Questionnaire Survey of African Scientists[1]

Jacques Gaillard[2]

Given the prevailing crisis conditions, what is it like to be a scientist in Africa today? To what extent have these conditions changed over the last three decades? How do these African scientists practise research and how do they perceive the role of science and scientists in society? What are the main hinderances to their research work? How dependent is their work on foreign funding? What is the impact of foreign support on their working environment, on their research practice and on their research careers? A questionnaire survey was carried out to answer this series of questions.

Introduction

In the 1960s, homegrown science and technology (S&T) in Africa rested on a poor foundation (Eisemon, 1979). However, during the 1970s and into the 1980s, Africa's scientific research institutions and universities experienced a period of vigorous expansion (Davis, 1983; Kolinsky, 1985; Gaillard et al. 1997) marked by dramatic increases in the number of university students and a steady rise in the number of research scientists (Gaillard and Waast, 1993). This expansion was largely driven by substantial funding from outside sources. The money received was invested in a variety of programmes, including fellowships for training, grants to individuals and groups, institution building, and North/South research programmes (Gaillard, 1999). By the end of the 1980s, the benefits derived from these investments were modest but tangible.

Since then, the state of science and technology has deteriorated substantially in most African countries. Severe cuts in government spending have pushed institutions of higher education and research centres into steep decline. National educational and research coordinating bodies, once the focal points of reform for science and technology policies, have lost much of their political power and influence. In fact, a significant number of these reform-minded bodies have even been dissolved. Adding to the decade-long litany of problems that have fractured Africa's science and technology infrastructure is the fact that virtually no recruitment of professional or support staff took place throughout the 1990s, and salaries, which took a nosedive throughout the period, eventually hit rock bottom, becoming insufficient to live on.

Recent assessments of African scientific research communities have detailed these prevailing dismal conditions time and again (Dahoun, 1997; Gaillard et al., 1997; Lebeau and Ogunsanya, 1999). One critical consequence of these developments is that universities that once served as beacons of hope, including the universities of Ibadan in Nigeria, Dakar in Senegal, Dar-es-Salam in Tanzania and Khartoum in Sudan, have been turned into shells of their former selves. Buildings are poorly maintained, modern laboratory equipment is rarely available, and faculty and staff are undervalued and, sometimes, unpaid. Meanwhile, external funding for

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[1] This text summarises the main findings of a report published by the International Foundation for Science (Gaillard and Furó Tullberg, 2001).

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science and joint research initiatives with universities and research institutes in other nations have also declined precipitously.

Given the prevailing crisis conditions, what is it like to be a scientist in Africa today? To what extent have these conditions changed over the last three decades? How do these African scientists practise research and how do they perceive the role of science and scientists in society? What are the main hinderances to their research work? How dependent is their work on foreign funding? What is the impact of foreign support on their working environment, on their research practice and on their research careers?

A questionnaire survey was carried out to answer this series of questions. Ideally, we should have sampled a population of scientists across the African continent. Given the resources at our disposal, this was too problematic. Instead, two samples were used: the African grantees of the International Foundation for Science (IFS) and the African beneficiaries of the STD3 and INCO-DEV1[3] programmes of the European Commission. In relation to the question of representativeness of the sample and in view of the interpretation of the results, we should always remind ourselves that IFS grantees and INCO beneficiaries are the outcome of a selection process. Thus, IFS grantees and INCO beneficiaries' working environments would supposedly be better than that of "average" scientists taken from a representative group of African scientists.

In addition to being part of a Research Project[4] on the assessment and prospects of Science in Africa, this "Questionnaire Survey of African Scientists" is a component of the Monitoring and Evaluation System for Impact Assessment (MESIA). This unit is being established at the IFS Secretariat to assess the impact of IFS activities on the achievements and career development of the IFS grantees.

1. Response rates

The questionnaire was sent out in March 2000 and a reminder in June 2000 to IFS grantees in Africa and African beneficiaries of the STD3 and INCO-DEV1 programmes (referred to as INCO beneficiaries in the rest of the text) of the European Commission. The two funding bodies cover partly overlapping scientific areas: IFS gives grants to scientists working in the areas of biological, agricultural and environmental sciences, while beneficiaries of the INCO programme are active in the areas of agricultural, environmental and medical sciences.

Altogether, 702 questionnaires were returned to IFS. Half of the IFS grantees (49.8%) and close to one-third of the INCO beneficiaries (30.4%) answered the questionnaire (see Table 1). The overall response rate was 41.8%. Taking into account the size of the questionnaire, the time frame of the survey (IFS grantees were awarded their first grants more than 25 years ago), postal delivery shortcomings, and the fact that many countries on the African continent have gone through various form of conflict or natural disasters in the recent past (in particular Burundi, Congo and Congo DR, Côte d'Ivoire, Mozambique, Rwanda and Sierra Leone) the

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[3] In the rest of the text, the African beneficiaries of the STD3 and INCO-DEV1 programmes of the European Commission are called INCO beneficiaries.

[4] This research project, co-ordinated by Roland Waast (IRD) and Jacques Gaillard, includes a comprehensive bibliometric study of Science in Africa during the 1990s (see Arvanitis et al., 2000), country case studies carried out in 13 African countries[4] and some 400 interviews of scientists conducted in the same countries.

overall response rate can be considered satisfactory, particularly for the population of IFS grantees.

