and 2006 leading to a critical ageing of the teaching staff population (4/5 are 50 years old or more than 50 years old; less than 4% of them are less than 40 years). Very few contribute to research activities on a regular basis (approximately 10%). The

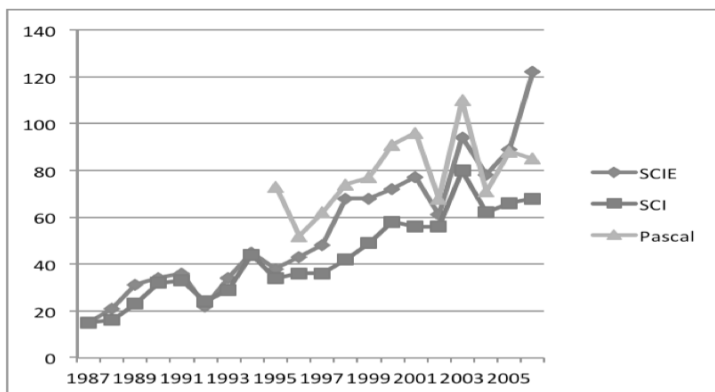
number of researchers in public research institutes has slightly decreased over the last ten years (today slightly less than 1,000). Staff ageing is even more critical for them. The youngest one was 38 years old and he the only one in the category below 40 years old.

The Malagasy budget for scientific and technical activities (national research budget, including wages) is in the lower range of research budgets in Sub-Saharan Africa. It has decreased from a high 0.9% in 1970 to 0.26% in 1986 (MRST, 1988). In 2007, it was estimated to be 0.14%. Research activities are seriously under funded. This is causing the Malagasy national research system to depend heavily on foreign funding and research. Nearly no research is taking place today in Madagascar without foreign funding. In addition, the Malagasy scientific community is dispersed and often isolated, with numerous small and scattered research units that all too often duplicate each other's work.

Madagascar scientific outputs

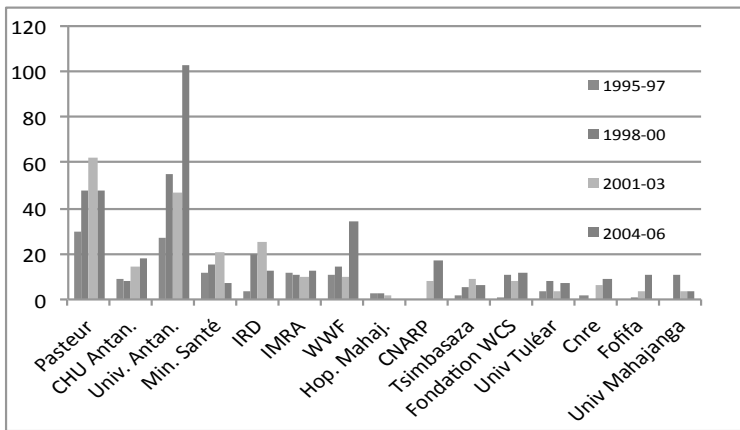
Madagascar's scientific output measured in number of publications indexed in international databases, despite its biases and limitations, is useful for positioning national science (in relation to the rest of Africa and the world) and identifying fields of specialisation, institutions and leading authors. Madagascar, with its modest but increasing scientific production (see Figure 1), has a halfway position in Africa (20th in Africa as a whole, 16th in Sub-Saharan Africa in 2006), immediately followed by countries such as Burkina Faso, Côte d'Ivoire and Zambia, and just ahead of The Gambia, Sudan and Mali.

Figure 1: Evolution of the number of publications in Madagascar (1987-2006) in three databases (PASCAL, SCI and SCI extended)



