

Strengthening Science Capacity in Tanzania

An Impact Analysis of IFS Support

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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 3,200 scientists in Africa, Asia and the Pacific, and Latin America and the Caribbean have been supported by IFS.

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Table of Contents

| | |
|---|----|
| Table of Contents | 3 |
| Preface | 5 |
| 1. Introduction | 7 |
| 1.1 Measuring the impact of IFS activities | 8 |
| 1.2. The components of the MESIA study in Tanzania | 8 |
| 1.3 The content of the report | 9 |
| 1.4 Acknowledgements | 9 |
| 2. Overview of national science and technology activities | 11 |
| 2.1 Research co-ordination and policy | 11 |
| 2.2 Research and higher education institutions | 12 |
| 2.3 Conclusion | 18 |
| 3 Funding and foreign donors | 21 |
| 3.1 A multiple professional dependency | 22 |
| 3.2 Changing modalities for research funding | 23 |
| 3.3 Emerging national research grant schemes | 24 |
| 3.4 Conclusion | 25 |
| 4. Applicants and grantees in Tanzania | 27 |
| 4.1 The application process | 27 |
| 4.2 Applications and success rates | 27 |
| 4.3 The grantees | 28 |
| 4.4 Conclusion | 30 |
| 5. Characteristics of the surveyed IFS grantee population | 31 |
| 5.1 Age, gender, and civil status | 31 |
| 5.2 Degrees held at the time of the first grant | 31 |
| 6. Research conditions | 33 |
| 6.1 Grantee livelihoods | 33 |
| 6.2 Communication | 35 |
| 6.3 Conclusion | 36 |

| | |
|---|-----|
| 7. Publication outputs | 39 |
| 7.1 Local science and international mainstream science | 39 |
| 7.2 Bibliometric study of grantees in Tanzania | 42 |
| 7.3 Conclusion | 45 |
| 8. IFS research project completion | 47 |
| 9. Grantee advancement and mobility | 49 |
| 9.1 Academic progression | 49 |
| 9.2 Promotion | 50 |
| 9.3 Mobility | 51 |
| 9.4 Conclusion | 53 |
| 10 Factors constraining research and an assessment of IFS support | 55 |
| 10.1 Main factors limiting grantees' research | 55 |
| 10.2 Relative importance of IFS support | 55 |
| 10.3 An assessment of IFS support | 57 |
| 10.4 Conclusion | 59 |
| 11 Science, society and grantees' career goals | 61 |
| 12. Conclusion and recommendations | 65 |
| 12.1 Highlights of the main findings | 66 |
| 12.2 Revisiting IFS work in Tanzania | 67 |
| References | 71 |
| Appendices | 73 |
| 1. The questionnaire | 73 |
| 2. Grantees interviewed for this report | 79 |
| 3. Acronyms and abbreviations | 81 |
| 4. Selection of transcribed interviews | 83 |
| 5. Additional tables and figures | 101 |

Preface

The International Foundation for Science (IFS) is an international NGO offering competitive research grants to promising young scientists in their early career. Developing country researchers are eligible to apply and IFS relies on a wide network of Scientific Advisers who assess the applications. Decisions on funding are made twice yearly and the value of the grant may be up to USD 12,000, the bulk of it being used to purchase scientific equipment and supplies. IFS signs a contract both with the grantee and the research institute or university department where the work is conducted. Thus, the grant benefits not only the individual grantee but also her/his institution.

Over the thirty-year period during which IFS has functioned as an international research council, more than 3,200 grants have been awarded. Close to one third of them have been allocated to researchers in Africa. Tanzanian scientists were among the first IFS grantees in Africa, and altogether 59 researchers in Tanzania have been awarded at least one research grant.

In order to measure the impact of IFS support to developing country scientists, a monitoring programme has been established at the IFS secretariat in Stockholm. The first impact study published through the Monitoring and Evaluation System for Impact Assessment (MESIA) investigated the research conditions of IFS grantees on the African continent. This report was closely followed by an impact assessment of IFS support to researchers in Mexico. The subjects of the current country case study are the IFS grantees working in Tanzania. Projects in the pipeline include a case study on grantees in Cameroon and a limited tracer study of IFS grantees in China. The MESIA country case studies provide an overview of the national science and technology landscape as well as a detailed analysis of the impact of IFS support for grantees in the country.

At the IFS secretariat MESIA is co-ordinated by Deputy Director Jacques Gaillard and Project Secretary Eren Zink. The bulk of data is derived from IFS' database supplemented by a questionnaire to all grantees and interviews with a sample of them, as well as field visits to selected national research institutions.

This report concludes that IFS grants have had positive impacts on the careers of grantees in Tanzania. They are among the most productive scientists in the country and have contributed a sizeable share of all Tanzanian mainstream science publications. In a few cases IFS grants led to major economic development. Of particular significance was the commercial development of the seaweed industry, which is a follow-up of one grantee's pioneering research. This enterprise generates export earnings of over USD 10 million annually and offers employment opportunities to more than 40,000 persons (mostly women).

The findings of the report show that it is worthwhile to provide well-targeted support to young scientists at the beginning of their research career in an environment characterised by a fragile scientific infrastructure and deficient funding. IFS grants have been instrumental in retaining these researchers in their home institutions and contributed effectively to research capacity building. The report argues that, in the long term, research capacity building would be best served by national research grant schemes geared to the younger generation of scientists, and that IFS could contribute to the development of such schemes. Meanwhile, the report indicates that IFS activities will continue to be an important source of research support in Tanzania during the short and medium term.

Stockholm, September 2002
Michael Ståhl
Director
International Foundation for Science

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. The core of IFS support is financial, and comes in the form of research grants with a maximum value of USD 12,000 that are renewable twice. The major budget items covered by grants 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 prize 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.

Since inception, IFS has had a particularly close relationship with the Tanzanian science and technology (S&T) community. Tanzania was among the first countries in Africa to be represented in IFS by a Member Organisation when the Tanzania National Scientific Research Council (UTAFITI)¹ became a member in 1973. Two eminent Tanzanian scientists have served on the IFS Board of Trustees: the late Prof W.K. Chagula, former President of UTAFFITI, and Prof H.K. Kayumbo from the Sokoine University of Agriculture. Furthermore, IFS staff have frequently visited Tanzanian universities and research institutes. The first visit took place at the beginning of the IFS granting programme in 1974, and four

IFS grants to Tanzanian scientists were awarded the same year.

During 1974-2002, IFS supported more than 3200 scientists in 99 developing countries, of which more than 1100 were in Africa and 59 in Tanzania. Of 40 recipient countries in Sub-Saharan Africa, Tanzania has the fourth largest number of IFS grantees and is preceded only by Nigeria, Kenya and Cameroon (Figure 1).

During the period under review in this report (1974-2000), IFS supported 55 scientists in Tanzania with 81 research grants. The total value of research grants awarded to scientists in Tanzania combined with travel grants to attend scientific meetings and to visit research institutes abroad equals approximately one million Euro. In addition, IFS has organised two workshops in Tanzania. The first was held in 1978 in Morogoro on rabbit husbandry, whereas the second workshop took place in Dar es Salaam in 1991 on the quality and nutrition of traditional African foods. At the beginning of 2002, 22 Tanzanian scientists continued to receive support from IFS.

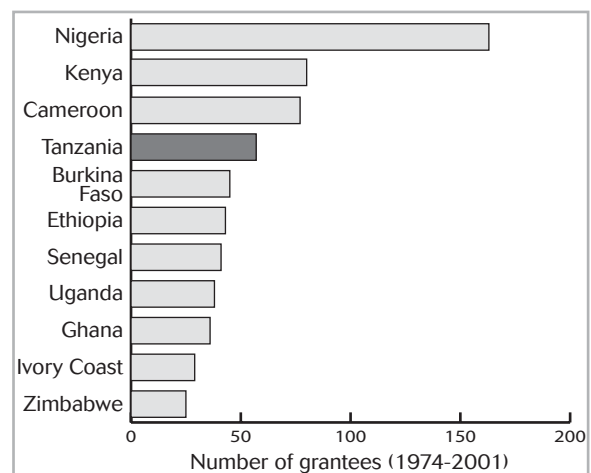


Figure 1
Top recipient countries in Sub-Saharan Africa (1974-2001)

¹ UTAFFITI was refounded as the Tanzanian Commission for Science and Technology (COSTECH) in 1986 (see below).

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) was 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 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 Tanzania. 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 Organizations as possible (Gaillard, 2000).

MESIA is an evolving tool that is responsive to the changing needs of the IFS constituency, and to the broader trends in research and development communities. The first MESIA 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 (Gaillard and Furó Tullberg, 2001). During 2001, another questionnaire was 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 report from this research is forthcoming. A third questionnaire, a revision and combination of the earlier questionnaires, has been sent to IFS grantees in Asia and in Latin America. In addition, 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). The Mexican country case study was published in December, 2001 (Gaillard *et al* 2001).

In the course of the Tanzania country case study, IFS benefited from the co-operation of its Member Organisation (MO) in Tanzania, the Tanzanian Commission for Science and Technology (COSTECH). COSTECH was very helpful to contact grantees and organise the programme during

Jacques Gaillard's visit to Tanzania. COSTECH also provided a car and a driver that greatly facilitated journeys within the country, including to places which are not so easily accessible by road, such as Mpwapwa. COSTECH's support is gratefully acknowledged.

1.2. The components of the MESIA study in Tanzania

The MESIA study in Tanzania was initiated during a visit to Tanzania by Jacques Gaillard in February 1999 during which interviews were conducted in Arusha, Dar es Salaam, Morogoro, Mpwapwa and Zanzibar in a variety of institutions specialised mainly in the biological and agricultural sciences, and, to a lesser extent, nutrition and health. The list of the institutions visited and scientists interviewed are found in Appendix 2. The present study covers the time period from 1974 until 2000, and includes the 55 grantees that participated in the IFS Programme during that time. While these grantees are working in 18 research institutions throughout the country, more than half of them are found in the top two recipient institutions in Tanzania: the Sokoine University of Agriculture (SUA) and the University of Dar es Salaam (UDSM) (see Table 1).

The study comprises five main components: an overview of S&T activities in Tanzania; a retrospective analysis of IFS applications, applicants and grantees; a questionnaire survey addressed to the IFS grantees in Tanzania; a bibliometric study of their scientific production; and 17 interviews of Tanzanian grantees. These five components are briefly presented below.

1.2.1 Overview of S&T activities in Tanzania

The main objective of the overview, prepared by Jacques Gaillard and presented in Chapter 2 and Chapter 3, is to describe the Tanzanian S&T environment. The topics covered include Tanzanian science policy, the institutional landscape, the conditions under which scientists work in Tanzania, the variety of funding mechanisms supporting S&T activities, and IFS grantees' roles in the Tanzanian S&T system. Organisations and individuals interested in working in Tanzania to strengthen science capacity will find it to be an informative and detailed introduction that can be used independently of the rest of the report

| Institution | City | No. of Grants |
|---|-------------------------|---------------|
| Sokoine University of Agriculture | Morogoro | 18 |
| University of Dar es Salaam (UDSM) | Dar es Salaam, Zanzibar | 12 |
| Mpwapwa Livestock Production Research Institute | Mpwapwa | 8 |
| Tanzania Food and Nutrition Centre (TFNC) | Dar es Salaam | 3 |
| Tanzania Forestry Research Institute (TAFORI) | Lushoto | 2 |
| Others | | 12 |
| Total | | 55 |

Table 1

Top recipient institutions in Tanzania (1974-2000)

1.2.2 Analysis of applications, applicants and IFS grantees

This central component of the study, for which 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 analysis of applicants' and grantees' success rates, and distribution, and grantees' project duration, quality of submitted reports, and academic and institutional promotion.

1.2.3 Questionnaire survey

As part of the "Questionnaire survey of African scientists", questionnaires were sent to 48 Tanzanian scientists in March 2000. A reminder was sent in June 2000 to those who had not responded. Twenty-four questionnaires were completed and returned to IFS. A copy of the questionnaire is found in Appendix 1 of this report.

1.2.4 Bibliometric study on scientific production

A bibliometric study was also carried out to determine the effect of IFS support on the trends in the nature and volume of the scientific output of the IFS grantees. Of 48 grantees, 31 sent publication lists containing a total of 608 publications (all document types). This 63% rate of response is considered to be very satisfactory (see chapter 6). Anna Furó Tullberg recorded the data in a database that was designed at IFS. The publication data was analysed by Eren Zink. The results of the bibliometric study are presented in Chapter 7.

1.2.5 Interviews

In total, 17 Tanzanian grantees were interviewed (15 in Tanzania and 2 by E-mail) by Jacques Gailard. This represents slightly less than one-third (31%) of Tanzanian grantees. Eight representative interview summaries are reproduced in Appendix 4 of this report. Qualitative information and quotes from the interviews have been used throughout the report. Interviews have also been summarized 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 12 chapters including this introduction and the conclusion with cross references between the chapters. Although an effort has been made to organize the chapters in a logical order, they can be read separately and/or in a different order. Chapter 12 summarises the main findings of the study and suggests recommendations for the future.

1.4 Acknowledgements

We would like to thank Brian Porter for designing the cover and assisting in the layout of the report. The backbone of this report comes from the Tanzanian 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.

2. Overview of national science and technology activities

This chapter provides an overview of the state of the science and technology (S&T) environment in Tanzania. The topics covered include Tanzanian science policy, the institutional landscape, the conditions under which scientists work in Tanzania, the variety of funding mechanisms supporting S&T activities, and IFS grantees' roles in the Tanzanian S&T system. Organisations and individuals interested in working in Tanzania 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.