Table 1

Overall response rates

Programmes	Sent*	Received	Response rate
IFS	989	493	49.8%
INCO	686	209	30.4%
Total	1677	702	41.8%

*Excluding the questionnaires returned to IFS and other special cases

(See details in Appendix)

2. Representativeness and main characteristics of the population surveyed

Given the above target groups, the scientists surveyed are active in research areas among the most widely representative of Africa today: biological, agricultural, environmental and medical sciences. Mathematics, physics, social and engineering sciences were therefore not represented in the survey. Most of the African countries were part of the survey. However, the two major science producers in Africa, namely South Africa and Egypt, were under-represented and the scientifically middle- or rather small-sized countries were over-represented.

Many characteristics of the population surveyed are representative of the African scientific community today, as observed in the different country case studies. 83.2% are male, 75.3% are more than 40 years old, 90.4% are married, and more than two-thirds have between one and three children. The spouses of African scientists are overwhelmingly skilled workers (researchers, university lecturers and schoolteachers accounting for about one-quarter of the total). Few are housewives. Given the grossly inadequate salaries of the scientists, working is a must for both partners.

Over 90% of the scientists surveyed work at public universities (60.0%) and public research institutes (32.7%). Relatively few work for NGOs (4.2%), private institutes (1.9%), and private universities (1.2%). The three latter percentages are likely to increase in the future. Whereas the scientists are largely satisfied with the job security, they are largely dissatisfied with their salaries and the social benefits.

3. A heterogeneous continent: North, South and Median Africa

Differences exist between North Africa, South Africa, and Median Africa in critical areas such as scientific infrastructure, budgeting, training, and publication output. Moreover, it is important to keep in mind that not even the division of Africa into three scientific geographical regions adequately conveys the diversity of experience detectable from a closer examination of the situation. For example, Median Africa, the continent's most troubled region today, is in itself far from being homogenous.

While African scientists acknowledge that they enjoy a high degree of job security, they also express strong dissatisfaction – indeed frustration – with their salaries and job benefits. However, scientists in South Africa are much less dissatisfied with their salaries (52.4%) than their colleagues in North Africa (62.2%). Not surprisingly, scientists in Median Africa are the most dissatisfied with their salaries. A startling 92% of the survey

respondents from this region said they were displeased with their earnings (see Figure 1, Adequacy of scientists' salaries by region).

The number of students pursuing a graduate and post-graduate education in African universities has increased considerably over the past three decades. Nevertheless, the higher the degree that is sought and ultimately earned, the more likely it is that a student will pursue his or her studies abroad – in Europe (mainly the United Kingdom and France) and to a lesser degree in the USA or Canada. While South Africa's university system now allows it to be "quasi self-sufficient" in the awarding of all degrees, the university systems in North Africa and, particularly, Median Africa, continue to depend on foreign institutions of higher education. This trend continues despite recent statistics indicating an increasing number of Master's and doctoral degrees received at home. (Figure 2 shows PhDs taken at home by period and region.)

The structure of research funding also varies from region to region in Africa (see Figure 3). Although international institutions or foreign nations remain the most important source of funding for science throughout Africa, Median African's scientific community depends more on outside donors than South Africa and North Africa. Similarly, South Africa and North Africa enjoy a higher percentage of funding from home-based institutions than Median Africa.

Other characteristics such as the relative importance and the trends in scientific output (discussed below) also show contrasting developments according to the region. What such figures reveal is that there is not one, but several, Africas and that the scientifically weakest countries are located in Median Africa.

4. Research as a profession

Although they earn on average nine times the minimum salary, scientists cannot survive on their salaries alone. Half of them supplement their incomes with extra jobs, which provide four times more income than their salary on average. To supplement their income they are employed either by a consultancy or private business (37.0%), in teaching (25.0%), in farming (13.0%), or have their own consultancy or private business (20.0%).

One-fifth of the respondents (20.4%) have been offered jobs abroad since the beginning of their career. INCO beneficiaries are more likely to be in such a situation (50.0%) than IFS grantees (9.5%), the difference mainly being attributable to the greater international mobility of the medical professions. A large majority of the scientists (72.3% for IFS and 60.3% for INCO) who were offered a job abroad accepted it. More than half of the offers came from the USA and European countries (mainly France and the United Kingdom), but African countries (mainly Kenya, Saudi Arabia, South Africa and Botswana) also made offers. Findings from interviews with IFS grantees and MESIA country case studies (Tanzania and Cameroon), however, suggest that mobility should be perceived as circulation rather than exodus.

5. Research practice, communication and perception of research

The vast majority of the scientists surveyed work with other scientists or in teams (93.2%). The proportion of IFS grantees working alone was only 8.3%. Given the fact that IFS targets its support to individual scientists

this is a rather unexpected result and tends to indicate that teamwork is more the rule than the exception in Africa. Similarly, scientists work in multidisciplinary teams to a very large extent (85.4%).