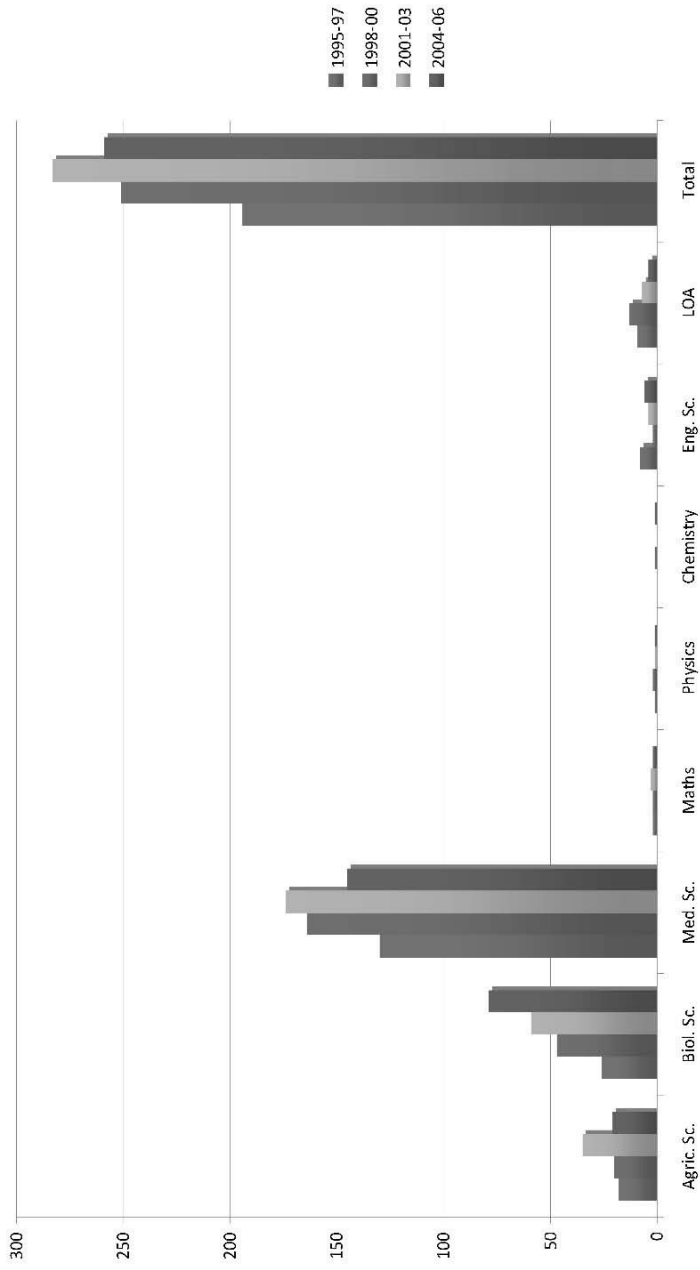
Two institutions are in the forefront and have produced half of the publications between 1995 and 2006 (see Figure 2): the Université d'Antananarivo and the Institut Pasteur de Madagascar (IPM). Actually over half (56%) when adding the output of the Antananarivo CHU (university hospital). The Université d'Antananarivo has gained considerable standing during the last few years, mainly because of the increased number of publications co-authored with foreign scientists working for NGOs, increasingly in fields related to environment and biodiversity preservation. Mention should also be made of the relative importance of IRD (French public research institute working with Malagasy research institutions) and IMRA. A small number of publications (average under two per year) are produced sporadically in two universities in the provinces (Tuléar et Mahajanga). This is also the case for four public research institutes (CNARP, PBZT, CNRE and FOFIFA).

Figure 2: Evolution of production of the most visible institutions (1995-2006, WOS)



A look at fields of specialisation shows the overriding prevalence of medical sciences (60-70%) and the relative weakness of agricultural sciences (about 10%). Biology (which includes biological resources, more specifically zoology, ecology, etc.) is the only field that is gaining ground (from 12% in 1996-67 to over 30% in 2004-06). Attention must be given to the very great weakness of the exact sciences (mathematics, physics and chemistry) and the Land-Ocean-Atmosphere (LOA) sciences that used to be a preferred area of research in Madagascar (Figure 3).

Figure 3: Relative importance of the main research areas over four periods



Source : base Pascal/Inist. Data computing : P.L. Rossi/IRD

Of the ten most reputed and prolific authors in international databases, two have received IFS grants. One is working at CNARP and the other one at IMRA. If we expand the selection to include authors who have published at least one publication per year between 2003 and 2007, there is another IFS grantee, now employed at IMRA (with seven publications indexed in five years). All three work on Natural Products. This is a positive outcome for IFS if we consider that more than half of the other scientists in the list of top publishing scientists are foreign scientists and/or scientists working at IPM, thereby not eligible for IFS grants.