During the last 30 years, numerous documents have been prepared on Tanzanian development and S&T activities². For this overview, recent reports prepared for NORAD and Sida-SAREC (Widstrand, 1992 and 1996; NORAD, 1999) as well as by COSTECH (1998) were important resources. They were particularly useful for mapping the institutional research situation, presenting the main research areas, and assessing the strengths and weaknesses of the Tanzanian national scientific system.

The IFS involvement in Tanzania since 1973 has also resulted in a rich record of the development of the Tanzanian S&T environment. This record, available in the IFS database of grantee information, in correspondence between the IFS secretariat and Tanzanian researchers, in interviews of Tanzanian grantees, and in MESIA-generated information, was essential to the development of this chapter.

2.1 Research co-ordination and policy

Established in 1968, the Tanzanian National Science Research Council (UTAFITI) was the first

national effort to co-ordinate research and development. While the mandate of UTAFFITI was rather limited, it neither supervised research activities among the national universities and research institutes nor had an advisory role, it was nevertheless one of the first national research councils to be established in Africa.

UTAFITI was the original IFS Member Organisation in Tanzania. Furthermore, the late Prof W K Chagula, former President of UTAFFITI and a prominent and well respected scientist in Tanzania, served on the IFS Board of Trustees during the period 1976-1978.

In 1986, by Act of Parliament No 7, UTAFFITI was succeeded by the Tanzanian Commission for Science and Technology (COSTECH)³. During the same year, COSTECH replaced UTAFFITI as the Tanzanian Member Organisation of IFS. The parliamentary act established COSTECH as a parastatal organisation with responsibility for co-ordinating research and technology development activities in Tanzania. Furthermore, COSTECH was appointed to be the chief advisor to the Tanzanian government on issues pertaining to science and technology and their use to promote socio-economic development in Tanzania⁴.

After its establishment, COSTECH developed a document on priority areas for research in Tanzania. This recently re-examined (COSTECH, 1998) document prioritises a wide range of research topics including agriculture and livestock, natural resources, environment, medicine and public health, industry and energy, basic sciences and social sciences. Research topics are more often addressed in short-term applied projects than long-term research projects of a more basic nature. The work of COSTECH is carried out in four directo-

² Among these are many study visits, reviews, evaluations and reports resulting from the activities of foreign aid organisations. Scandinavian countries have been particularly involved in providing development assistance to Tanzania.

³ A new and impressive building was erected in the early 1990s outside Dar es Salaam on the Bagamoyo road to accommodate COSTECH's staff and headquarters. In January 1999, there were 87 staff members (of which 27 were professionals) working for the secretariat.

⁴ This description is based upon information available on the COSTECH Website. More information is available at www.costech.or.tz.

| Institutions | Main tasks/responsibilities |
|---|--|
| The planning Commission of the President's Office | Co-ordinates national and sectorial policies and plans |
| Ministry of Science, Technology and Higher Education (MSTHE) | Responsible for the operation of Tanzania's three universities, 14 technical training centers and COSTECH |
| Sectorial ministries (with research departments, institutes, policies, and plans) | eg Agriculture and Health coordinate research activities in line with national plans and priorities |
| Higher Education Council | Established in 1994 with main objectives to coordinate the development and planning of higher education |
| COSTECH | Co-ordination, research funding, national policy making, Responsible for 19 affiliated national institutes |

Table 2

Main research (and higher education) policy bodies

Source: adapted from NORAD (1999)

rates, out of which the Directorate of Research Co-ordination and Promotion⁵ is the most relevant for IFS.

Among recent noteworthy activities, COSTECH is developing an electronic communication network to link Tanzanian research and development (R&D) institutions to each other and the rest of the world. This project involves the organisation of training seminars. However, due to budgetary constraints, these training activities remain rather limited. COSTECH also established a National Fund for the Advancement of Science and Technology (NFAST) in 1995 to allocate research grants, mainly to individuals, to support research and technology projects in Tanzania (COSTECH, 1996)⁶. Again, because of severe budgetary constraints, NFAST granting activities are very partially financed or even not implemented at all⁷ (see section 3.3 for a further discussion of NFAST).

Following the establishment of COSTECH, the Tanzanian research superstructure was completed by the creation of a Ministry of Science, Technology and Higher Education (MSTHE) in 1992. The role of the Ministry is to be responsible for national policy-making, whereas COSTECH should act as a coordinating body that is also in charge of making and revising the national research agenda. Such a division of labour would require a strong working relationship between COSTECH and its "mother ministry". However, as of 2002 this relationship

has yet to be established. The main relationship is that MSTHE directly finances COSTECH's administrative expenses (staff salaries, running expenses, etc.). While the two core bodies for research policy and coordination are MSTHE and COSTECH, other institutions are also involved as policy bodies for research and higher education (see Table 2).

2.2 Research and higher education institutions

The Tanzanian research and higher education system consists of a diversity of institutions and policy making bodies. The recent mushrooming of new private and non-governmental organisations has added some confusion to the institutional landscape, which is overall somewhat lacking coherence and co-ordination.

2.2.1 Universities

The first university to be established in Tanzania was the University College in Tanganyika⁸ in 1960, one year prior to independence. Initially affiliated to the University of London, from 1962 until 1970 it was a component of the University of East Africa together with Makerere University College (in Uganda) and the Nairobi University College (in Kenya). Following the dissolution of the University of East Africa it became the University of Dar es

⁵ The other directorates include: the Directorate of Technology Development (recently renamed Centre for Technology Development and Transfer), The Directorate of Information and Documentation, and the Directorate of Finance and Administration.

⁶ This fund operates according to procedures very similar to those of IFS. In addition to national funding, Danida has contributed to this programme.

⁷ Most recent grants recommended by NFAST were not awarded due to lack of funds.

⁸ Tanganyika is the continental part of today's Tanzania. In 1964, Tanganyika merged with Zanzibar to become Tanzania.

Salaam (UDSM). The first students were enrolled in the Faculty of Law. More Faculties were added during the 1960s including Science (1965), Arts and Social Sciences (1967), Medicine (1968) and Agriculture at Morogoro (1970).

In 2002 there are three public universities in Tanzania: UDSM, Sokoine University of Agriculture (SUA) and the Open University of Tanzania (OUT). Thus far, the latter is the only university south of the Sahara to offer degree courses through distance learning. UDSM and SUA, the two main public universities, are briefly presented below.

Tanzanian universities are home to well-trained and competent scientists that are committed to using the tools of science to generate both new knowledge and new opportunities for national development. However, university staff face a number of difficulties that challenge their ability to achieve their scientific goals. A general feature of the public universities is a lack of financial resources that results in under-paid staff, reduced numbers of scholarships, overcrowded and deteriorating facilities, constrained research activities and shortages of scientific equipment. Furthermore, the recruitment of young scientific staff to the universities was marginal in the 1990s following the implementation of the structural adjustment programmes. A government moratorium on recruitment of new staff meant that what little recruitment occurred was funded by foreign donors. By 2002 the moratorium on recruitment had been lifted, and some critical positions were being filled in the universities.

Low recruitment meant an overall aging of the science community. In the two main public universities (UDSM and SUA), not a single staff member was under 30 years old in 1998, with the bulk of the academic population being between 40 and 50 years old (see Table 3). In order to maintain the high standards of the Tanzanian university system,

| Age | Percent of total staff |
|-----------------|------------------------|
| Less than 30 | - |
| 30-39 | 16.4% |
| 40-50 | 74.6% |
| Greater than 50 | 9.0% |

Table 3
Average age profile of academic staff at UDSM and SUA in 1998

| Institution Type | Institutions |
|------------------------------|------------------------------------|
| Public University | The Universities of Dar es Salaam |
| | Sokoine University of Agriculture |
| | The Open University of Tanzania |
| Private University | St Augustine University |
| | Tumaini University |
| | KCMC Campus |
| | Makumira Campus |
| | Iringa Campus |
| | Tanzania Adventist College |
| | Waldorf College |
| | Hubert Memorial University |
| | Intl Medical and Tech University |
| | Zanzibar University |
| Technical College | Dar es Salaam Inst of Technology |
| | Technical College Arusha |
| | Mbeya Technical College |
| Institution under a Ministry | Inst of Development Management |
| | Community Devel Training Institute |
| | Mweka Wildlife College |
| | Karume Technical College |
| | Inst of Rural Development Planning |

Table 4
Higher Education Institutions in Tanzania

additional resources for the recruitment of young scientists to the university must be found.

Due to the lack of scholarships for postgraduate degrees and the prevailing terms of employment, academic degrees are awarded at a relatively advanced age. On average, a BSc degree is obtained at 28, a MSc degree at 33 and a PhD at 42. It is in fact rather common to meet Tanzanian scientists finishing their PhD training in their late 40's or early 50's. This trend could have important consequences for IFS in the future, given the policy of funding only researchers who have not yet reached their 40th birthday.

A recent development is the proliferation of private universities (see Table 4) whose establishment is encouraged by the Government on the condition that they meet the same criteria as public universities. Given the high fees demanded, relatively few Tanzanian students can afford to register in these private universities. Nevertheless, higher salaries and better working conditions at newly established

private universities attract a limited number of academic staff from the public sector.

With an estimated 2,000 students graduating from public universities yearly out of an estimated total population of 32 million (seven graduates per 100,000 people), Tanzania lags far behind many countries in the region. In comparison, South Africa leads the region with 244 graduates per 100,000 people followed by Namibia (140), Swaziland (64), Kenya (41) and Botswana (40)⁹. Student enrolment at the University of Dar es Salaam fell by 16.5% between 1980 and 1990 while during the same period, student enrolment increased by 33% in Zimbabwe, 45% in Burundi and 208% in Kenya (URT, 1998). Even if overall student enrolment increased during the recent years, the situation in Tanzania sharply contrasts with that of Kenya, which has roughly similar demographic and resource characteristics. While Kenya has a university student population of about 50,000, the total number of students studying at local higher education institutions was 20,000 in Tanzania in 2000 (Teferra and Albach, In press)¹⁰.

2.2.1.1 *The University of Dar es Salaam (UDSM)*

As of 2002, the UDSM main campus has six faculties: Arts and Social Sciences, Commerce and Management, Education, Engineering, Law, and Science. Five research and development institutes are also part of the research and graduate studies system of the UDSM: the Institute of Development Studies, the Institute of Kiswahili Research, the Institute of Marine Sciences, the Institute of Production Innovation, and the Institute of Resource Assessment. UDSM's Faculty of Medicine was transformed into The Muhimbili University College of Health Sciences (MUCHS) in 1991. Today MUCHS has an additional four faculties: Dentistry, Medicine, Nursing and Pharmacy (UDSM, 1998/1999).

The University College of Lands and Architectural Studies (UCLAS), was established as a constituent College of UDSM in 1996. It was originally founded in 1956 as a Survey Training School. UCLAS comprises one institute (Housing Studies and Building

Research), two centres (Continuing Education and Geo-information) and two faculties (the Faculty of Architecture, Quantity Surveying, and Urban and Rural Planning, and the Faculty of Land Surveying, Land Management and Valuation and Environment Engineering).

By any standard of comparison the UDSM has a low student enrolment given its physical facilities and the number of teaching and supporting staff¹¹. One of the main objectives of the UDSM Transformation Programme is to expand the undergraduate student enrolment from slightly more than 5,000 in 1998 to 13,000 by the year 2008. Another challenge for the university is to respond to demands from the productive sector. As long as UDSM is not in a position to respond to new demands, private alternatives are established. This is the case for specialised training in IT and telecommunications for which private colleges and courses have been established.

In 1999, the UDSM main campus had a core of 584 academic staff¹² out of which 61% were PhD holders (44 full professors, 62 associate professors and 169 senior lecturers). Despite the affirmative policy to promote women into academic positions, women today represent approximately 10% of the academic staff.

Meanwhile, the university has produced a substantial number of graduates over the years. It is estimated (Sida, 1996) that more than 10,000 undergraduate degrees and 1,633 higher degrees were awarded by UDSM up to 1995. Of the 144 PhD degrees awarded through 1995, 17 (or 15%) recipients were women. From 1995 until 1998 UDSM produced a total of 21 PhDs from all disciplines, and only one recipient was a woman. During the same period 47 individuals received their MSc, seven of them going to women (MSTHE 2000).

Research at UDSM received marginal funding from the government during the 1990s. According to UDSM sources, the government has been allocating about USD 30,000 annually to the UDSM for research activities over the past years, out of a total

9 Followed by Lesotho (29), Zimbabwe (29), Zambia (24), Uganda (19), Angola (13), Malawi (12) and Mozambique (10).

10 The situation in Tanzania is similarly challenged by that of Botswana, with a current university student enrolment of about 10,000, against the country's population of only 1.5 million. Other similarly challenging proportions are presented by Ethiopia, Namibia, and a few other neighbouring countries in Eastern and Southern Africa.

11 A teaching staff of 584 and a student population of about 5126 gives a staff to student ratio 1:8.8 (UDSM, 1999 enrolment figures).

12 Staff members numbered fairly constantly around 600 between 1985 and 1990. After 1990 staff numbers started to decrease and given the government moratorium on employment in the civil service and in the parastatal sector, retirement, mobility, and mortality, the figure for 2002 is likely to be lower.

budget of slightly more than USD 10 million. It corresponds approximately to USD 50 annually per academic staff member and to 0.3% of the overall university budget. Without support from donors, opportunities to pursue research activities would be even more constrained than they are presently.

2.2.1.2 *The Sokoine University of Agriculture (SUA)*

From 1963 until its establishment as an independent institution in 1984, the Sokoine University of Agriculture (SUA) was organised as a college: the Morogoro Agricultural College. In addition, in 1970 the college was integrated with UDSM as a faculty¹³. Today, the independent SUA has three faculties (Agriculture, Forestry, and Veterinary Medicine) and two institutes (the Institute of Continuing Education and the Institute of Development Studies). A new Faculty of Science was also established at SUA with support from Belgium.