The highest mean frequency of communication is with scientists from one's own department, and the lowest with scientists in Asia or Latin America. Overall, scientists also communicate less with colleagues in Africa than with colleagues in Europe. This illustrates the generally low South-South level of collaboration (Figure 4, Mean frequency of communication with scientists and other people). On average, INCO beneficiaries tend to have higher communication frequencies with all categories of people listed, except for funding agencies. It is also interesting that scientists in Africa communicate more with their colleagues in Europe than with their colleagues in Canada and the USA. In the case of INCO beneficiaries, this is only to be expected, but the same behaviour is also present for IFS grantees.

The two most important statements characterising the role of science and scientists in society for the African researchers are, in order of importance: "science contributes to development" and "science knowledge is universal" (Figure 5, Mean responses to value statements). This confirms the existing tension for the African scientists between addressing local questions relevant for the development of their societies and, at the same time, being part of mainstream science and recognised by the international scientific community. As for the choice of research topics, the fact that the statement "research topics are set by employers" is placed at the end of the list with the lowest score, strongly suggests that the research agenda is far from being driven by the African universities and research institutes.

Despite the rapid development of communication technologies in Africa, many African scientists interviewed during the last two years complained that they still suffer from a feeling of isolation. At the time of the survey, slightly more than half of the respondents (53.0%) had access to the Internet and slightly less than half (46.9%) had easy access to bibliographic databases. On average, the respondents have attended around 20 scientific conferences since the beginning of their research careers. More than half of these conferences took place in the respondent's own country (55.6%) with mainly national and self-support, followed by conferences in the rest of Africa (20.1%) with mainly foreign support and conferences in Europe (15.7%), also with mainly foreign support. Fewer conferences are reported in the USA (5.4%) and even fewer in the rest of the developing world: Asia (2.4%) and Latin America and the Caribbean (0.8%). Opportunities to attend conferences abroad over the last five years seem to be on the increase (slightly more than one a year).

More than half of the respondents (57.2% for IFS and 64.6% for INCO) reported that their research work was regularly evaluated. The most important criterion for the promotion of scientists by far is "publications in international journals". This is followed by "publications in local journals", "seniority", and "contribution to development". The criteria considered as slightly less important are "contribution to teaching", "strategic social relations", "contribution to the institution", and "award of research grants".

6. Research funding

Public research budgets in Africa have been cut to such an extent that, with a few exceptions, hardly any research activities can be undertaken without foreign aid. During 1999, INCO beneficiaries had access to a

higher budget than IFS grantees. 15.1% of the IFS grantees had a research budget (excluding salaries) between USD 1,001-5,000 and one-third (33.3%) between USD 5,001-20,000. A large proportion of them (29.9% for the IFS and 24.0% for INCO) reported no research budget at all during 1999. The main component of research funding comes from international organisations (52.2%), followed by the home institution (20.2%), national public funds (13.1%), foreign industry and foreign private foundations (5.9%), and national industry and national private foundations (1.5%).

Altogether, more than 300 foreign research-funding sources were reported. The four main funding sources are, in order of decreasing importance, USAID, the European Union, the *Coopération française* and WHO (see Figure 6, 30 main foreign funding organizations sorted by frequency of occurrence). The Rockefeller Foundation, the International Development Research Center (IDRC-Canada), as well as a number of organisations in the Nordic countries, including NORAD (Norway), Danida (Denmark), and Sida/SAREC (Sweden), obtained the best scores for recipient satisfaction.

If IFS or INCO support had not been available, half of the respondents reported that they would have still been able to pursue their research work but "on a reduced scale", and 15.0% claim that they would have done it "in a substantially different form". There are no significant differences in the responses between IFS and INCO. This tends to suggest that IFS and INCO support is more enabling than decisive. However, approximately one-quarter of the scientists (23.3% for IFS and 27.9% for INCO) answered that they would not have been able to pursue their research work at all without IFS or INCO support. Interestingly, the proportion of IFS grantees in the latter group has increased over time: 12.6% for the period 1974-1985 and 25.7% for the period 1986-1999, thereby suggesting that support from research funding schemes such as IFS are even more important today than twenty years ago.

7. Main hindrances to research work

The main constraint on research work (for IFS and INCO together) is reported to be lack of funds (25.2%) immediately followed by the availability of research equipment (18.6%, including the lack of basic research equipment, access to equipment, and equipment maintenance and repair). Then come, in order of decreasing importance, poor library facilities (6.6%), lack of competent support staff (6.2%), low salaries/the lack of incentives (4.0), too much teaching and administration (3.7%), and lack of transportation (2.8%).

8. Relative importance of IFS/INCO mode of work

IFS or INCO support has had a catalytic effect on obtaining funding from additional sources. It was easier for the recipients of both programmes to get additional funding from an international institution, particularly for IFS grantees (49.5% for IFS and 35.7% for INCO), somewhat less easy from their home institution (36.7% for IFS and 17.0% for INCO), and even less so from a national funding institution (22.8% for IFS and 17.0% for INCO). The individual reward (in the case of the IFS grant) seems to have carried more weight than team support (in the case of INCO) for the purposes of obtaining additional funding, particularly from foreign sources. Almost 60% of the respondents reported that it was easier for them to

obtain scientific and technical assistance from their home institution after having received support from IFS or INCO.