International collaboration, measured through international co-publications, i.e. publications signed jointly with foreign authors, are very important, even excessively so. This phenomenon is not new, but they now account for 90% of all publications. The importance of collaboration with USA authors has grown since the end of the 1980s and, since 2005, has outweighed collaboration with Europe. As co-authored publications with USA rose, co-authoring with French scientists dropped proportionately. At the end of the 1980s, 60% of co-authored publications were with French scientists; in 2008 the level had dropped to 20%.

3. Results of the impact study of IFS activities

In an average year, IFS receives about ten applications for grants from Malagasy scientists of which two or so are eliminated at pre-screening, eight or so are scrutinised by the IFS scientific advisors and two or three are successful. It is noteworthy that an increase in IFS visibility through meetings, workshops, repeated visits by members of the IFS Secretariat, etc. usually leads to an increase in the number of applications. Since 2000, the average annual acceptance rate has been 24% of all applications received, which is well above the average for the African continent (18%) and the average for the countries of Sub-Saharan Africa (19%) during those same years. It is also above the average for Asia (19.5%) and for the world (21.5%) but slightly lower than the average for Latin America (28.6%). An analysis of the relative success rate for the last nine years shows major variations from one field to the next. Besides the quality of the project and of the candidate, very decisive factors are related to the relative development level of a research tradition and infrastructure and the quality of supervision they receive at their home institutes. Applications from young scientists working for institutions outside Antananarivo with little or no research traditions have nearly all been rejected.

IFS grantees' profiles

The largest number of grantees works in chemistry of Natural Products (16 scientists, 25 grants awarded) followed by Forestry and Agro-Forestry (10 scientists, 11 grants) and Crop Science (7 scientists, 11 grants). Natural Products is an old research topic in Madagascar, understandably so since the country is rich in endemic biodiversity and has discovered many drugs derived from plants. It has attracted a goodly number of national teams working in both public and private Malagasy institutions (CNARP, IMRA, CNRE, FOFIFA), universities, (mainly the Université d'Antananarivo), NGOs and the international pharmaceutical industry. Certain fields such as aquaculture (Aquatic Resources), and Food Science, even Animal Production have received very few grants, especially during the last few years. Yet, these fields are of high priority for Madagascar's development. Water Resources and Social Science are relatively new to the IFS granting programme, which may explain the relatively low number of research grants awarded in these two fields to Malagasy scientists. Recent efforts have been made to encourage grant applications in both of them.

On average, first-time IFS grant applicants are less than 34 years of age. Applicants and awardees over the last few years include scientists in the very early 30s and even some applicants under the age of 30. This may seem surprising since the average researcher in Madagascar is considerably older, but can be traced to the fact that a growing number of IFS grantees selected during the last ten years are actually PhD students without permanent employment. Many of them are hired on contract and/or have short-term teaching jobs, which allow them to survive, and/or work for NGOs. In Madagascar, 38% of the grantees are women. This is less than parity but is high in comparison with the percentage of female IFS grantees in Sub-Saharan Africa (15.6%) and the world (25%). It is about the same as the ratio in Latin America (37%), the continent with the highest percentage of female grantees. For the period as a whole, around half (51%) of the awardees have more or less the equivalent of a PhD (3rd cycle thesis, doctoral thesis in Engineering, PhD thesis or Doctorat d'Etat). This is equivalent to what was found in the MESIA study in Cameroon (52%) and higher than in Tanzania (35%). Most of them (close to 75%) were trained in Madagascar and 20% studied in France (mainly doctoral studies). Two of them have studied and one is studying in the USA, as part of a sandwich programme.

Research as a profession

On the question of salaries, the results of the survey are almost unanimous: 28 out of 30 respondents said that their salary is not enough to cover their

needs and the needs of their family. Eight went, as far as to say that, considering the cost of living, the salary was "far too low", even after adding bonuses. Besides their "main employment", all of these scientists (30 out of 30) had other jobs, such as overtime teaching in their home institutions or other public or private institutions, consultancies and private business (2/3rds of them), to which they devote a considerable amount of their time (more than half spend over 40 hours a month on their second jobs). These activities generate added revenue, sometimes enough to double or more their basic salary.

Despite these "other jobs", the respondents said they spent more time on research in their home institutions than on teaching. The tendency to spend more time on research is even more pronounced among the current, younger batch of IFS grantees. This is a positive outcome for IFS in the Malagasy context where, especially in the university teacher-researchers population, only a small number of professionals do research, and the pace is very irregular.