In 1998, there were 1308 undergraduate students for 204 staff members. The bulk of the students are to be found in the Faculty of Agriculture (81%), followed by Veterinary Medicine (11%) and Forestry (8%). SUA is planning to increase student intake. The total number of staff holding teaching positions in 1998 was 204, of which 25 (12%) were women. The number of supporting staff was 614. Most of the teaching staff hold a PhD (72%). Today, women represent approximately 12% of PhD holders and academic staff in general.

SUA has good links with the Tanzanian Ministry of Agriculture and Cooperatives (MoAC)¹⁴, and COSTECH. At the international level, SUA has developed collaborative links with the CGIAR centres and with some 25 universities in Europe, in the United States and in Africa. Long-standing relations have been developed with the Agricultural University of Norway (NLH). International links are also important with the Flemish universities in Belgium (Antwerp, Ghent, Leuven) and the University of Liège, the Agricultural University of Sweden (SLU), the University of Nottingham in the UK, and Moi University in Kenya to mention only the most important ones. Greater efforts should however be made to create stronger links with major universities in Eastern and, particularly, in Southern Africa¹⁵.

As a consequence of the implementation of the structural adjustment programme, SUA has been in an unstable financial position for a number of years with government allocations being recurrently lower than the expected contributions. Donor contributions today represent 50% of the total budget of the university with NORAD being, by far, the major external donor to SUA. It is estimated that Government funding for research at SUA is approximately 1% of the total budget of the University. In late 1997, 95% of the total budget for 100 research projects being carried out at SUA was funded by 40 donor agencies (NORAD, 1999).

The University Council approved a new strategic plan "Corporate Strategic Plan to the Year 2005 and Beyond" in June 1997. It gives a more client oriented role to the university. Special emphasis is put on the need expressed by various user groups (small holders, large-scale farmers, and the agro-industry) and on the need to link research with development issues, environmental concerns and conservation of natural resources.

2.2.2 *Research institutes*

Tanzania is home to a large number of research institutes that are either affiliated to COSTECH (see Table 5) and/or to the sectorial ministries (primarily Agriculture and Health). We briefly present below the main institutes in these two sectors: Agriculture and Health.

2.2.2.1 *Agriculture Research*

Agricultural research in Tanzania has been subjected to repeated criticisms and subsequent reorganisations. The most frequent criticisms are related to the lack of clear research priorities and to the dispersion of research efforts. The policy document "Agricultural Policy of Tanzania" acknowledges the need to downsize the agricultural research system, to create fewer stations, and to link research, extension and NGO's to the development and transfer of agricultural technology.

One reorganisation took place already in 1989 based mainly on the recommendation and on the initiative of the World Bank and the Special Pro-

¹³ The Faculty of Agriculture, Forestry and Veterinary Sciences.

¹⁴ SUA entered into a memorandum of understanding with MoAC in 1992 in order to enhance complementarity between the two institutions. The Tanzanian Agricultural Research Plan II (TARP II) covering the period 1998-2002 is likely to further strengthen collaborations between SUA and MoAC.

¹⁵ Except for Moi University in Kenya, and to a lesser extent Makerere University in Uganda and the University of Zimbabwe, major universities in Zambia, Malawi, Kenya, Mozambique and South Africa do not have any collaborative links with SUA.

gramme for African Agricultural Research (SPAAR). The World Bank in particular was instrumental in formulating a National Agricultural Masterplan conceived and carried out within a larger agricultural research restructuring programme entitled "The National Agricultural and Livestock Research Project (NARPLI)" (see Box 1). The total cost of the programme was estimated to be USD 25.3 million and was supported with funding by the World Bank/IDA, the African Development Bank/ADF and grants from the United Kingdom, Germany, The Netherlands and some funding from Tanzania.

The Tanzanian Agricultural Research Plan II (TARP II) is the follow-up of the efforts to strengthen the agricultural research service under MoAC after NARPLI (see Box 2). TARP II covers the period 1998-2002 for a total budget of USD 46 million. The bulk of the funding is a loan from the World Bank/IDA (47.2%) and bilateral donor contributions (50.1%)¹⁶, the rest comes from the Tanzanian Government (1.6%) and user fees (1.1%). While the major part of the World Bank funding is for rehabilitation of centers, stations, and infrastructural investment, the heavy dependence of MoAC on donor funding to implement TARP II and in particular for operational costs raises some strong

| Institution name |
|---|
| Building Research Units (MRU) |
| Center for Agricultural Mechanisation and Rural Technology (CAMARTEC) |
| Institute of Production Innovations (IPI) |
| The National Agricultural Research Council (NARC) |
| National Construction Council (NCC) |
| National Institute of Medical Research (NIMR) |
| National Social Welfare Institute (NSWI) |
| Serengeti Wildlife Research Institute (SWRI) |
| Tanzania Automotive Technology Centre (TATC) |
| Tanzania Bureau of Standards (TBS) |
| Tanzania Food and Nutrition Center (TFNC) |
| Tanzania Forestry Research Institute (TAFORI) |
| Tanzania Industrial Research Development Organisation (TIRDO) |
| Tanzania Industrial Studies and Consulting Organisation (TEMDO) |
| Tanzania National Radiation Commission (TNRC) |
| Tropical Pesticides Research Institute (TPRI) |
| Uyole Agricultural Research Center (UARC) |

Table 5
Research institutions affiliated to COSTECH

Box 1
NARPLI

The major components of the National Agricultural and Livestock Research Project (NARPLI) were:

- A new unified organisational structure for agricultural research including merger of former parastatals under a Department of Research and Training (DRT) within the Ministry of Agriculture and Cooperatives (MoAC)
- The establishment of zones and Zonal centers
- Preparation of a Research Masterplan
- Supply and procurement of essential research facilities
- Skill improvement of research staff
- Rehabilitation of research stations and construction of a new headquarters for research
- Establishment of an Agricultural Research Fund

doubts concerning the long term sustainability of this ongoing agricultural research plan.

Today most of the agricultural research institutions in Tanzania are organised under the Directorate of Research and Training (DRT) in the Ministry of Agriculture and Cooperatives (MoAC) which is also responsible for implementing the Tanzanian Agricultural Research Plan (TARP II). A National Agricultural Research Council was also established in 1990 as part of the reorganisation under MoAC. The Council is only an advisory body and meets once annually. In addition to DRT and MoAC, the council consists of representatives from SUA, UDSM, the major agricultural research institutes, the Planning Commission and COSTECH. The Chairman of the Council is the Director General of COSTECH.

The National Agricultural Research Institutes under MoAC consist of seven Zonal Research and Training Centers, eight Research Centers and 15 Research Stations. The aim is to decentralise responsibility to the Zonal Centers and to bring research and technology development closer to the farmers. Farmers and other user groups should have an influence on the running of the Centers since the Zonal Executive Committee consists of $\frac{3}{4}$ non-scientists. The total number of staff employed in the National Agricultural Research Institutes is estimated to be 1826 with 325 holding graduate degrees. As is

Box 2
TARP II

TARP II contains the following components (World Bank, 1997):

- Decentralisation of research management with main responsibility at the Zonal level
- Zonal level autonomy with regard to resource allocation and decision making
- Small-holder demand-driven and farming system oriented research
- Private sector involvement
- Sustainable level of resource funding
- Proper information systems
- Incentives for research staff
- Collaborative research efforts with SUA and international collaboration

shown in Table 6, the proportion of PhD holders is much lower than at UDSM (61%) and SUA (71%).

The comparison to university staff may not be entirely fair since scientists in the National Agricultural Research Institutes are carrying out research programmes of a more applied nature. Nevertheless, TARP II has set a target of achieving a scientific employment mix of 1:3:1 between degree holders (BSc:MSc:PhD).

During the late 1990s, many of the PhD holders were approaching the compulsory retirement age of 55 years. Thus, out of 54 PhD holders, only two were below 40 years of age (1 male and 1 female), and 40% would reach the retirement age in 5-6 years. Clearly, there was an urgent need for post-graduate training of existing staff and recruitment of new young and qualified staff. As of 2002, the immediate crisis had been temporarily averted by raising the age of retirement to 60 years of age.

Low salaries also contribute to instability in employment and in execution of research programmes. Government salaries for agricultural research scientists under MoAC, SUA and in many other research institutions in Tanzania are today largely inadequate to meet living costs for a scientist with a family. Monthly salaries range from approximately USD 60 to USD 120. Many researchers must therefore turn to additional income earn-

ing activities to cover family living expenses and education costs for their children.

Meanwhile, non-salary incentives for Tanzanian researchers can, in some cases, compensate for low salaries. Non-salary incentives, as documented in the interviews conducted for this report, may include allowances provided by foreign grants (travel, per diem etc.), provision of housing and transport, free health care for family members, and travel grants to attend conferences and workshops in Tanzania and abroad (See chapters 3 and 6 for more discussion of livelihoods and incentives).

In addition to the zonal system, there are other specialised Agricultural Research Institutions with a national mandate. The most important include the Tanzanian Forestry Research Institute (TAFORI) established as a parastatal organisation under the Ministry of Natural Resources and Tourism with headquarters in Morogoro. TAFORI has seven centers countrywide in addition to the semi-autonomous Tropical Pest Research Institute (TPRI) in Arusha and the Uyolet Agricultural Research Center (UARC). Some agricultural research is also carried out at UDSM and on private estates (see Box 3).

2.2.2.2 Medical and Health Research

Three bodies are in charge of setting priorities and co-ordinating health research in Tanzania: the Ministry of Health (MoH), COSTECH, and the National Institute of Medical Research (NIMR). By tradition, the division of labour between the MoH and NIMR was that NIMR was responsible for medical research and the Ministry for purely operational health systems research. This is changing as NIMR is also moving into research on health

| Highest degree held | No. of men (% of men) | No. of women (% of women) | Total no of degree holders (% of all) |
|---------------------|-----------------------|---------------------------|---------------------------------------|
| PhD | 44 (16%) | 10 (19%) | 54 (17%) |
| MSc | 151 (56%) | 30 (55%) | 181 (56%) |
| BSc | 76 (28%) | 14 (26%) | 90 (27%) |
| Total | 271 | 54 | 325 |

Table 6
Degree holders in National Agricultural Research Institutes

16 Bilateral donors who pledged support include the following: the Netherlands (10.0); the UK /DFID (2.85); Germany/GTZ (2.50); Sweden/Sida (0.65); the European Union (5.60); Ireland (1.50); Norway/Norad (N/A) and Denmark/Danida (N/A).

systems and services and getting more operational. COSTECH and the Ministry of Science and Technology are formulating the priorities for health research in general: the primary focus is placed on communicable diseases, in addition to maternal and child health (COSTECH, 1998).

Health research in Tanzania is performed in three categories of institutions: governmental health research institutions such as the National Institute of Medical Research (NIMR), universities such as UDSM's Muhimbili University College of Medical Science (MUCHS), and private health research institutions. While IFS does not generally provide research grants for health research, it has had links to MUCHS where there is a department of natural products chemistry.

MUCHS was established as a university college of UDSM in 1991. In addition to being part of UDSM, MUCHS in combination with the Muhimbili Hospital constitute the Muhimbili Medical Center (MMC). As part of MMC, the staff of MUCHS receive their salaries from the MoH. Research funding is also supposed to come from MoH, but most research is financed by donor support. In the 1994-95 financial year, the Government of Tanzania provided the MMC with a budget of Tsh 4.0 billion, out of which 0.1% (or the equivalent of USD 6,000) was allocated to research. The same year, MUCHS received USD 1.0 million for research from donors. The main donors are: SAREC-Sida, NUFU, DANIDA, WHO, Carnegie Corporation, UNICEF and the World Bank.

2.3 Conclusion

This overview of Tanzanian science and technology activities reveals a research environment with several characteristics important for organizations

supporting capacity building. The current capacity of Tanzanian universities to educate students is underutilised. Because few degree holders are produced by the universities and because the researchers at universities and research institutes are aging, the continued reproduction of the Tanzania scientific community is in peril. Meanwhile, national financial support for scientific research is weak and, as a result, scientific research in national universities is possible only with the support of foreign donors. This situation is discussed in more detail in the next chapter. Growth in the number of private universities in Tanzania may offer relief for established researchers, but thusfar high fees make these institutions unreachable for most potential students and thus limit the number of academic positions that become available.

Given the erosion of research possibilities, the need for IFS support in Tanzania has probably grown. Yet, the low recruitment of new staff and the scarcity of fellowships for advanced academic training contribute to a decreasing pool of young Tanzanian scientists eligible for an IFS grant. At the beginning of 2002, IFS had 21 grantees with active research projects in Tanzania, and during the previous 28 years IFS awarded 81 first and renewal grants to researchers in Tanzania. Researchers at Sokoine University of Agriculture, Mpwapwa Livestock Production Research Institute, and the University of Dar es Salaam have been the primary recipients of IFS support, though in recent years the University of Dar es Salaam has provided few successful applications (see Box 4). In the following chapters the situation, experiences, and productivity of these researchers will be analysed and discussed with the aim of better describing the role of IFS in supporting young scientists within the Tanzanian scientific community, and evaluating whether there is a need for greater IFS involvement in countries such as Tanzania.

Box 3

Agricultural Research Centres at UDSM and on private estates

The institutes at UDSM include a special center for horticulture (the Horticultural Research Center), for irrigation of food crops (The Collima Agro-specific Research Center), wine research (the Viticulture Research and Training Center), animal diseases (the Animal Disease Research Center - ADR), and for trypanosomiasis (the Tse-Tse and Trypanosomiasis Research Institutes - TTRI). Research is also carried out at the Center for Agriculture Mechanisation and Rural Technology (CAMARTEC) in Arusha with partial financing from GTZ via the Ministry of Industry.