Opportunities to collaborate with new partners were provided for most respondents, thanks to the two support programmes (95.6% for INCO and 85.9% for IFS). This result is not unexpected for INCO, since partnership collaboration is central to its mandate. For IFS, however, while its support is targeted at individual scientists, it clearly shows that – through its extensive network of scientific advisers, grantees and other associated scientists – it also provided many opportunities for new partnerships. Participation at IFS organised workshops and other international conferences with IFS support was also reported as a unique opportunity to meet new partners in many interviews. Most of the respondents (87.0%) also claimed that they continued to collaborate with their new partners once the IFS/INCO support terminated.

In order to assess the IFS/INCO mode of work and support, and to identify some of the main constraints of the working environments of African scientists, they were asked to rate 13 activities from "selection process" to "follow up activities once the supported project is terminated". IFS received significantly higher scores for its three most highly ranked activities, namely "grant administration", "purchase of research equipment", and "contacts with staff". In general, activities that received the lowest scores related to scientific visibility and networking ("scientific counselling", "research training", and "networking activities"), "maintenance of research equipment", as well as "follow-up activities" and the "assistance with publication of research results".

9. Future career goals of African scientists

Despite the different professional constraints presented in this report, the future career goal for 40% of African scientists is a national scientific career (43.0% for IFS and 38.6% for INCO). Paradoxically, there are many more IFS grantees among the younger generation (first grant awarded during 1986-99) who favour a national scientific career as compared to the older generation (first grant awarded during 1974-85). A career within national development programmes (30%) is the second most favoured career goal, followed by private business (12%). The other career opportunities, including administration, politics, foreign or international organisations or own consultancy are less attractive (See Figure 7, Future career goal (IFS vs. INCO).

Conclusions

There is a relative abundance of literature on science and technology in Africa scattered through numerous journals, seminar reports, and proceedings. One of the latest is the symposium on Science and Technology in Africa organised by UNESCO[5]. Most often, these reports document past developments, pinpoint priorities for the future, include official speeches, and highlight "Plans of Action"; but there are far too few empirical studies assessing the state of science in Africa and the conditions under which African scientists are carrying out their research activities. It is hoped that this report will

[5] The first Conference of Ministers responsible for the Application of Science and Technology for Development in Africa (CASTAFRICA I) was held in Dakar, Senegal in 1974. The second conference (CASTAFRICA II) took place in Arusha, Tanzania in 1987.

contribute towards filling this gap.

Although the "Questionnaire Survey of African Scientists" is based on scientists who received research support from IFS and INCO only, it is believed that many characteristics of the population surveyed are representative of the African scientific community today as observed in the country case studies of MESIA. Most of them were awarded their highest degree abroad. They are active in research areas representing the largest share of science in Africa today: biological, agricultural, environmental and medical sciences. Over 90% of the scientists surveyed work at public universities (60.0%) and public research institutes (32.7%). Whereas the scientists are largely satisfied with job security, they are largely dissatisfied with the salary scale and the social benefits. Although they earn on average nine times the minimum salary, they cannot live on their salaries alone. Half of them supplement their family income with extra jobs providing, on average, four times more income than their salary.

Most of the African countries are part of the survey. However, the two major science producers in Africa, namely South Africa and Egypt, are under-represented, and the middle- or rather small-sized countries in terms of scientific production are over-represented. Apart from the geographical distribution, the representativeness of the sample is biased for another reason. Being the result of a selection process at an international level, the sample features a group of African scientists who are likely to be better off than the "average" African scientist. This is probably even truer for the population of IFS grantees. Through its competitive research grant scheme, IFS has selected African scientists at the beginning of their research careers who had already decided to get established in their respective countries at the time of applying for their first grant. While IFS has, no doubt, enabled them to fulfil that goal, very few are planning to get established abroad. Thus, compared to the African continent as a whole, few cases of true 'brain drain' were found in the surveyed population and in the country case studies. In spite of these biases, it is believed that the main findings are not only useful to the IFS and INCO programmes but contribute more generally to the reader's understanding of how, by whom and under what conditions research is actually being conducted in Africa.

These main findings are highlighted below.

African scientists are highly dependent on foreign funding to carry out their research activities and claim that the lack of funds is the main hindrance to their research. The proportion of IFS grantees who answered that they would not have been able to pursue their research work at all without IFS support has increased over time, thereby suggesting that IFS support is even more important today than 15 or 20 years ago.

While foreign dependency is the rule across the continent, important differences exist between Northern Africa, South Africa, and the rest of Africa. The latter group of countries (far from being homogenous) shows the highest degree of dependency. Other characteristics, such as relative adequacy of salaries, confirm that it is not possible to reduce the African continent to a single entity: there is not one Africa but several, and IFS support is most needed in the weakest countries in Sub-Saharan Africa.

Even though they occupy specific niches, IFS and INCO are not the only scientific capacity strengthening organisations in Africa. More than 300 research-funding sources were reported by the respondents. Interviews conducted with IFS grantees revealed that, very often, support received

from other sources came after IFS support or during the second or third grant period, but in a few cases it came before IFS support.