IFS Malagasy grantees were also asked to give their opinion on the relative advantages versus disadvantages of a number of characteristics related to their professions (table 2). Responses reveal a rather mixed picture (Table 2). Salary scale is clearly identified as a disadvantage whereas job security, career development and promotion opportunities are perceived as an advantage of the profession. Opinions are more divided concerning retirement and social benefits

Table 2: Advantages and disadvantages of various professional characteristics

Professional characteristics	Positive	Negative	Neutral
Promotion opportunities	14	7	9
Salary scale	4	17	9
Career development	21	2	7
Job security	19	7	4
Retirement benefit	10	5	15
Social benefit	8	9	13
Total	76	47	57

Except for one scientist who said his 2008 research budget (excluding salaries) was US\$37,000 the vast majority have budgets of between US \$2,000 and US\$13,000. These are relatively small budgets, especially for two of them whose budgets, they said, were under US\$250. Yet, most of these

reported budgets are much higher than the average (or median) individual research budget in Madagascar. As with all of the Malagasy research scientists, IFS research grantees, both past and present, are very dependent on foreign funding. Two-thirds of them claim to be totally dependent on funds provided through bilateral technical assistance, international organisations and private foundations. The amount of foreign funding varies enormously, ranging from a few thousand US dollars to US\$430,000 for a project recently funded by IDRC (International Development Research Centre, Canada). Only 14 grantees have provided detailed information on foreign funding. For the IFS grantees all told, the magnitude of total foreign funding for research (excluding IFS and national funding) can be estimated to an amount approximately ten times bigger than the IFS investment during the same period of time. Besides international funding by the International Atomic Energy Agency (IAEA), the European Union (EU), the Agence Universitaire de la Francophonie (AUF) and the World Bank, especially through the FADES programme, there is also bilateral funding, led far and away by French technical assistance and French research institutes (mainly CIRAD and IRD) that provide support tools and programmes for research in partnership with French scientists.

Research practice, communication and perception of research

Concerning scientific interaction and contacts, the IFS grantees said both were close with their immediate colleagues but relatively weak with Malagasy colleagues in other institutions, thus evidencing the fragmentation and compartmentalisation of the Malagasy scientific community. There are also more opportunities to work with European colleagues than with colleagues from other African countries. Although IFS contributed to establish or promote a number of research networks in the region involving Malagasy scientists (e.g. the Natural Products Research Network for Eastern and Central Africa – NAPRECA), there is a need to further promote these regional and/or south-south networking activities.

The main limitations to their research are, in descending order: lack of equipment, materials and consumable items, (reported 18 times), lack or shortage of funding (16 times), difficulty in obtaining documentation (11 times), lack of knowledge (9 times), lack of time (7 times), scientific isolation (7 times), lack of science policy (6 times), administrative red tape (3 times), and lastly, lack of adequate financial incentive (3 times). When asked to rank certain recurrent problems, the scientists once again pointed most emphatically to "the procurement, access to and maintenance of research equipment" and "access to source documents". These results are very comparable to the

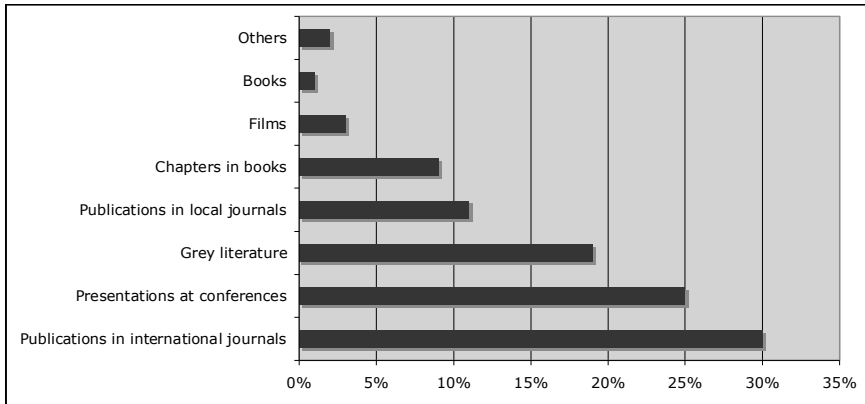
two other impact studies carried out in Africa to date i.e. Tanzania and Cameroon (Gaillard et al., 2002; Gaillard and Zink (2003).