Private research institutions include the Tea Research Institute of Tanzania (TRIT) based at Kifyulilo Tea Research Station with a staff of 12 postgraduate degree holders, and the Tanzania Industrial Research and Development Organisation (TIRDO). The latter is a semi autonomous research enterprise carrying out agricultural research on a contractual basis. TIRDO has a staff of 80, 17 of whom have postgraduate degrees.

Box 4

IFS in the Tanzanian S&T landscape*The University of Dar es Salaam:*

Despite the need for research support at UDSM, the frequency with which IFS awards grants to researchers at UDSM is declining. During the period between 1974 and 1984 eight researchers at UDSM were awarded research grants. Meanwhile, from 1985 to 2000 IFS received 21 applications from researchers at UDSM and, of these, four individuals received an IFS grant. During the last five years only one grant has been awarded to a UDSM researcher (a renewal grant), and during the 1990s only one first grant was awarded to a UDSM researcher. In addition to the age criteria at IFS, the small number of grants to researchers at UDSM might be due to the increasing development of national research grant schemes such as the one sponsored by Sida-SAREC (see Chapter 3).

Sokoine University of Agriculture:

SUA is the institution in Tanzania that is the most successful at securing IFS funding. During the period 1985 to 2000, 53 applications for first-time grants were received from SUA researchers, and 15 were funded (28% approval rate). This rate of success is greater than the figure for all Tanzanian applicants (21.5%), and the number of grants is much greater than for any other single institution in Tanzania. In 2000, two new SUA projects were approved and in 2001 an additional first project was funded by IFS.

National Agricultural Research Institutes under the MOAC:

IFS awarded 11 first grants to researchers at Ministry of Agriculture research institutes during the 1985 to 2000 period. Successful research projects were selected from a pool of 48 first applications during the period. Of 16 research institutes, the Mpwapwa Livestock Production Research Institute in Mpwapwa was the single largest source of applications (13 applications) to IFS. This center was also highly successful in winning grants; eight of the 13 applications have been awarded funding.

COSTECH Research Institutes:

From TAFORI and TPRI, both of which are COSTECH Research Institutes, IFS has received ten applications since 1985 and awarded three grants.

Table A2 in Appendix 5 provides further information about the numbers of applications received from researchers at individual Tanzanian universities and research institutions.

3. Funding and foreign donors

In Tanzania, foreign support is essential at each stage of research capacity building, including MSc and PhD studies. The Tanzanian system is surviving because it attracts external financial support. Without major subsidies, and numerous micro-projects, Tanzanian universities and research institutions could support very little research¹⁷.

Nevertheless, official publications advocate the importance of science for the development of the country and state that 1% of the GNP should be allocated to science and technology (S&T). However, this target is yet to be reached. In the early 1990s the Tanzanian government spent about 0.35% of GNP on S&T activities (Widstrand, 1992; 1996). According to COSTECH, in 2002 this number was further reduced to 0.22% of GNP. This level of financing covers the costs of salaries and other personnel costs, but it contributes only marginally to other activities such as research.

Foreign funding agencies usually concentrate on particular institutions or faculties (notably the two

main universities: University of Dar es Salaam; and Sokoine University of Agriculture). Table 7 provides examples of some of the most important long-term aid relationships during the last 15-20 years.

In the field of agricultural research, bilateral cooperations occurs in conjunction with the support from the World Bank in order to implement National Research Programmes (NARPL1 and TARP II). In addition to the European Union, seven European countries are involved: UK (DFID), Germany (GTZ), The Netherlands, Sweden (Sida), Norway (NORAD), Denmark (DANIDA) and Ireland.

The Sokoine University's reliance on foreign donors for research funds is a typical example of external dependence. Between one third and one half of SUA's expenses are covered by aid, a dependence that has increased in recent years. Figure 2 shows the importance of foreign contributions at SUA during the late 1990s and Figure 3 shows the main budgetary sources in 1997-1998. In particular, the

| Funding agency | Country | Tanzanian | Beneficiaries |
|----------------|-----------------|-----------|---|
| NORAD | Norway | SUA | Faculty of Forestry |
| NORAD | Norway | UDSM | Department of Chemistry |
| NORAD | Norway | UDSM | Department of Chemical and Process Engineering |
| FINNIDA | Finland | UDSM | Department of Geology |
| DANIDA | Denmark | SUA | Department of Animal Science |
| SDC | Switzerland | UDSM | Departments of Mathematics and Physics |
| GTZ | Germany | UDSM | Faculty of Engineering |
| NUFFIC | The Netherlands | UDSM | Department of Microbiology |
| ISP* | Sweden | UDSM | Department of Seismology |
| ISP* | Sweden | UDSM | University Library |
| World Bank | International | MoAC | Rehabilitation of Agricultural Research Centers |

Table 7

Selection of important long-term aid projects supporting Tanzanian research capacity

* These activities of the International Science Programme (ISP), located at Uppsala University in Sweden, are funded by Sida-SAREC.

¹⁷ For a comparative analysis of research aid dependency in Tanzania and Senegal see Gaillard and Waast, 1999.

dependence of research activities on aid is even greater, foreign support representing more than 90% of financing for research.

At SUA, Norway (NORAD) became the primary foreign financial source¹⁸ after Denmark (DANIDA) reduced its contribution. The other main donors are ENRECA (a Danish programme), VLIR (the Belgian Vlaamse Interuniversitaire Raad), the USAID and the European Union. Different countries are also represented (Australia, the United States, France, Japan, the Netherlands among others), as well as NGOs, and several regional or Pan-African organizations. In total, not less than 48 foreign sources, including IFS, finance research and postgraduate studies at SUA (See Table A1 in Appendix 5). This fragmented system of support, where each source is individually administered, causes significant management, accounting, reporting and co-ordination problems.

3.1 A multiple professional dependency

In addition to affecting research activities, reliance upon foreign aid also shapes the profession of researcher. Nearly all Tanzanian university staff members that have not completed their education strive to do a Masters degree or a PhD. However, without foreign aid, it is difficult to continue training, even at a Tanzanian university. University funds go to staff development fellowships, and there are only a few such positions at each department. The difficulty of obtaining such support for continued studies partly explains the fact that Tanzanian scientists are obtaining their higher degrees at a relatively advanced age.

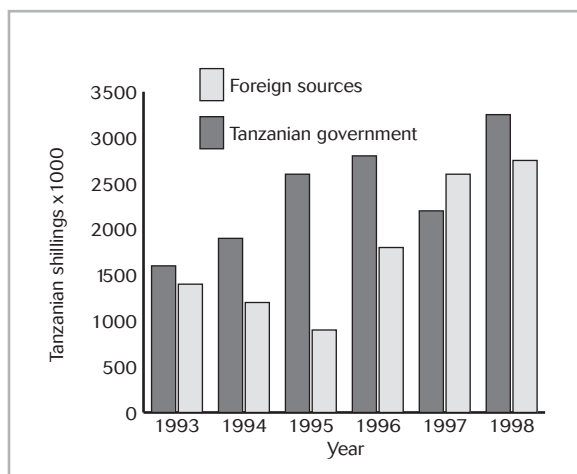


Figure 2
National and Foreign Funding at SUA (Source: SUA)

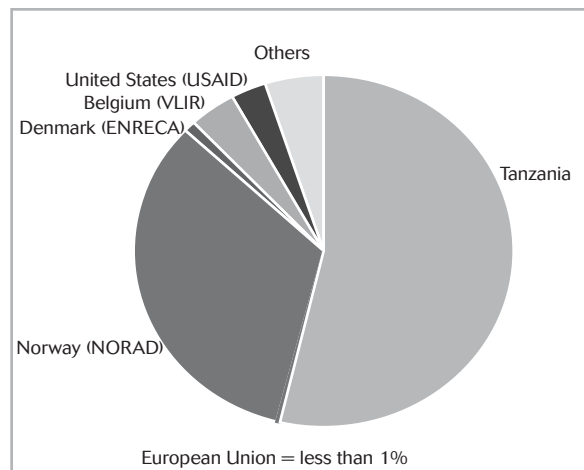


Figure 3
Main Funding Sources at SUA (1997-1998)
Source: Research News, SUA, 1998.

At SUA in September 1998, out of the 251 candidates pre-registered for postgraduate studies (mainly Masters level), only three could finance their own studies, and 99 could register after having obtained a grant to pay the registration fee and their tuition. More than 90% of these grants came from foreign sources, 53 from NORAD (Norway) and 13 from the Belgian Cooperation (Research News, 1998). A similar Sida-SAREC sponsored programme of support at the University of Dar es Salaam funded the education of 43 PhD students and 90 Masters students during the period 1998-2000 (Sida Research Council, 2000).

All of the current and former IFS grantees encountered during this MESIA study reported that they are reliant on foreign donors for research funds (See Box 5). Furthermore, the interviews indicate that a period in a laboratory abroad (to prepare a thesis, for example) increases the chance that a researcher will be able to obtain financial support. Current and former grantees responding to the questionnaire survey indicated that their research budgets for 1999 ranged from USD 0 to USD 95,000, and equaled a total of over USD 200,000. Most grantees' research budgets, however, were at the lower end of this spectrum, giving an average research budget of USD 8400. Furthermore, the large bulk of these funds came from foreign sources (see Figure 4).

International sources of funding, including private industries and foundations, accounted for 80% of the combined sum of grantees' research budgets. This reliance on foreign sources is much greater than for grantees in Africa as a whole where 57%

18 In 1994, NORAD's contribution represented as much as 83% of foreign aid.

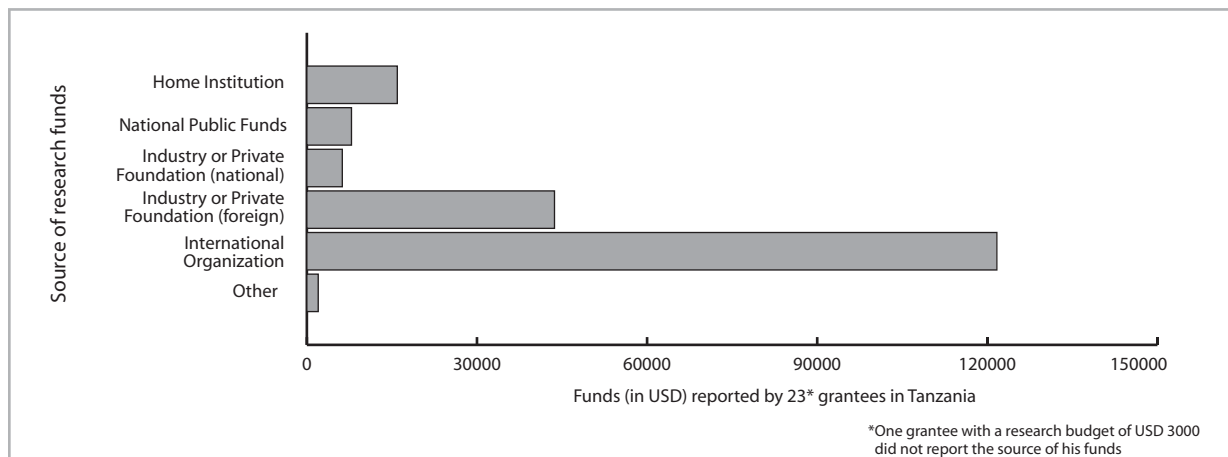


Figure 4
Source of grantee research budgets (Questions 41 and 42)

research budgets come from international sources (Gaillard and Furó Tullberg, 2001)¹⁹.

In addition to reliance upon foreign sources of research funding, Tanzanian researchers' are dependent on foreign colleagues at each stage of

their scientific work, from access to literature to analysis of samples and requesting the use of equipment not available in Tanzania. Furthermore, they usually need a foreign co-author, as a guarantee, to facilitate publication of their works in international journals. South-North scientific cooperation is therefore most often a prerequisite for promoting international contacts and enhancing the scientist's credibility within the international scientific community. However, such partnership too often entails collaboration between unequal partners that leads to a division of work that consigns the Tanzanian partner to field activities more so than to analytical work²⁰.

Box 5
IFS grantees' sources of funding

IFS grantees, like other researchers in Tanzania, are largely dependent upon foreign sources of support to fund their PhD studies, as well as their professional research careers.

During interviews, the funding sources that were most often cited included:

Sida-SAREC (Sweden), NORAD (Norway), DANIDA (Denmark), and GTZ (Germany).

Other sources of funding that grantees mentioned were:

ODA (now DFID) and OXFAM (United Kingdom), FINNIDA (Finland), DAAD (Germany), CIDA and IDRC (Canada), USAID and Fulbright (USA), Ford and Rockefeller Foundations (USA), African Development Foundation (USA), African Academy of Sciences (Kenya), Africa Capacity Building Foundation (Zimbabwe), Tropical Soil Biology & Fertility Network (TSBF - Kenya), European Commission, FAO, UNDP, GEF, World Bank (TARP).

3.2 Changing modalities for research funding

In the 1980s and 1990s, what is now Sida-SAREC became a very important strategic donor for research activities in Tanzania²¹. This strong relationships continues in 2002, however Sida-SAREC's mode of support has changed over time. The first Sida-SAREC support for Tanzanian research dates back to 1977. At that time, most of the funds were channelled through the National Science Council (UTAFITI) based on the idea that the rather newly established research council should not be bypassed if it were to play its national coordinating role. After an evaluation conducted by SAREC in 1985, the support to UTAFFITI was, in effect, discontinued. Later, the emphasis was put

19 The contrast is even greater when one compares to the situation in Mexico. There, less than 20% comes from international sources (Gaillard et al, 2001).