Apart from the direct funding of African scientists, the IFS and INCO programmes have a number of catalytic effects including the obtaining of additional funding and collaboration with new partners. As repeatedly pointed out during the interviews, IFS support is more than a grant. The IFS grant brings recognition nationally and internationally and opens up new avenues and contacts. The turning point of many a grantee's career has often been an invitation to participate in a workshop or scientific meeting, or a meeting with a senior scientist, which in turn opened up new networks of contacts and participation in networking activities.

In general, the respondents assessed the mode of work of IFS and INCO favourably. Activities that were given the lowest scores relate to scientific training and networking (scientific counselling, research training, networking activities, access to literature), maintenance of research equipment, as well as follow-up activities, including assistance with the publication of research results.

Despite the different professional constraints, the future career goal of 40% of African scientists is a national scientific career. Paradoxically, there are many more IFS grantees of the younger generation (first grant awarded during 1986-99) who favour a national scientific career than of the older generation (first grant awarded during 1974-85). Following the African survey, a similar questionnaire was sent to the IFS grantees in Mexico. Some 50 interviews of IFS grantees were also conducted in Mexico during 2000. A rapid comparison of the results of the two surveys shows clear differences not only in the working environment, the salaries received and the research funding structure, but also in the career goals of the respondents, in the Mexican scientists favour. Not surprisingly, whereas 40% of the African scientists had a national scientific career as a career goal, 85% of the Mexican grantees opted for such a career goal (see the forthcoming MESIA report No.3). The results from the Mexican survey are just an example of the growing disparities between an increasing number of countries in Latin America and in Asia and Africa.

Acknowledgements: A number of people and institutions have contributed to the "Questionnaire Survey of African Scientists". The survey and the questionnaire were conceived and prepared by Jacques Gaillard. Anna Furó Tullberg contributed to the layout of the questionnaire and its translation. She coordinated the mailing, reception and coding of the questionnaire. The transfer of the data from the questionnaires into a database was sub-contracted to AAA Analysexperten, a Stockholm-based company. Data analysis was made at IFS by Jacques Gaillard, Anna Furó Tullberg, Eren Zink and Henrik Hovmøller. Last but not least, the backbone of this report comes from the African scientists themselves (IFS grantees and INCO beneficiaries). Without their answers to the questionnaire, and the very many enlightening discussions during the interviews, this report could not have been written. Their contribution is gratefully acknowledged. Finally, we would like to express special appreciation to the IFS, the French *Institut de Recherche pour le Développement* (IRD), the European Commission (DG Research), and the French Ministry of Foreign Affairs for their financial backing.

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Figure 1
Adequacy of scientists' salaries by region