Overall, IFS grantees did participate actively in national and international conferences, most of them taking place in Madagascar and Europe. Since the beginning of their careers, the 30 IFS grantees who responded to the questionnaire-survey attended 485 conferences, of which more than one-third (37.5%) were held in Madagascar, over one quarter (28.8%) in Europe, less than one-fifth (17.7%) in other African countries and one-tenth (9.7%) in Asia. Relatively few of the scientists attended conferences in North America (26 conferences) and even fewer went to Latin America (4 conferences). IFS provided financial support for grantees to attend 57 of the 485 conferences, slightly over one conference out of ten (11.7%), mainly in Madagascar (23) and the rest of Africa (21), but also, to a lesser extent, in Europe (6), Asia (6) and North America (1). Most funding (58%) for participation in conferences abroad came from foreign sources (IFS + other foreign sources). In recent years (last 5 years), one quarter of the respondents did not participate in any conferences abroad, and one-third attended only one. A small minority (5 of the 25 scientists who answered this question) participated in at least five conferences abroad during the last five years, i.e. at least one conference per year. This latter group are all part of an earlier cohort of IFS grantees, but their grants were terminated at least ten years ago.

Research outputs and outcomes

Concerning scientific publications, 27 scientists (out of the 30 who participated in the survey) responded to this question. The group was extremely heterogeneous, concerning both the number and types of publications and the publication strategy. The most prolific (ex IFS grantee) scientist produced close to half of all works published in international journals and presented at conferences. At the other end of the spectrum, one grantee reported 95 written works in the "grey literature"² category, 8 in international journals, and even fewer presentations at conferences. There were many scientists between these two extremes; they published rather little. The most frequent mode of publication is articles in international scientific journals, conference presentations and conference proceedings. And then there was the grey literature, which by definition is not published, but which nonetheless was in third position, well before articles published in local journals. Following the grey literatures was chapters in books, films and documentaries and, finally, whole books (Figure 4).

Figure 4: Relative importance of scientific outputs



The relatively low number of articles published in local journals can be explained by the small number of local journals that exist in Madagascar and the fact that they are not published regularly. The relative share of publications that can be traced directly to IFS-supported work is 15%. It is slightly lower than in Cameroon and higher than in Tanzania. The number of publications per scientist, for each channel of publication, obviously depends on the scientist's relative seniority. Scientists working on Natural Products, publish the most in international journals (16.8 publications on average per scientist throughout his/her career), make the most presentations at seminars and conferences (12.2) and write the most book chapters (5.1). It is noteworthy that papers in international journals are nearly all co-authored with foreign authors.

Besides publications, the IFS grantees in Madagascar also transmit their research findings by teaching in establishments of higher education and by training and supervising students working toward Masters and doctoral thesis. Several participate actively in NGOs, producer associations and community organisations to help optimise and transmit their research. Out of the 30 respondents to the questionnaire, 7 said that their research had led to at least one patent, commercial application or innovation. One-fifth of 32 patents, applications and innovations identified through the survey came from IFS-supported research. As for publications, we can recognise a concentration factor: two grantees produced 20 out of 32 (i.e. close to two-thirds) of what we have called "other research products". Furthermore, one of the two filed for 10 of the 14 patents listed. This grantee works on Natural Products and is also the grantee who published most in international scientific journals.

After having completed an IFS supported research project, and submitted a project report, grantees may apply for renewal grants. In total, a researcher is eligible to receive today³ three research grants from IFS. Among the 23 Malagasy scientists whose IFS grants have ended, 14 obtained one grant, three obtained two, four obtained three, and two (belonging to the first generation of IFS grantees in Madagascar and working in the field of Natural Products) received four. Natural Products enjoyed the highest grant renewal rate, followed by Crop Sciences. The four grantees working in Animal Production received one grant each. The timeframe of an IFS research project or period should normally be 1-3 years. The average research period for the grants awarded to the 23 Malagasy scientists whose grants have ended, is 6.8 years⁴, i.e. double the normal maximum length of an IFS research period (3 years). It however varies from 2 years up to 11 years. Scientists who enjoyed more than one grant tended to shorten their research periods (5.3 years) while the research period for one-time grantees was longer (8 years). Delays (and, to a certain extent, non-renewals) were caused by difficulties reported back to the IFS Secretariat, and during visits by experts and interviews on site. The main reasons were delays in purchasing and installing research equipments, administrative problems, difficulties in getting to the field, professional reassignments, unforeseen obstacles in conducting the research, personal crises and socio-political conflicts that caused the universities and research institutes to be closed for several months or even a whole year.