20 For a more in depth discussion concerning the division of labour between researchers in the North and the South see Gaillard (1994) and Gaillard and Schlemmer (1996).

21 SAREC was an autonomous Swedish government agency until 1995. For a detailed presentation of SAREC approaches see Bhagavan (1992). In 1995, SAREC was incorporated into the reorganised Swedish International Development Cooperation Agency (Sida). Today's Sida-SAREC is the main department of Sida with responsibility for research cooperation.

on bilateral research cooperation and direct cooperation between research institutions in Sweden and in Tanzania. This was believed to be an important way of building research capacity and providing additional research training opportunities. Collaborative projects increased significantly in the late 1980s and early 1990s. This approach has contributed to increased Swedish capacity in development research and to the internationalisation of Tanzanian science, but it has also brought negative effects such as fragmentation problems at the local university level discussed above²².

In the late 1980s and during the 1990s, SAREC support to regional research networks and regional research projects involving several institutions also increased. Thus, Tanzanian institutions and scientists have become involved in an archaeology network programme in East Africa, a coastal management programme in the Western Indian Ocean region, and the African Economic Research Consortium.

Altogether, Sida-SAREC support to Tanzanian research has combined key areas of strategic importance: development of institutional capacity, development of academic capacity, strengthening of regional cooperation and internationalisation. Yet, in the early 1990s Sida-SAREC began rethinking its overall strategy based on the critique that the research aid process had, in many cases, been too much supply- or donor-driven (including by individual Swedish researchers) and that consequently, Tanzania had not been able to develop national research priorities. "Many years of donor influence and donor-imposed research projects and ideas have made the research community inclined to listen very carefully to donors and adapt readily to suggestions" (Widstrand, 1996: 41).

In 1995 Sida-SAREC adopted a new strategy for its research co-operation in Tanzania whereby support would be concentrated on one institution: UDSM. This decision was precipitated by an encouraging initiative at UDSM, the "Institutional Transformation Programme", to reform and improve the management of the university's research resources. Furthermore, Sida-SAREC recognised that by concentrating on UDSM, Sweden could effectively contribute to the further development of UDSM's national comparative advantage in education, research and consulting services (Sida Research Council, 2000).

Under the current strategy, Sida-SAREC support is focused on three areas: reform and manage-

ment, research facilitation activities (eg library support, Masters degree scholarships, a faculty research grant scheme), and research collaboration. After a generally positive review of Sida-SAREC support to UDSM during the period 1998-2000, support for UDSM was renewed for the period 2001-2003 (Sida Research Council 2000).

Similar to the current Sida-SAREC strategy, Norwegian research co-operation, under a framework agreement between UDSM and NORAD (effective from July 1997), allocates funds through the central level of the university administration. NORAD justifies this approach by arguing that the present agreement provides a balanced and coherent support to the university, and not only to its individual faculties and departments (NORAD, 1999).

Denmark's DANIDA pursued another strategy. Danida argued that if all funding is in the form of direct support to universities and research institutes, then the ability of national coordinating bodies for research and higher education to set research priorities would be undermined. Hence, DANIDA directly supported the COSTECH research grants fund (this and other national research grant schemes are discussed below).

3.3 Emerging national research grant schemes

The National Fund for the Advancement of Science and Technology (NFAST) administered by COSTECH was established in 1995. It is a selective research grant scheme with support from the Tanzanian Government. In addition to providing research and development grants, the fund is also used to support other activities such as fellowships for short-term training and travel, grants to institutions to host scientific meetings or acquire equipment, promotion of science education in schools, and awards to individuals or institutions that have excelled in scientific or technological innovation.

While it was recommended that NFAST be launched with a fund of one billion shillings (approximately USD 1.9 million in 1995) and an annual budget not less than that amount, government funding for the programme has been much lower between 1995 and 2002, ranging from between 10.5 million shillings to 150 million shillings per year. In addition to these modest funds, following the estab-

22 For a general discussion concerning North-South Research partnership see Gaillard (1994) and Carlsson (1995).

ishment of NFAST, DANIDA provided 47.5 million shillings in support.

Though there is a great demand for NFAST support in Tanzania, underfunding and irregular funding have imposed severe budgetary constraints that have limited the programme's ability to meet its goals. During the first five years of its existence, NFAST received 145 research proposals with a total value of USD 1.1 million, but could only support 33 projects with a total of USD 86,000. From 1999 through 2002, no new allocations were made despite receiving a number of research proposals. From January until July 2002, for example, eight project proposals were received with a total value of USD 130,000.

The Agricultural Research Fund was established in 1991 as a competitive fund for financing high quality research is administered by DRT in MoAC. According to NORAD²³, criticisms related to slow and cumbersome handling of research proposals and the fact that the fund does not cover some basic operational costs has made the fund less attractive than expected. A Zonal Agricultural Research Fund (ZARF) is also being created and three pilot zones have been selected. Funding for the ZARF is intended to come from bilateral donors, NGOs and the private sector.

Sida-SAREC's model of research co-operation supports 13 programmes at UDSM. These include all faculties (except the Faculty of Law), institutes, staff training, Gender Dimension Programme, PMU and UCLAS.

The Health Research Users' Trust Fund with support from the Swiss Development Cooperation (SDC) invites research proposals from health professionals. The scheme is advertised nationally and all researchers can compete for funding.

3.4 Conclusion

National investment in science research is at a very low level in Tanzania, and both IFS grantees and the scientific community in general rely upon foreign donors to fund their research activities and their scientific training. In this context, the IFS support is important for providing financial support, for contributing to the internationalisation of the grantees' scientific contacts, and for opening new doors to additional funding opportunities.

This chapter shows that foreign funding modalities have changed over the last 20 years, from direct support to national co-ordinating bodies' core budgets to promoting and funding the establishment of research and research training programmes as well as granting schemes at public universities and research institutes. Such a change in policy is expected to lead to greater ownership and promote the culture of peer review systems. Yet, during the establishment of these national schemes, operational difficulties are to be expected, as reported in this chapter.

In addition to supporting scientists in Tanzania with research grants, a new role for IFS might be to support the emergence and development of national granting programmes by offering to share and further develop knowledge and experience that IFS has accumulated during 30 years of operating its own small grants programme. Other means of supporting national research support schemes can also be envisioned (see the final chapter of this report). Meanwhile, Tanzania should be encouraged to increase its support to S&T activities to ensure a needed revival. In the long range, no sustainable development of the national S&T capacities can take place without a strong political will and financial commitment at the national level.

23 In 1995, 10 out of 52 received proposals were granted. The information reported here comes from NORAD (1999).

4. Applicants and grantees in Tanzania

Researchers in Tanzania have submitted applications to IFS and been awarded research grants since 1974. In this chapter the process of applying for IFS funding is briefly reviewed, followed by a description of the applicants and grantees in Tanzania and a concise review of their distribution among institutions and research areas. Also described are the success rates of applicants.

4.1 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 recommendation is made to IFS 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.

4.2 Applications and success rates

During the period 1985-2000, IFS received 179 applications²⁴ for a first grant from scientists in Tanzania. Of these, 38 research proposals were approved, giving a 21% success rate. Data on applications for Africa, Asia, and Latin America in general is only available for 1991 until 2000. For this decade, the success rate of researchers in Tanzania (19%) is slightly greater than that for Africa (15%)

and Asia (17%), but lower than that for Latin America (30%).

In general, IFS receives between 8 to 12 applications from researchers in Tanzania each year, and awards between 1 to 3 grants (see Table 8). 1997 stands out as a year of very few applications (four), and 1994, 1998 and 2000 as years with many applications. Years with many applications can often be linked to particular recruitment efforts in Tanzania. The twenty applications received in 2000, for example, are likely the result of increased IFS visibility in Tanzania in conjunction with Jacques Gaillards' travel and information seminars during his visits for this MESIA study.

| Year | Applications | Grants awarded |
|-------|--------------|----------------|
| 1985 | 10 | 2 |
| 1986 | 10 | 3 |
| 1987 | 8 | 3 |
| 1988 | 12 | 2 |
| 1989 | 9 | 3 |
| 1990 | 11 | 2 |
| 1991 | 9 | 2 |
| 1992 | 9 | 1 |
| 1993 | 10 | 4 |
| 1994 | 18 | 3 |
| 1995 | 10 | 3 |
| 1996 | 12 | 2 |
| 1997 | 4 | 1 |
| 1998 | 15 | 1 |
| 1999 | 12 | 3 |
| 2000 | 20 | 3 |
| Total | 179 | 38 |

Table 8
Number of applications and first grants by year (1985-2000)

²⁴ This figure does not include applications for renewal grants by researchers that had completed their first IFS research project.

During the period under review, IFS targeted its support towards eight different research areas²⁵. Two research areas, Rural Technology and Environmental Sciences, were discontinued and incorporated into the other six areas after a relatively brief existence. In Tanzania, IFS received most applications from researchers with project proposals that addressed issues relevant to animal production (see Table 8). The Food Science Research Area had the highest success rate of all the Research Areas (60.0%), though the number of applications was small. Of the two research areas with the greatest

| Research Area | Applications | Grants | Success rate (%) |
|-------------------------|--------------|--------|------------------|
| Food Science | 10 | 6 | 60 |
| Animal Production | 71 | 18 | 25 |
| Aquatic Resources | 14 | 3 | 21 |
| Forestry / Agroforestry | 22 | 4 | 18 |
| Crop Science | 41 | 6 | 15 |
| Natural Products | 14 | 1 | 7 |
| Rural Technology* | 4 | 0 | 0 |
| Environmental Sciences* | 1 | 0 | 0 |
| Total | 177** | 38 | 21.5 |

* Discontinued Research Areas
 ** The total is 177 because two applications were not designated with an area

Table 8
 Number of applications and first grants per research area (1985-2000)

| Institution | Applications | First grants | Success rates (%) |
|---|--------------|--------------|-------------------|
| Sokoine University of Agriculture | 53 | 15 | 28 |
| COSTECH Research Institutes | 27 | 7 | 26 |
| Ministry of Agriculture Research Institutes | 48 | 11 | 23 |
| University of Dar es Salaam (UDSM) | 21 | 4 | 19 |
| Others | 28 | 1 | 3.6 |
| Total | 177* | 38 | |

Table 9
 Distribution of applications and first grants according to type of higher education establishment

number of applications, Animal Production had a higher rate of success than did Crop Science, ie 25% vs 15%, respectively.

From 1985 to 2000, 179 researchers at 45 different universities and research institutes in Tanzania applied to IFS for a first grant. Detailed information about many of these institutions is found in the overview of the Tanzanian science and technology activities in Chapter 2. Nearly 30% of all applications for IFS support come from Sokoine University of Agriculture (SUA), closely followed by the heterogeneous group of research institutes under the Ministry of Agriculture (Table 9). For information on the number of applications provided by each individual institution, the reader is referred to Table A2 in Appendix 5.

Researchers at SUA, COSTECH research institutes, and the Ministry of Agriculture research institutes had similar rates of success. However, researchers affiliated with other research institutes in Tanzania (See Table 9 and Table A2) had little success in securing IFS support.

4.3 The grantees

During the period 1974-2000, 55 scientists in Tanzania became IFS grantees. Of these, 21 were still active and receiving support from IFS in 2001. Animal Production (B) is the Research Area with the greatest percentage of grantees in Tanzania

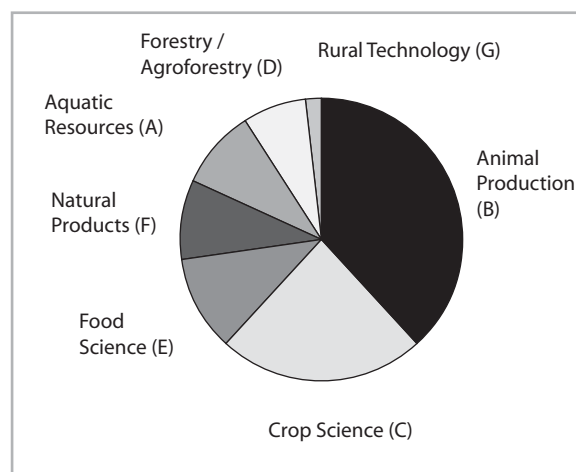


Figure 6
 Grantees by Research Area

25 As of May 2001, IFS is deemphasizing its individual Research Areas and instead describes its Small Grants Programme in terms of supporting research relevant to the sustainable management of biological resources. This change in emphasis also opens the door to researchers from social science disciplines and researchers working on topics such as biodiversity, water resources, and climate change, given that their research is justified in terms of sustainably managing the biological resource base and is relevant to local social, economic, and environmental conditions.

| Research Area | One grant | | Two grants | | Three grants | | Total No. of scientists |
|----------------------------|-----------|-----------|------------|-----------|--------------|-----------|-------------------------|
| | Active | Completed | Active | Completed | Active | Completed | |
| Aquatic Resources | 1 | 3 | 0 | 0 | 0 | 1 | 5 |
| Animal Production | 9 | 4 | 4 | 3 | 0 | 1 | 21 |
| Crop Science | 0 | 10 | 0 | 2 | 0 | 1 | 13 |
| Forestry/ Agroforestry | 2 | 1 | 1 | 0 | 0 | 0 | 4 |
| Food Science | 2 | 2 | 1 | 1 | 0 | 0 | 6 |
| Natural Products | 0 | 1 | 1 | 2 | 0 | 1 | 5 |
| Rural Technology | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| Total number of scientists | 14 | 22 | 7 | 8 | 0 | 4 | 55 |
| | 36 | | 15 | | 4 | | |

Table 10

Grantees in Tanzania: number of grantees by Research Area, period, and status

(38%), while Crop Science (C) accounted for 24% of grantees (see Figure 6). Number of grantees by research area, research period and activity status ("active", still ongoing; "completed", support from IFS terminated) are shown in Table 10.