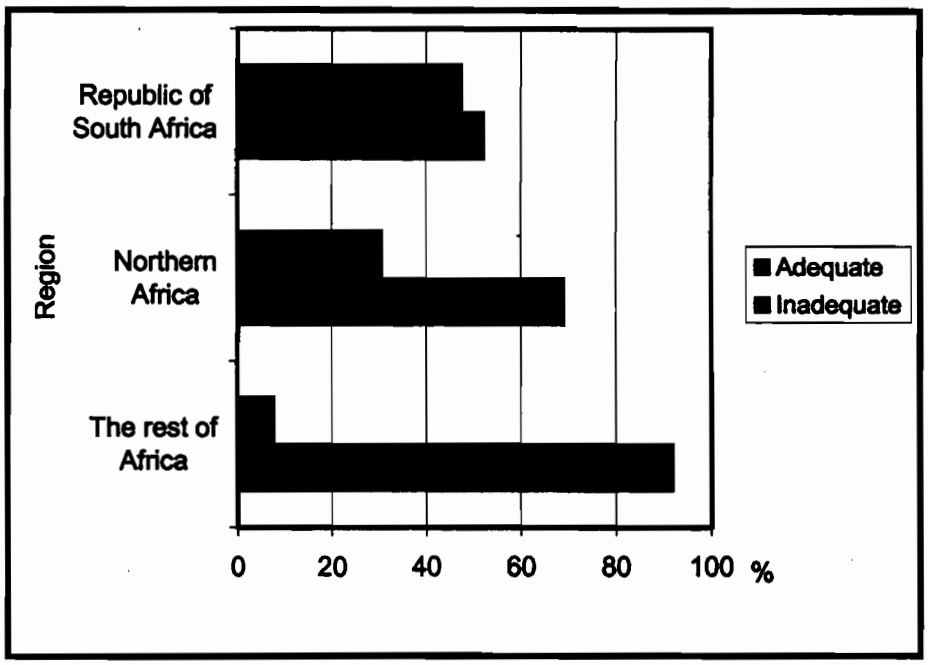


Figure 2
PhD taken at home by time-period and region

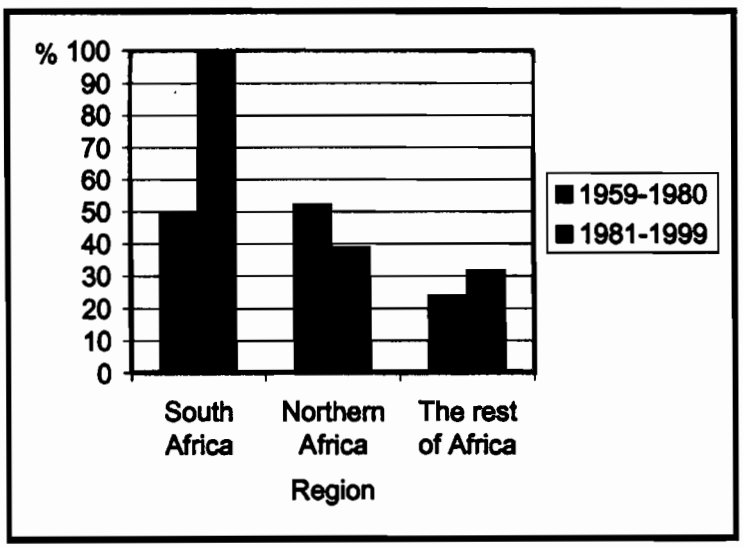


Figure 3
Structure of research funding by regions in Africa

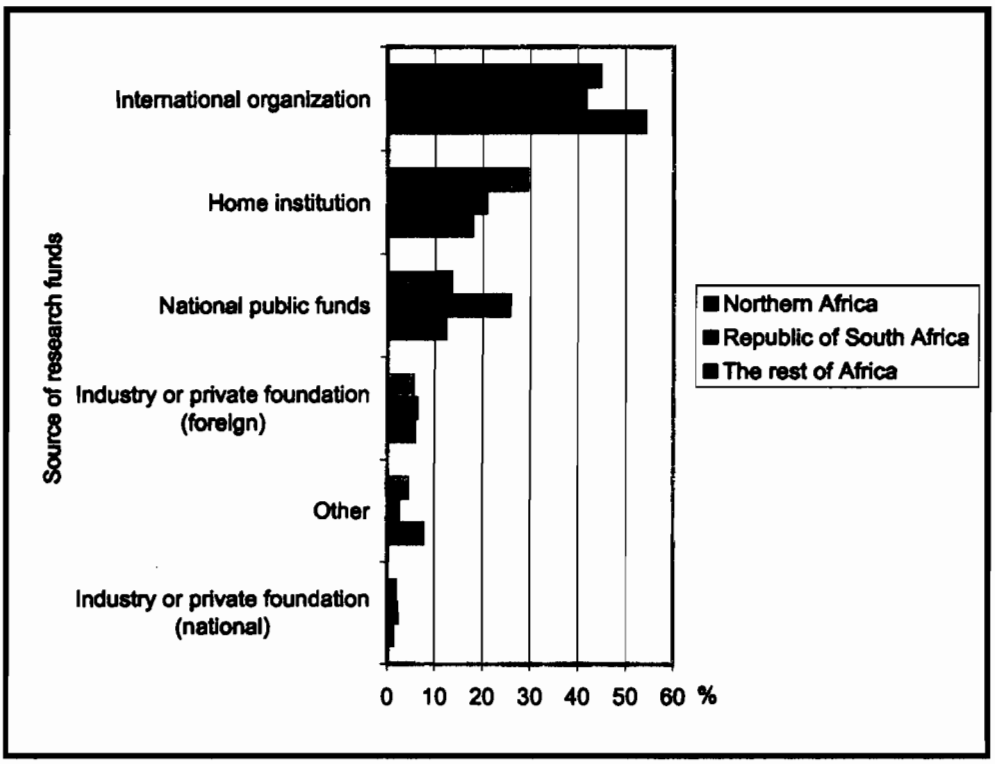


Figure 4
Mean frequency of communication with scientists and other people
1 = never, 2 = rarely, 3 = annually, 4 = monthly, 5 = more often