To date, out of the 23 Malagasy scientists no longer supported by IFS 8 grantees (about one-third) have submitted a final report to IFS. The cumulative figure for final reports and partial reports sent to IFS i.e. 15 (nearly two-thirds) can be considered as rather satisfactory. In 6 cases, IFS did not receive any partial or final reports by the time the grant files had been closed. All six were grantees were scientists who received one- grant only. On average, the number of grantees' files closed without reports in Madagascar is lower compared to Tanzania (Gaillard, Zink and Tullberg, 2002) but higher compared to Cameroon (Gaillard and Zink, 2003). For the 15 who submitted partial and/or final reports, the quality of the reports was very varied. Six were considered poor or unsatisfactory, five satisfactory, and four, good or excellent. These results concerning the quality of the reports were on average comparable to findings in Tanzania but less good than in Cameroon where the large majority of the reports (88%) were judged to be "satisfactory" or better than satisfactory.

Advancement and mobility

Madagascar's IFS grantees made notable academic progress. In the majority of cases, they were able to defend their doctoral thesis thanks to research projects carried out with IFS funding (3rd cycle thesis or doctorat d'Etat⁵). By 2008, 24 out of the 30 scientists (80%) had reached a level equivalent to PhD or above, at the least, while only 14 (less than half) had reached that level when the first grants were awarded. Since obtaining IFS support, several Malagasy scientists have been recruited to leading positions in research institutes and at the Université d'Antananarivo, or as advisors to ministers.

As in other IFS country impact studies carried out to date (Cameroon, Mexico, Tanzania and Vietnam) Malagasy scientists supported by IFS, remain in Madagascar throughout their research career, i.e. long after the IFS support was discontinued. Despite their high international mobility, they have all been committed to working in their home countries and strengthening local science capacity from the inside. Thus, to get an higher education degree, 20 of the 30 scientists who responded to the questionnaire survey had studied abroad for a period of between 1 and 10 years, the average being 4.1 years. The total number of years spent abroad (for studies and other reasons) is longer, since 21 of them spent between 1 and 30 years outside their country, the average being 5.7 years. The scientist who spent the most time abroad (30 years) is the only one among the 45 who moved abroad permanently for retirement after having worked for 13 years in Madagascar, and 6 years in Côte d'Ivoire and Tunisia.

The grantee tracer study, carried out as part of this impact study showed that there were no confirmed cases of the "brain drain" among the Malagasy grantees. The case mentioned above reflects "inter-African circulation" rather than a typical case of South-North brain drain. We also saw a certain number of inter-institutional movements at the national level, but nearly all the Malagasy IFS grantees continued to work actively in their national scientific community. Many of them, as we saw above, work in research or higher education institutions, but as a sideline undertake expert studies or work as consultants. Only one scientist, up to now, went as far as to resign from his institution (CNRE) to become a full-time consultant to a mining firm, thus ending his IFS-sponsored project. Lastly, a teacher-scientist at the École Supérieure Polytechnique of the Université d'Antananarivo, who also worked as an expert in renewable domestic and industrial energy (mainly for the World Bank) created a company called Energie Technologie of which he is the manager and majority shareholder. This means that he combines teaching at the university, and working as an expert, a developer and a businessman.

An assessment of IFS support

Although a majority of the respondents said that lack of funding was the main constraint to their research, only 3 (out of the 27 who answered the question) said that they would not have been able to continue their project without the IFS grant. In contrast to their peers in other African countries, not many Malagasy scientists say that their research would not have been possible without the support of IFS. The fact that only 8 said that they could have continued their work without more financial support from IFS suggests that the majority of them were prepared to seek (and, according to what they said, obtain) support from other funding sources and/or eventually redesign (or even downsize) their project.