Of the 55 grantees in Tanzania, 10 are women (18%) and 45 are men (82%). The percentage of grantees that are women is greater than the percentage of scientists that are women in Tanzania (see chapter 2). Women are also better represented in the population of IFS grantees in Tanzania than they are in the population of

| City | No. of grantees |
|---------------|-----------------|
| Arusha | 1 |
| Dar es Salaam | 17 |
| Kilosa | 1 |
| Lushoto | 2 |
| Mbeya | 1 |
| Morogoro | 18 |
| Moshi | 1 |
| Mpwapwa | 8 |
| Mtwara | 1 |
| Mwanza | 1 |
| Tabora | 1 |
| Tanga | 1 |
| Zanzibar | 2 |
| Total | 55 |

Table 11

Distribution of grantees by city

IFS grantees in Africa in general (11%). Meanwhile, women represent 22% of the entire population of IFS grantees, and over 30% of new grantees from all countries in 2001.

Dar es Salaam and Morogoro are the two Tanzanian cities with the highest concentration of IFS grantees (at the time of the first grant). Together, they hosted 64% of the grantees in Tanzania (Table 11 and Map 1). Except for Zanzibar, where the University of Dar es Salaam has a branch, the other locations are the sites of

smaller research institutes under COSTECH or the Ministry of Agriculture with only one or two grantees. The exception is the Mpwapwa Livestock Production Research Institute under the Ministry of Agriculture with eight grantees (see Table A2 in the appendix). The rather exceptional situation of the latter institute can be explained by the strong and long-term collaborative links it has developed with the Swedish University of Agricultural Sciences (SLU). Many staff members from Mpwapwa have been trained at SLU and several staff members from SLU regularly visit Mpwapwa and thereby ensure useful mentorship activities.



Map 1
Cities hosting IFS grantees

4.4 Conclusion

This chapter shows that IFS grantees in Tanzania are concentrated in the cities where the two major universities are located; Dar es Salaam and Morogoro. Women are underrepresented, but they are better represented in the population of IFS grantees in Tanzania than they are in both the population of IFS grantees in Africa and the population of scientists in Tanzania. This chapter also shows that applicants that are not attached to one of the major universities or research institutes in Tanzania, with the exception of the Mpwapwa Livestock Production Research Institute, have very little success in winning support from IFS.

IFS received a fairly constant number of applications per year from scientists in Tanzania during the 1990s, and there has been rather little fluctuation in the annual number of grants awarded to scientists in Tanzania. Increased numbers of applications, such as during the year 2000, can be attributed to increased IFS activity in Tanzania. However, in the future one might expect the number of applications for research support from Tanzanian scientists to decline due to the low level of recruitment of young scientists that was described in Chapter 2.

5. Characteristics of the surveyed IFS grantee population

In this chapter the general characteristics of the IFS grantee population in Tanzania is described. Information about respondents to the questionnaires, all IFS grantees in Tanzania, and general characteristics of the science community in Tanzania are compared.

5.1 Age, gender, and civil status

Looking at the entire pool of grantees in Tanzania (and at Tanzanian respondents to the questionnaire survey), their average age at the time of their first grant from IFS was 36 years old. During the past ten years (1992-2001) this figure rose slightly to 37.5 years of age. One difference is that during the 1970s and 1980s, scientists in their late 20s and early 30s applied for and were awarded grants. In recent years, however, the youngest grantees have been in their mid-30s. This trend towards older grantees can be expected to continue, given the aging of the Tanzanian science community and its difficulty to produce enough new, young scientists to replace retiring researchers.

Ten of 55 scientists that were awarded grants between 1974 and 2001 were women (18%). If we consider the percentages of academic staff that are female at UDSM (10%) and SUA (12%), we see that women may be slightly overrepresented in the IFS population compared to the general population of women working at universities in Tanzania. Discussions with women scientists in Tanzania suggest that the 40 year age limit for IFS applicants may be more of an obstacle for women than it is for men. Women's choice to have children after completing their studies, as well as institutional impediments to women becoming scientists, means that they may turn 40 before they reach the stage of their career where they are prepared to apply for IFS funding. However, there is only anecdotal evidence to support this hypothesis. Since 1992 the three women in Tanzania to receive grants from IFS were 37, 41, and 41 years of age when IFS funding was made available to them. The small

numbers of women grantees make it difficult to draw convincing conclusions regarding the IFS age limit using only IFS data.

The questionnaire survey is biased towards women, both in terms of its representivity of the population of Tanzanian scientists, and its representivity of the population of IFS grantees in Tanzania. Seven of ten women responded to the questionnaire, while only 17 of 45 men replied (38%).

Twenty-three grantees provided information about their marital status, two women were single, 20 grantees were married, and one was a widow. At the time that they answered the questionnaire, the respondents ranged in age from 35 years old to 55 years old, with an average of 44 years old. Responding grantees had between zero and six children, but on average 2.2.

Fifteen grantees reported the occupation of their spouses. The four women that reported that their husbands were researchers or doctors/lawyers. One man was married to an engineer, five had wives that worked at home, three wives had intermediate administrative positions, and five wives were small businesswomen or artisans.

5.2 Degrees held at the time of the first grant

The majority of the grantees in Tanzania (55%) had a MSc when they applied for their first grant at IFS (Table 12). This is a different situation compared to Mexico, where instead 61% of the grantees applying for their first grant held a PhD (Gaillard et al, 2001).

| Degree | No. of Grantees | % of Total |
|--------|-----------------|------------|
| BSc | 5 | 10 |
| MSc | 28 | 55 |
| PhD | 18 | 35 |
| Total | 51* | |

Table 12
Degree held at the time of the first grant

The countries where the degrees held at

the time of the first grant were obtained are listed in Table A3 in Appendix 5. Not surprisingly, the majority of the degrees were taken in the United Kingdom, the former colonial power. However, the importance of the United Kingdom as a source of higher degrees has declined from nearly 60% during the period 1974-1980 to just below 30% during 1991-2000. The same downward trend can be noted for the United States, from over 20% to 7% for the same time-periods. In parallel, the proportion of degrees taken in Tanzania has risen from 14% during 1974-1980 to 20% during 1991-2000. While the trend is towards a higher proportion of grantees having degrees of higher education from their own country, Tanzania is far from being self-

| Country | No. of BSc | No. of MSc | No. of PhD | Total degrees |
|-----------------|------------|------------|------------|---------------|
| Tanzania | 44 | 11 | 9 | 64 |
| United Kingdom | 2 | 13 | 10 | 25 |
| United States | 2 | 8 | 6 | 16 |
| Sweden | 0 | 5 | 3 | 8 |
| Kenya | 2 | 1 | 0 | 3 |
| Nigeria | 0 | 2 | 1 | 3 |
| The Netherlands | 0 | 1 | 2 | 3 |
| Canada | 1 | 1 | 0 | 2 |
| Russia | 0 | 1 | 1 | 2 |
| Australia | 0 | 0 | 1 | 1 |
| Belgium | 0 | 1 | 0 | 1 |
| Denmark | 0 | 0 | 1 | 1 |
| India | 1 | 0 | 0 | 1 |
| Norway | 0 | 0 | 1 | 1 |
| South Africa | 0 | 0 | 1 | 1 |
| Total | 52 | 44 | 36 | 132 |

Table 13
Countries where IFS grantees in Tanzania have been awarded degrees

| Institution(s) | BSc | MSc | PhD | Total |
|---|-----|-----|-----|-------|
| COSTECH Research Centres | 0 | 7 | 0 | 7 |
| Ministry of Agriculture Research Institutes | 3 | 10 | 1 | 14 |
| University of Dar es Salaam (UDSM) | 1 | 2 | 7 | 10 |
| Sokoine University of Agriculture (SUA) | 0 | 7 | 10 | 17 |

Table 14
IFS grantees and their degrees: an institutional perspective

sufficient in terms of higher education. Apart from the United States and the United Kingdom, Tanzanian scientists are mainly studying in Northern European countries (10% of grantees from the last decade had studied in Sweden), Canada or Australia. Nigeria is the only African country visited for higher education purposes in this category.

Looking at all the degrees taken by Tanzanian grantees, irrespective of when they were taken, 48.5% of them were completed in Tanzania, 18.9% in the United Kingdom, and 12.1% in the United States (see Table 13). It is most common that grantees in Tanzania received their BSc in Tanzanian universities (85%), but those that later took higher degrees, generally did so outside of Tanzania (75%).

Table 14 shows that the majority of the IFS grantees from Sokoine University of Agriculture (SUA) and the University of Dar es Salaam (UDSM) hold a PhD, while the majority of IFS grantees employed at Ministry of Agriculture Research Centres and COSTECH Research Institutes hold a MSc.

Though it was most common for grantees in Tanzania to have an MSc at the time of their first grant, there are variations when one looks at each individual IFS Research Area. Crop Science (Area C) and Natural Products (Area F) accounted for one half of the PhDs, but for less than 30% of the grantees (see Table 15).

As was discussed in Chapter 4, IFS grantees in Tanzania are rather evenly distributed between public research institutes and public universities at the time of their first grants. The respondents to the questionnaire were not different. Ten respondents work at public universities, thirteen at public research institutes, and one at an NGO.

| Area | BSc | MSc | PhD | Total |
|---------------------------|-----|-----|-----|-------|
| Animal Production (B) | 3 | 11 | 7 | 21 |
| Crop Science (C) | 1 | 4 | 6 | 11 |
| Food Science (E) | 0 | 5 | 1 | 6 |
| Aquatic Resources (A) | 0 | 3 | 1 | 4 |
| Forestry/Agroforestry (D) | 0 | 4 | 0 | 4 |
| Natural Products (F) | 0 | 1 | 3 | 4 |
| Rural Technology (G) | 1 | 0 | 0 | 1 |
| Total | 5 | 28 | 18 | 51 |

Table 15
Degrees held at the time of the first grant by Research Area

6. Research conditions

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 connection 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 Tanzanian scientific community.

6.1 Grantee livelihoods

Of 23 grantees in Tanzania, only four responded that their salary as a scientist was adequate to support themselves and their family, two of whom had held positions outside of Tanzania²⁶. At USDM, for example, the average net monthly salaries for researchers during the year 2000 ranged between USD 200 and USD 700 (Table 16). In their work as scientists, grantees generally felt that their possibilities for career development and their job security were advantages, but that salary, social benefits, and retirement benefits were more often a disadvantage (Table 17).

| Position | Year | |
|---------------------|------|------|
| | 1998 | 2000 |
| Tutorial Assistant | 170 | 200 |
| Assistant Lecturer | 215 | 270 |
| Lecturer | 290 | 370 |
| Senior Lecturer | 470 | 545 |
| Associate Professor | 580 | 665 |
| Professor | 685 | 770 |

Table 16
Net monthly salaries at USDM

Given the difficulty of supporting oneself on a scientist's salary in Tanzania, scientists supplement their incomes with honorariums and "fringe benefits" from research grants. The foreign aid that researchers receive not only serves to purchase equipments and supplies, but actually constitutes a survival strategy for the researchers and their families. Researchers often complement their salary with travel expenses and/or per diems given to attend meetings and conferences. The most fortunate ones manage, within programmes financed with foreign funds, to buy a vehicle that they can use for more than strictly scientific purposes. Many foreign agencies and programmes are concerned by this problem of inadequate salaries. As a matter of policy, some agencies, such as IFS and Sida-SAREC in Sweden, do not contribute to the salaries of developing countries personnel (see Box 6). Others, like ENRECA in Denmark, include salaries in their support or research incentives. Meanwhile, TARP II (see Chapter 2) intends to provide research incentives through establishment of monetary awards for outstanding research performance and awards for publications.

IFS grantees in Tanzania also supplement their incomes with extra jobs. Fourteen grantees reported having extra jobs in this study. By working, on aver-

| Factors | Grantees identifying the factor as a(n): | |
|--------------------|--|--------------|
| | Advantage | Disadvantage |
| Salary scale | 8 | 14 |
| Career development | 20 | 3 |
| Job security | 19 | 4 |
| Social benefits | 10 | 13 |
| Retirement | 7 | 16 |

Table 17
Advantages and disadvantages to grantees employment as scientists

²⁶ Based on the 20 interviews carried out in Tanzania, we estimate that Tanzanian scientists have to multiply their salaries by 3-5 in order to reach a level that they consider adequate.

Box 6
Honorariums

Whether or not to provide an honorarium to researchers is an important policy question. In the case of IFS and Sida-SAREC, the policy has been to not provide honorariums. The main rationale behind this policy is the following: if research is a priority for a developing country, it should be translated into adequate salaries for its nationals engaged in research work (see Bhagavan, 1992 for a further discussion).