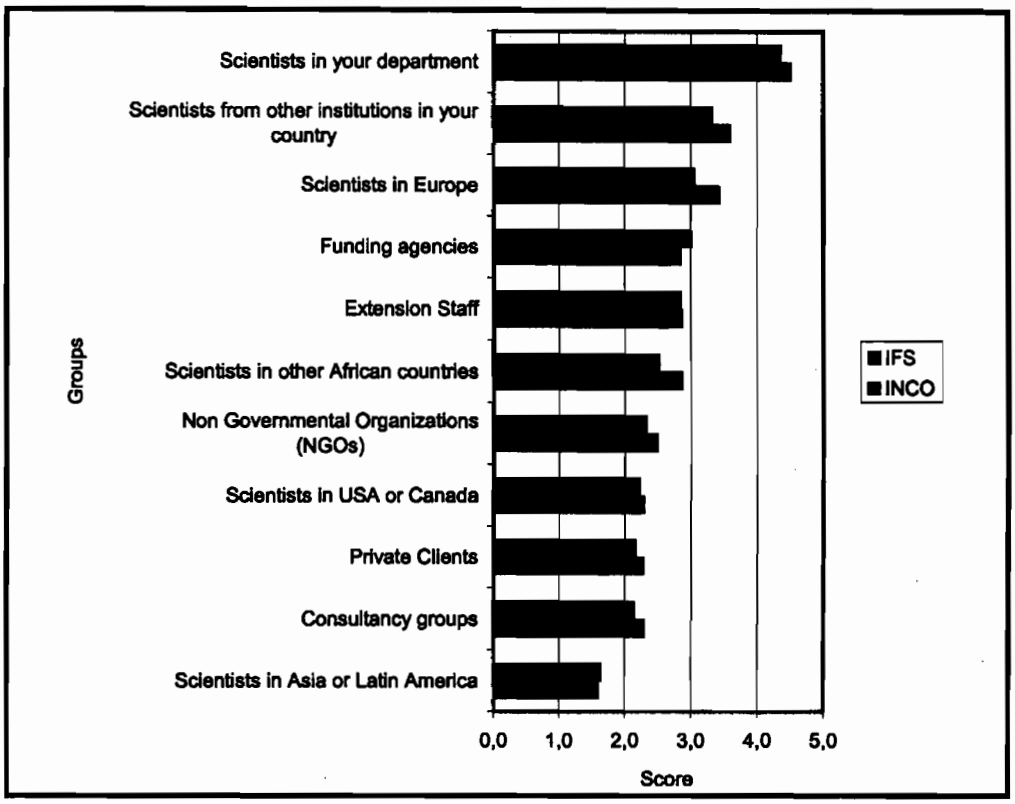


Figure 5
Mean responses to value statements
(1 = disagree completely to 5 = agree completely)