But there is a contradiction here: IFS has played a role in enhancing capacity for accessing other sources of funding and for obtaining support for the research activities. Out of the 25 grantees who answered the related question in the questionnaire survey, 19 said that the IFS grant helped them obtain other international funding, 16 said they received funds from their home institutions and 12 obtained national (public or private) funding. Receiving the grant allowed 15 of them to obtain better scientific and technical assistance from their institution and in 21 out of 23 cases to start new partnerships which lasted after the grant ended. So, on the one hand, some grantees are saying that they could have continued their project without the IFS grant but at the same time assert that the IFS grant was indeed very useful, if not pivotal, for their project/career.

The IFS Malagasy scientists were also asked to rate the quality of a number of services provided by IFS, even if some of them have been discontinued. Overall they have a positive or very positive opinion of IFS services. The services that ranked highest were: grant administration, purchase of research equipment, selection process, scientific workshops and contacts with the IFS Secretariat. The services which most grantees considered generally "satisfactory" but which received the highest number of "bad" and "very bad" ratings were: networking activities, publication assistance for research findings, follow-up activities after project completion, and research equipment maintenance, the only service for which negative opinions outnumbered the "good" and "excellent" ratings. Research equipment maintenance is typically a service that is no longer provided by IFS. The same applies to publication assistance of research findings that has never been a core activity of the IFS granting programme. For IFS, this is an indication of services that may be important to (re-) consider in the future in particular when IFS wants to focus its support to the scientifically weakest countries.

Science, society and scientists' career goals

The answers to the questions related to the role of science in society were confirmed by opinions conveyed during the interviews: IFS' Malagasy grantees support the traditional values of national public science. All of them feel that science contributes to development; nearly all feel that science is a public good, that scientific knowledge is universal and that the main goal of science is the production of knowledge. These values are enhanced by values related to loyalty to one's institution and one's country (most of the grantees feel that it is normal for the scientific institutions to select the research topics and the government to define the scientific priorities). Similarly, values linked to economic development and markets are, by the vast majority, considered to be positive; most of the grantees feel that science should first and foremost contribute to practical innovations, and that scientists should have business and managerial skills and should produce goods for a competitive market. Career choices also reflect the grantees' attachment to scientific professions and national ethics. Only three of the grantees would like to work for foreign or international institutions; the great majority would like to continue to work for national public research and/or development institutions.

4. Conclusion

Science was introduced into Madagascar before the colonial period and the colonial administration laid the grounds for the first scientific institutions between 1896 and 1960. Yet, the development and the institutionalization of the Malagasy science and technology system is of recent origin. The first University (Université d'Antananarivo) was founded in 1960 at the same time as the newly born Malagasy Republic. Research institutions were nationalized and the institutional landscape was redesigned from 1972. Today, Madagascar has six public universities (the main one being in Antananarivo in the capital city), ten national research centers, some 50 private higher education institutions created over the last twenty years and several private research centres (e.g. The Institut Pasteur de Madagascar (IPM) and the Institut Malgache de Recherches Appliquées (IMRA) ranking among the most dynamic private centres).

Since early 2009, Madagascar went through a long-lasting political crisis which outcome is difficult to predict. This led to a sharp cut in foreign funded activities and to a slowing down in research activities. Political crises are recurring in Madagascar and they are, in part, responsible for the difficulties regularly invoked by the recipients of IFS to explain the delays and constraints in their work. Malagasy researchers eventually adapt the best

they can taking maximum advantage of the limited resources they have. But relying on one's own resources has its limits in a context of declining institutions. The universities are weakened, endangered by asphyxiation due to the massive increase in student numbers and face the "off-shoring" of research that is done increasingly outside its walls⁶. Several provincial universities and national research institutes are nothing more than empty shells, or in the process of becoming empty shells. The "de-institutionalization" of science is accompanied by a "de-professionalization" of research.

The deteriorating purchasing power and working conditions have resulted in the emigration of scientists even though many Malagasy scientists stayed at home (this is the case of IFS grantees), surviving by supplementing their meagre wages from various additional activities. The decline of institutions and the deterioration in the exercise of the profession of researcher have intensified due to the withdrawal of state, which was further increased in recent years. The former political power never truly trusted Malagasy researchers that it considered "mediocre" and not contributing to national development. The stated goal for 2010 by the "Madagascar Action Plan (MAP) to devote 0.1% of Gross National Product (GNP) to the national research budget (GERD) also confirms the lack of ambition of the deposed government to strengthen its national research capacity⁷. In the absence of a national research strategy, policies are often reduced to *laissez-faire*. It is therefore hoped that a new democratically elected government will soon restart the process of developing a dynamic and ambitious national research policy to allow a real strengthening of research capacity in Madagascar.