Meanwhile, the interviews for this report pointed to an important potential consequence of this policy. One grantee explained that the IFS support was an “eye opener” and the starting point of his research career. It helped him to embark on his PhD studies, and also helped him to be promoted from Lecturer to Senior Lecturer at his university. However, he criticised IFS support for the lack of an honorarium to compensate for the very low salaries at the university. Included in a grant he received from a large American foundation was a small honorarium (USD 700 for 13 months) which to him made a big difference. The fact that very few scientists from his university apply for an IFS grant is, according to him, due to two main factors: the aging staff and the lack of incentives in the form of an honorarium.

age, slightly less than 12 hours per week at their extra job(s), grantees earned an average amount that was 2.7 times greater than their basic salary as a scientist. The most common extra job was farm-

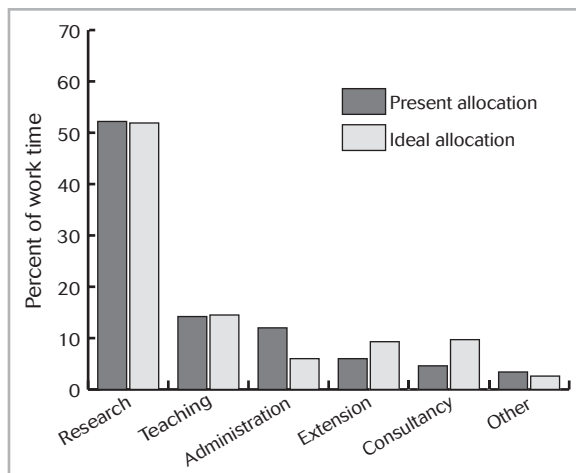


Figure 7
Time allocation of work activities (Q15)

ing (12 grantees) followed by businesses and consultancies (8).

Consultancies, the rates of which increasingly approach international rates, are most often financed by foreign organisations and carried out in Tanzania. Relatively lucrative incomes from consultancies are often invested in a company or a shop managed by a member of the researcher’s family, often their spouse²⁷. Academic staff members from Sokoine University of Agriculture (and the researchers from agronomical institutes) frequently invest in agricultural production and firms; and those from UDSM (and the other research institutes) often invest in services like transportation or small shops. Consultancies are usually contracted directly with the scientists, or through small consultancy firms created with other colleagues. Meanwhile, institutions to which the scientists belong try to better control this new development and take advantage of it. The University of Dar es Salaam, for example, created a “University Consultancy Bureau”, but scientists were reluctant to contract consultancies through it given that the bureau withheld a consultancy fee.

In addition to soliciting information about salaries, the MESIA Questionnaire asks grantees to indicate the amount of work-time time that they presently spend on five activities: teaching, research, administration, extension and consultancy, as well as other unspecified activities. Figure 7 presents the mean response of the grantees in Tanzania. Administration was the activity that grantees would most like to reduce, and consultancy work was the one that they would most like to increase. This result is not unexpected, given the inadequacy of scientific salaries and the potential earnings that consultancies represent.

While present and ideal time spent on research appear to be quite close in Figure 7, the variation in the responses of grantees is hidden. The standard deviation within the categories “present time spent on research” and “ideal amount of time spent on research” were 27 and 24 percentage points, respectively. Furthermore, grantees responded that the ideal amount of research time was from 17 percentage points less time to 20 percentage points more time. The average difference between present and ideal was about 8 percentage points. One may conclude that the population of respondents vary widely in the amount of time that they dedicate to research, but that they generally seem satisfied with

27 As we saw earlier, only 10% of university academic staff in Tanzania are women.

| Groups | Never (1) | Rarely (2) | Annually (3) | Monthly (4) | More often (5) | Mean score |
|---------------------------------------|-----------|------------|--------------|-------------|----------------|------------|
| Scientists in grantees' department | 0 | 0 | 3 | 2 | 17 | 4.6 |
| Scientists in grantees' country | 0 | 7 | 8 | 5 | 4 | 3.3 |
| Scientists in Europe | 4 | 9 | 5 | 3 | 3 | 2.7 |
| Scientists in other African countries | 1 | 14 | 6 | 2 | 1 | 2.5 |
| Scientists in the US and Canada | 9 | 8 | 3 | 4 | 0 | 2.1 |
| Scientists in Asia or Latin America | 11 | 10 | 2 | 1 | 0 | 1.7 |
| Extension staff | 0 | 6 | 4 | 5 | 9 | 3.7 |
| Funding agencies | 0 | 5 | 10 | 2 | 6 | 3.4 |
| NGOs | 5 | 7 | 6 | 3 | 3 | 2.7 |
| Private clients | 6 | 6 | 7 | 2 | 2 | 2.5 |
| Consultancy groups | 5 | 9 | 2 | 3 | 2 | 2.4 |

Table 18
Scientific and professional communication (Q29)

the amount of time they presently spend on this activity.

Meanwhile, information obtained from the interviews with grantees indicates that general satisfaction with the amount of time for research is not universal. It may be that those scientists who are

least satisfied, and most motivated to do research decide to leave Tanzania (see Box 7).

6.2 Communication

Although IFS support is targeted to individual researchers, IFS grantees in Tanzania overwhelmingly (22 of 23 respondents) work in research teams. Furthermore, the same proportion of grantees reported that they work in multidisciplinary teams, thus supporting the IFS claim that targeted support to individuals does not only benefit individuals, but does have implications for larger groups of scientists. Information gathered during interviews with Tanzanian scientists also indicates that the IFS support contributed to the formation of research teams.

When grantees are questioned regarding with whom they communicate, it becomes clear that the home institution is the most frequent place where scientists discuss their research (see Table 18). Eleven of 24 respondents do not discuss their research with any scientists outside their department more than once per year. Seventeen respondents did not discuss their research with anyone outside of Tanzania more than once per year. A handful of grantees had frequent contact with scientists outside of Africa, mostly in Europe.

Nine grantees reported that they did not have easy access to the Internet. These grantees, in comparison to the 15 that did have easy access, consistently

Box 7

The decision to leave Tanzania

There is no single explanation for why grantees sometimes choose to leave Tanzania. As is discussed in Chapter 9, many of those grantees that do leave Tanzania are not examples of "brain drain", but rather are part of a regional circulation of scientists in Eastern and Southern Africa.

Meanwhile, for other researchers, the constraints to conducting research in Tanzania can be a factor that encourages them to move further abroad. For example, when asked what the main reason for leaving Tanzania was, one grantee that moved to North America responded:

"I had reached a stage where I needed more interactive exposure to new information and to new technology in my field. Financially, I was not earning enough salary to support myself and family without having small business outside my profession, and that took time out of science and limited by professional growth. I felt that by leaving the country I could achieve the professional level I desired and at the same time maintain a decent standard of living."

| Location | National Support | IFS Support | Foreign Support | Without Support | Total |
|--------------------------------|------------------|-------------|-----------------|-----------------|-------|
| Tanzania | 150 | 9 | 39 | 25* | 223 |
| Africa (excluding Tanzania) | 12 | 22 | 49 | 2 | 85 |
| Europe | 2 | 2 | 25 | 0 | 29 |
| The United States or Canada | 2 | 4 | 20 | 0 | 26 |
| Latin America or the Caribbean | 0 | 1 | 2 | 0 | 3 |
| Asia | 2 | 4 | 9 | 1 | 16 |
| Total | 168 | 42 | 144 | 28 | 382 |

Table 19

* One grantee accounted for 20 conferences

Conferences attended by responding grantees, grouped by source of funding and location of conference.

reported that they communicated less often with scientists from outside of their department.

Outside of scientific circles, grantees most often spoke to extension staff followed by funding agencies (Table 18). Only five respondents had no contact with consultancy groups, but a majority had only rare or annual contact.

The 24 grantees had attended 382 scientific conferences since the beginning of their careers (Table 19). Nearly 60% of these conferences (n=223) were within Tanzania, and the majority of these visits were funded by national sources. In contrast, only 18 of 159 trips to conferences outside of Tanzania were funded by national sources, indicating that international sources of funding are essential for Tanzanian scientists to meet with all but the nearest of their colleagues. IFS was responsible for supporting 21% of the respondents' trips to conferences outside of Tanzania. Between 1995 and 1999, grantees reported that they had attended, on average, 4 conferences outside of Tanzania. Table 20 shows the variability within the group.

Ultimately, the success of the scientific endeavor lies in the ability of scientists to communicate their

| No. of conferences | No of grantees |
|--------------------|----------------|
| 0 | 4 |
| 1 - 5 | 15 |
| 6 - 10 | 4 |
| 11 - 15 | 0 |
| 16 - 20 | 1 |

Table 20

Number of conferences outside Tanzania attended by respondents during a five year period (1995-1999).

research results (the topic of the following chapter) and to access other scientists' results. In Tanzania, the latter form of communication is often hindered by lack of adequate library facilities, and poor access to bibliographic databases. Among the questionnaire respondents, 12 of 24 did not have access to the latter resource.

6.3 Conclusion

The results from the questionnaire survey presented in this section support the major conclusions of the overview of the Tanzanian scientific community presented in Chapter 2. In this chapter it was shown that a large portion of grantees in Tanzania are scientifically isolated in their institutions. Many have no regular contact with scientists outside of their department, and only a few have regular contact with scientists outside of Tanzania. Grantees go to conferences outside of their country, on average, less than once of year. Access to the Internet was not universal, and access to bibliographic databases was only partial.

This information indicates that the demand for IFS support for international communication and participation in conferences is high, and that these services should be strengthened. An appropriate framework for addressing the needs of grantees in Tanzania is the Regional Programme for Sub-Saharan Africa that was initiated by IFS in 2002. (see Chapter 12)

This chapter also shows that grantees believe that their basic salaries as scientists are not sufficient to support themselves and their families, and more than half of the respondents reported that extra jobs provide significant shares of their incomes. Farming was the most common extra job, but

working as a consultant or in a small business was common. In general, grantees would prefer to spend less time working in administration and dedicate more time to consultancies and extension work. It is clear that for scientists in Tanzania time is both scarce and valuable, and the incentive to conduct research (in the absence of a stipend or honorarium) is often at a disadvantage when compared to incentives to spend extra time on consultancies or business.

In response to this finding, IFS might consider opening a discussion on the importance of providing a small honorarium to grantees in combination with the research grant. Alternatively, IFS might consider requesting that COSTECH or the grantees' institution provide a research honorarium for the length of a grantee's IFS supported project.

7. Publication outputs

The ultimate value of scientific research depends on its availability to the public. The most common way of making research public is through publication. Publishing is at the heart of the scientific enterprise. It is a measure of productivity and an important criterion used for advancing a scientist's career in many countries. As demonstrated in the questionnaire survey, publication is considered to be an important criterion for the promotion of scientists in Tanzania (see Figures 15 and 16 in Chapter 9).

This chapter provides an overview of scientific publication in Tanzania²⁸, as well as a bibliometric study of a group of IFS grantees in Tanzania.

7.1 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. While local science is important, there is generally greater academic prestige associated with carrying out international science.

An often 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. 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.

The question of adequately representing science produced in the developing world in international databases was the main point of discussion at a 1985 conference organized at ISI in Philadelphia. The final conference report, *Strengthening the Coverage of Third World Science*, pointed to a glaring 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 1985:3).

Tanzania's annual research outputs are low given the size of the national scientific community. During the 1990s, Tanzanian scientists authored or co-authored approximately 100-200 articles per year that were published in international journals²⁹. Between 1991 and 1997, 988 such articles were published with Tanzanian authors or co-authors. In Africa, Tanzania ranks 8th with approximately 2% of the total African production of articles in mainstream journals³⁰. Yet, despite constraints to research and publication, Tanzania has significantly increased its scientific production during the 1990s. (see Figure 8).

According to the ISI database, which does not track social science journals, a large share of the Tanza-

28 This section draws on Gaillard et al. 2001, as well as other original research at IFS.

29 Journal articles were indexed in one of two databases: ISI/SCI (US) and PASCAL (France).

30 In the ISI database and 11th in the PASCAL database, but whereas ISI has a bias in favour of English speaking countries, PASCAL has a bias in favour of French speaking countries. Hence, ISI data for Tanzania is used in the rest of this section.

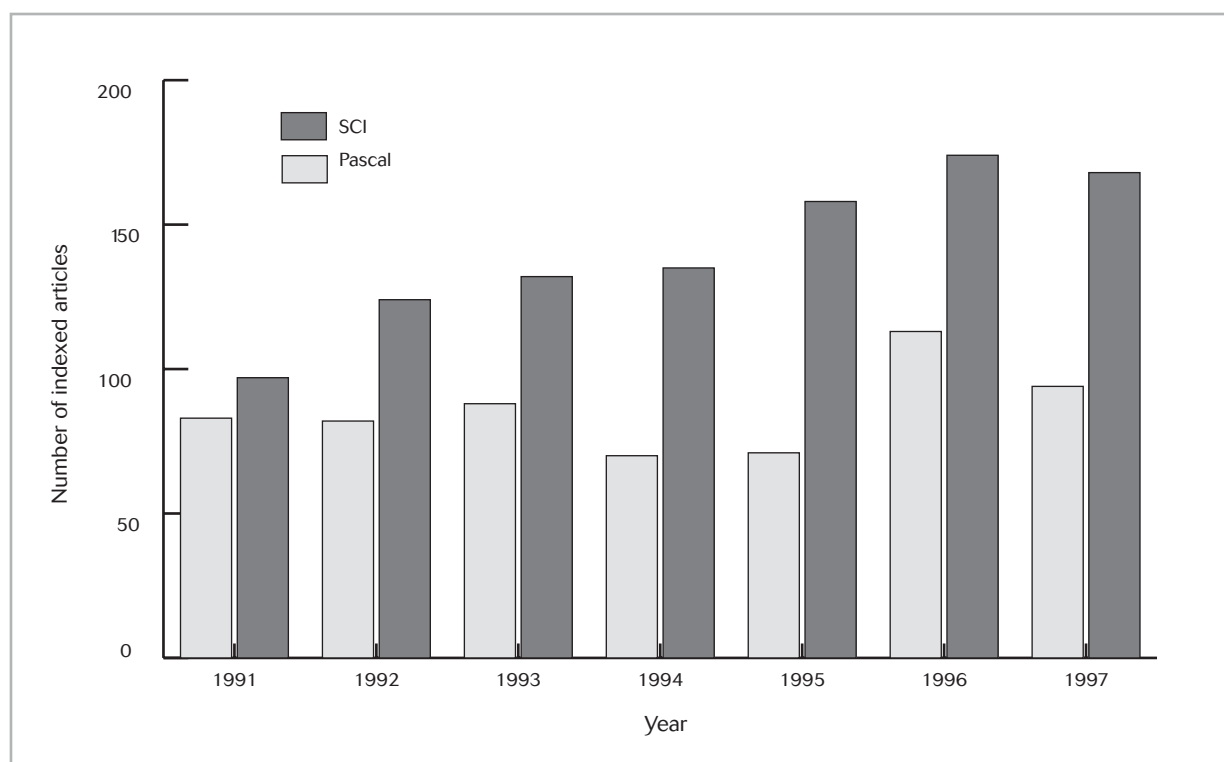


Figure 8
Tanzanian publications indexed in SCI and Pascal (1991-1997)

nian scientific production is within clinical medicine (57%), followed by biology (24%), and biomedicine (10%). Earth sciences (mainly soil and environmental sciences) account for 4%, engineering and technological sciences for 2%, and physics, chemistry and mathematics 1% each. This production originates from more than 100 institutions in Tanzania, many of them being responsible for a

very limited number of publications³¹. Meanwhile, the top four institutions produce half (49,6%) of the total scientific production (see Table 21) in mainstream journals.