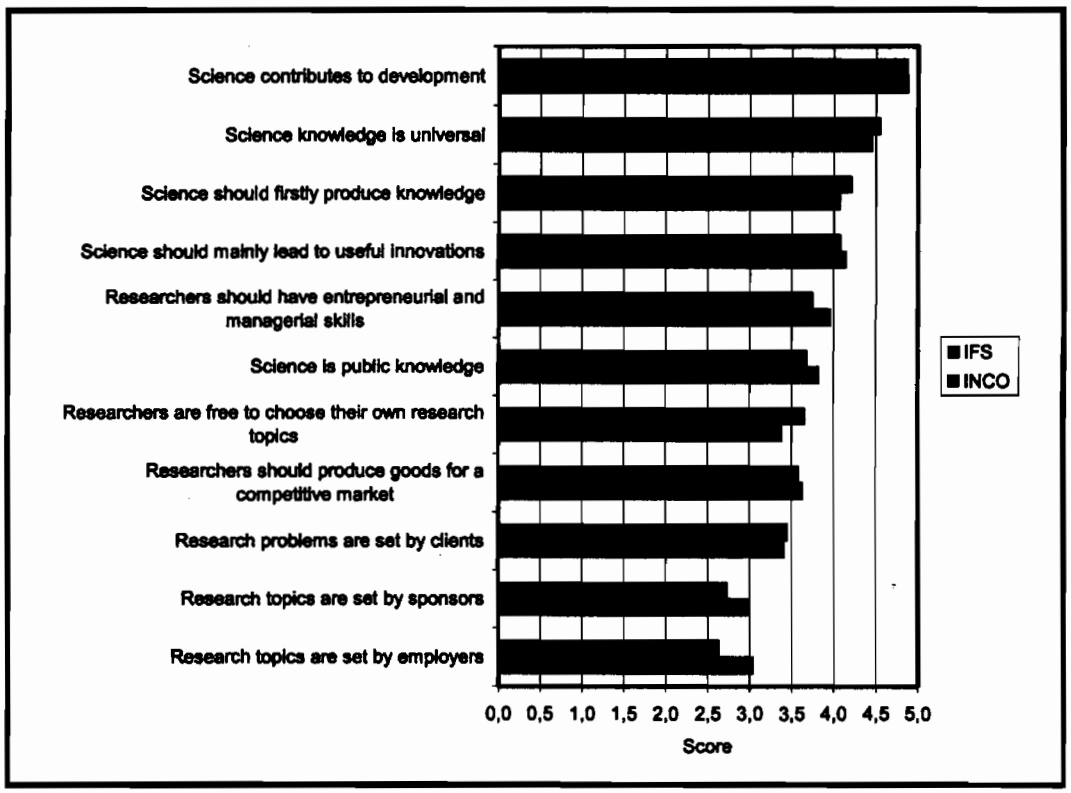
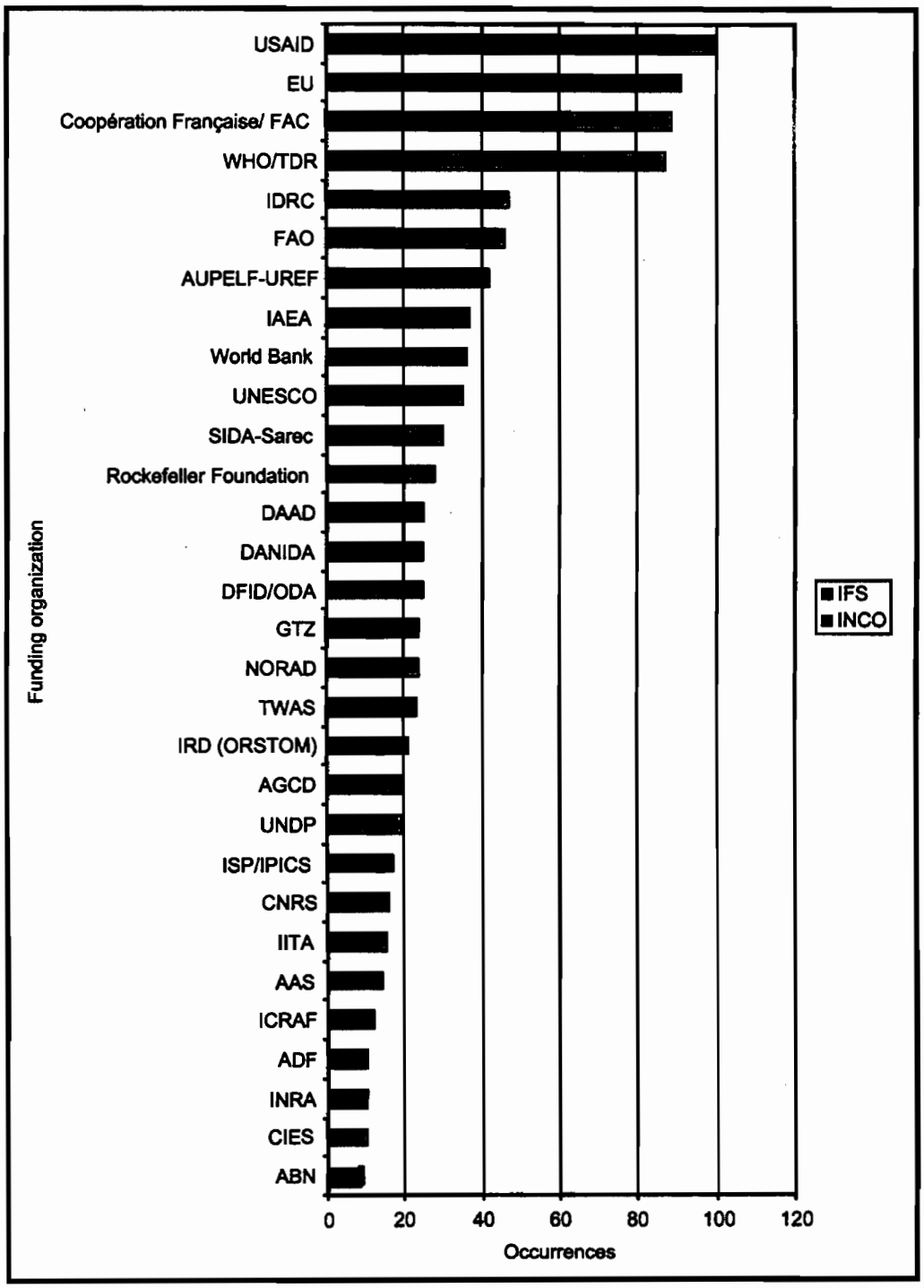
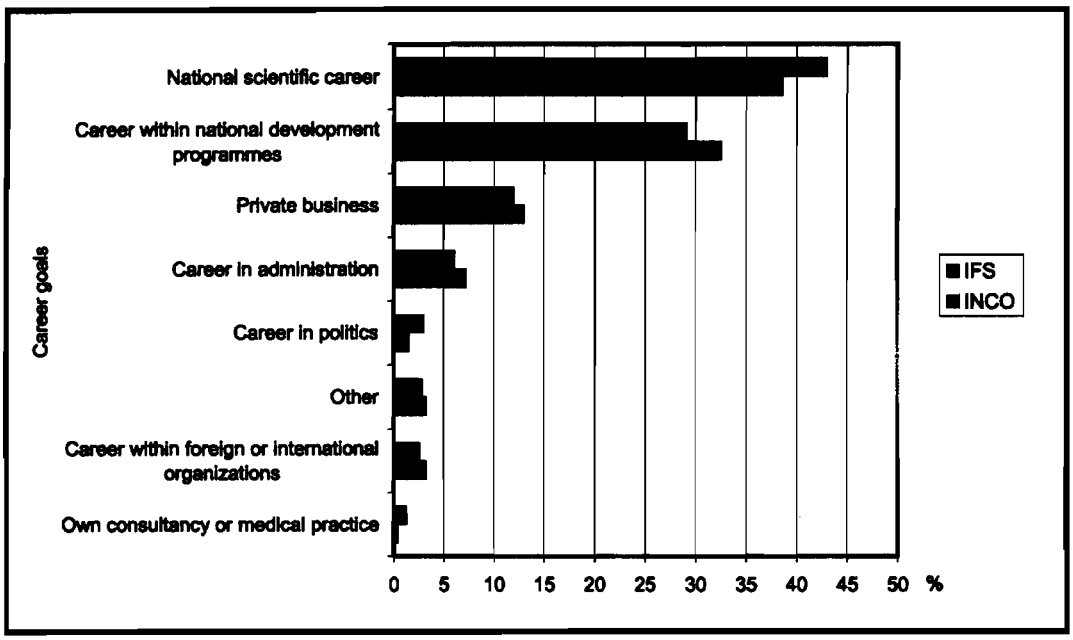


Figure 6



30 main foreign funding organizations sorted by frequency of occurrence

Figure 7
Future career goal (IFS vs. INCO)



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