The foregoing put the performance and outcomes of IFS grantees into context and perspective. It stresses the difficulty of developing and strengthening science in countries having weak institutions and weak scientific capacities. In such a context, there is a necessary tension between activities such as building a new road, which can generate increased production and development, thereby reducing poverty, versus improving the learning and working conditions of an increasing number of graduates and researchers, who will take a longer period of time before they contribute to development, and even then often indirectly, to poverty reduction.

The above-described context explains, at least partly, some of the main results of the impact study presented in this article, including the heterogeneous and sometimes unsatisfactory results of the research projects and outputs, especially with regard to reports submitted, publications, conference presentations, patents, commercial applications and innovations. This said, the positive results obtained by IFS in many ways, e.g. academic advancement of the grantees, access to executive positions, avoiding the brain drain, stimulation, and high degree of satisfaction for the IFS granting programme and additional services indicate that IFS has, to a great extent,

fulfilled its mission and that its strategy is sound. Madagascar needs IFS today even more than before, but considering the growing uncertainty of the employment market, IFS, even more than in the past, must look more carefully that the future grantees will be able to devote enough time to research, and that their home institutions and laboratories can offer them good-quality and long-term on-the-job training and supervision. It means, among other things, carefully selecting not only the individual young scientists based on his/her own merits but also the research team and the institution where he or she works.

At a time when the International Foundation for Science has embarked on a process of reflection and review on the future direction of its support to young scientists in the developing world, the results of this impact study should be rather timely⁸.

Notes

- ¹ This does not preclude the existence of traditional knowledge and various forms of ethno sciences in Madagascar prior to the introduction of Western science. These ethno sciences no doubt contributed to transforming and shaping Western science being introduced to Madagascar (see e.g. Harding, 1996). On the spread of Western science in non-Western societies see Basalla (1967).
- ² The term « grey literature » (or « gray literature ») is often, but not exclusively, used for scientific research. Examples of « grey literature » may include scientific or technical reports (e.g. IFS non published progress or final reports), working papers from research groups or committees, white papers, or preprints. The identification and acquisition of grey literature poses difficulties for librarians and other information professionals for several reasons. Generally, grey literature lacks strict bibliographic control, meaning that basic information such as author, publication date or publishing body may not be easily discerned. Similarly, non-professional layouts and formats and low print runs of grey literature make the organized collection of such publications challenging compared to more traditional published media such as scientific journals and books.
- ³ Note that since the inception of the IFS granting programme and until 1994, a researcher was eligible to receive up to four grants from IFS.
- ⁴ The definition of a research period may differ and be controversial particularly for the last research grants awarded by IFS depending on the ending date taken in consideration: date of submission of final report or date of closure of a grantee's file. The definition used in this report is the time between a grant is awarded by IFS and the date when IFS officially terminates its support. Research

periods average duration would be slightly shorter when using report submission as an ending date.

- 5 Inherited from the French system, these two diplomas are replaced today by a unique “doctorat” as part of the LMD reform (LMD = Licence, Master, Doctorat or BSc, Master and PhD). The duration of a 3rd cycle thesis or 3rd cycle doctorat was normally three years, the first year being devoted to courses and the submission of a research report for the delivery of a DEA and the two last following years for conducting a research project. The delivery of the doctorat d’Etat is a much longer term enterprise: up to seven years and sometimes more for the basic and experimental sciences and even more for the social sciences (10-15 years). The later degree recognizes a higher level of original research than the PhD. It was mainly used in the universities to become professor.
- 6 The success of the IMRA and the strengthening of research activities of several NGOs including at the the outskirts of the University of Antananarivo confirm this trend that is common to many Sub-Saharan African countries (Waast, 2001).
- 7 The average country in sub-Saharan Africa (excluding Malawi, Uganda and South Africa) is about 0.3%.
- 8 As a consequence of these envisioning activities, the research grant process has been temporarily suspended. The IFS research grant application process is now re-opened. There will be two time-bound research grant application sessions before a new three programme strategy is adopted in 2012.

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