The top four institutions include two public universities (UDSM and SUA) and the Muhimbili University College of Medical Science (MUCHS). The

| Institutions | No. of pubs in ISI | % of all pubs in ISI |
|--|--------------------|----------------------|
| University of Dar es Salaam (UDSM) | 266 | 17.7 |
| Muhimbili Medical Center (MMC) | 191 | 12.7 |
| Muhimbili University College of Medical Science (MUCHS, part of MMC) | 154 | 10.3 |
| Sokoine University of Agriculture (SUA) | 134 | 8.9 |
| National Institute of Medical Research (NIMR) | 91 | 6.1 |
| Ministry of Health (MoH) | 66 | 4.4 |
| Kilimanjaro Christian Medical College (KCMC) | 42 | 2.8 |
| Ifakara Health Research and Development Center (IHRDC) | 33 | 2.2 |
| Tanzania Food and Nutrition Center (TFNR, under MoH) | 31 | 2 |
| Amani Medical Research Center (under MoH) | 26 | 1.7 |
| Remaining 139 institutions | 468 | 31.2 |
| Total | 1502 | 100 |

Table 21
Top ten international science research-producing institutions in Tanzania (1991-1997)

31 66 institutions have produced only one publication (17: 2, 14: 3, 6: 4 and 7: 5).

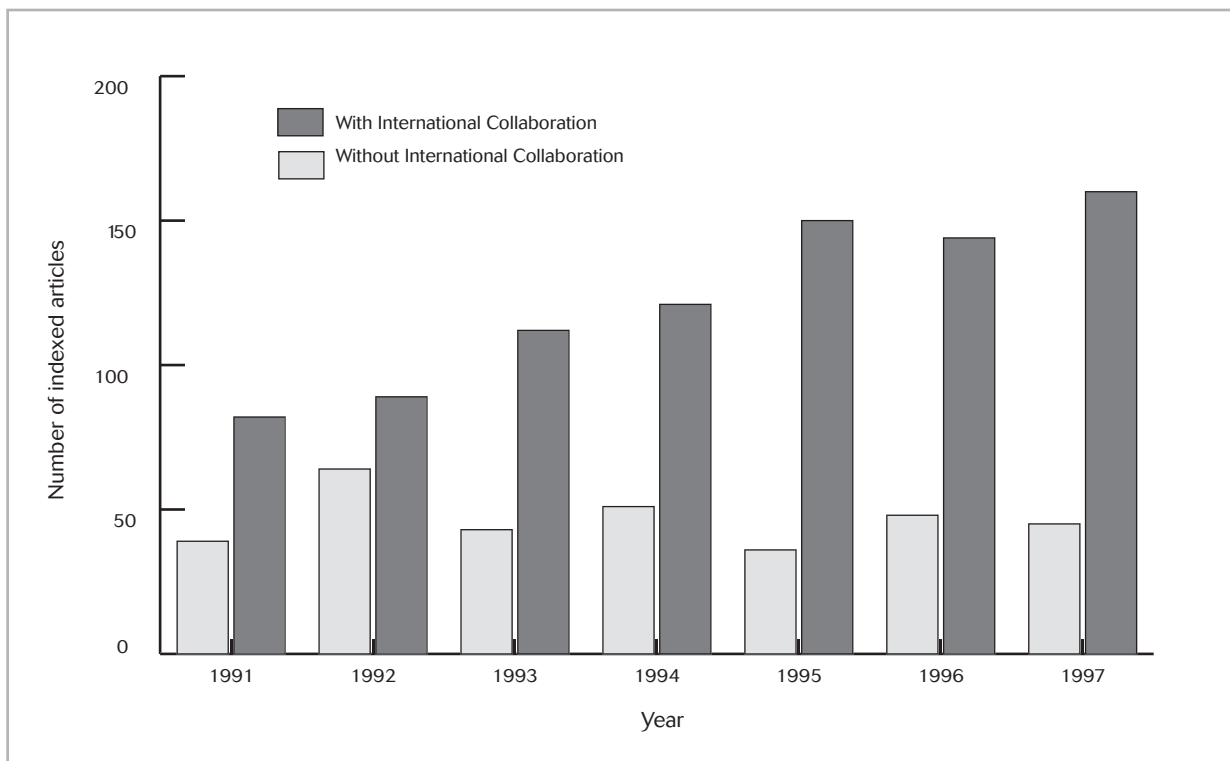


Figure 9

Articles in indexed journals by Tanzanian scientists: the importance of collaboration

main private institutions in the field of health research (KCMC and IHRDC) occupy a high position given their smaller size. The agricultural (and forestry) research institutes are not absent from the list, but they do have few publications. The first to appear is the Tanzanian Forestry Research Institute in 16th position with 15 publications, followed by the Central Zone Research Institute in Mpwapwa (Livestock Research Center) in 21st position with 9 publications. While the ISI database tends to underestimate agricultural sciences, the main reasons for fewer mainstream journal publications in agriculture is probably that agricultural scientists in Tanzania are often less qualified and more applied oriented than scientists from other disciplines, and publish relatively less and in less visible journals than scientists in other disciplines.

Another characteristic of Tanzanian scientific production is that it is highly dependent on international collaborations (see Figure 9). Science in Tanzania appears to be at the same time the most international and the most dependent of all African countries. As much as 72% of the articles being published are published in collaboration with foreign authors. Foreign co-authors are predominantly from the US (21%) and from the UK (19%) where the Tanzanian scientists have been

Box 9

Terms and definitions used in this chapter

Total publications: All publications regardless of type listed in the publication lists collected by IFS.

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.

often been trained. Meanwhile, the relative importance of Swedish (10%), Dutch (10%), Swiss (6%), Danish (5%), German (4%) and Norwegian (4%) co-authors is related to the long standing cooperation programmes between these countries and Tanzania (see Figure 10). Only seven percent of the co-authored articles are published in collaboration with scientists from other African countries (mostly Kenya and Uganda). Collaborations with Asian scientists account for three percent of the articles.

7.2 Bibliometric study of grantees in Tanzania

In 1999, requests for publications lists were sent to all present and former IFS grantees who were working, or had been working in Tanzania³² (49 grantees). 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 concentrate on publication output in mainstream science. However, because we wanted to measure the total publication output of grantees in Tanzania, we did not limit this bibliometric study to only those publications found in the ISI databases. Instead we consider all scientific work produced by grantees in Tanzania using their complete publication lists.

The complete bibliographical information (title, date, pages, publisher, etc.) of each reference in the publication list 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.

Of the 49 grantees, 31 participated in the survey by providing publication lists. Eleven of 17 current grantees participated, and 20 of 32 former grantees submitted publication lists. Publication records were not available for three deceased grantees. Although the overall rate of participation in the bibliometric study is satisfactory (63%), it is

not known to what extent those grantees that did not respond are individuals who have published less often or not at all.

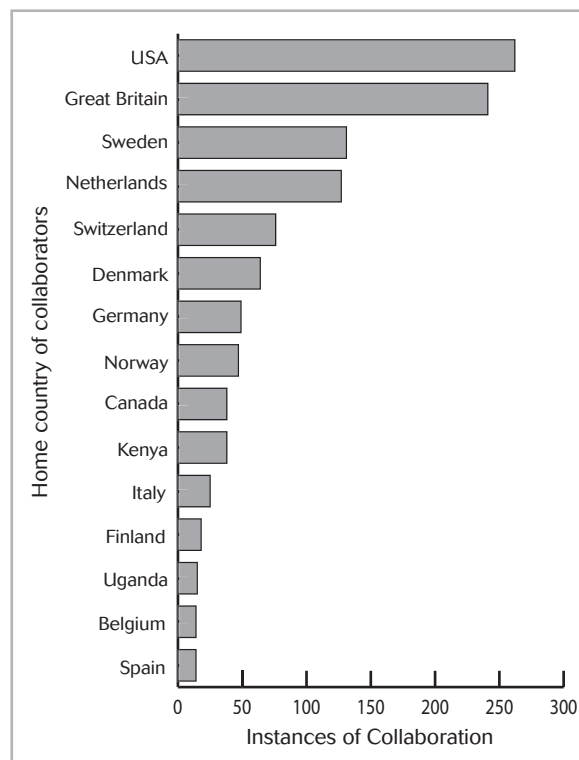


Figure 10
Tanzanian scientists and international collaboration: Top ten collaborating countries

| No of pubs reported | Number of grantees | |
|---------------------|--------------------|----------------------------|
| | All publications | IFS supported publications |
| 1 - 5 | 8 | 9 |
| 6 - 10 | 5 | 5 |
| 11 - 15 | 5 | 0 |
| 16 - 20 | 2 | 1 |
| 21 - 30 | 4 | 0 |
| 31 - 40 | 4 | 1 |
| 41 - 50 | 0 | 0 |
| 51 - 60 | 0 | 0 |
| 61 - 70 | 2 | 0 |
| 71 - 80 | 1 | 0 |
| (Mean) | (19.6) | (3.3) |
| Total no. of pubs | 1502 | 100 |

Table 22
Publication productivity of individual grantees

32 Publication records were requested from scientists that received grants prior to the 1999 granting sessions.

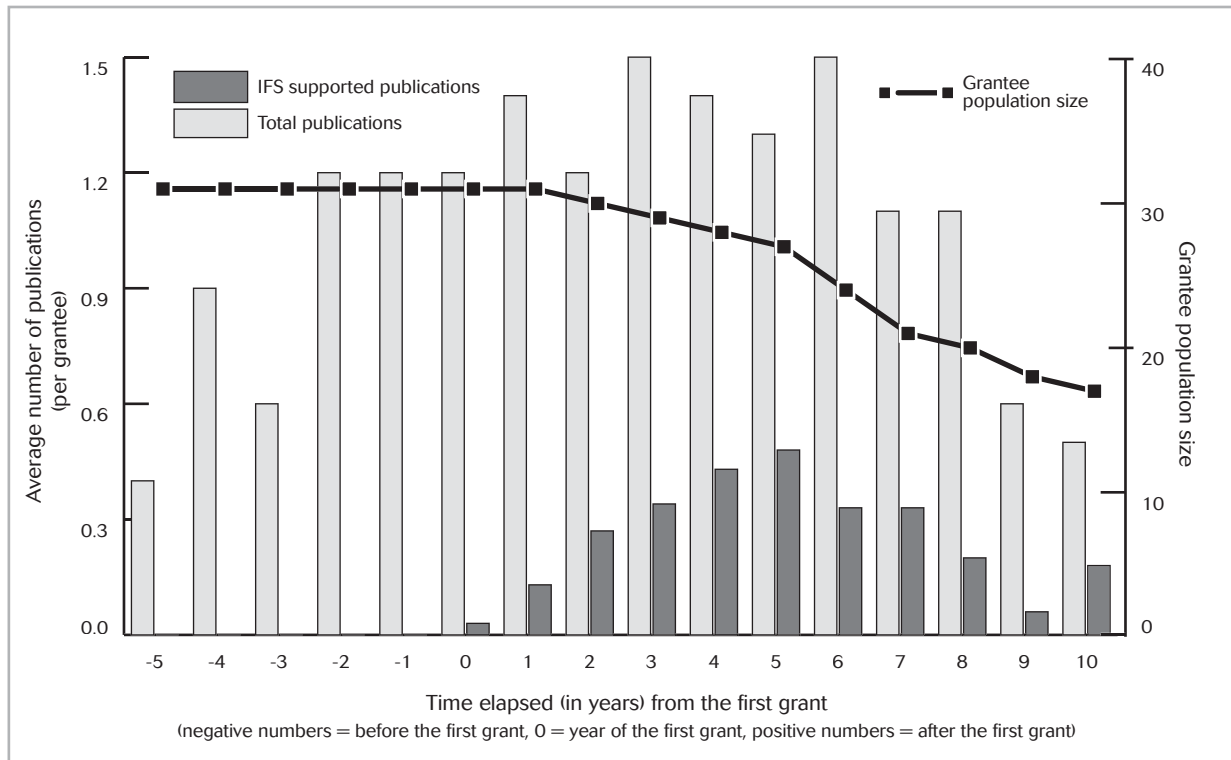


Figure 11
Average publication output in relation to the first grant

7.2.1 Publication output

The 31 publications lists contained a total of 608 publications, of which 103 (17%) were identified as IFS supported publications³³. Individual grantees published between one and 73 publications, with a mean number of publications per grantee slightly below twenty (Table 22). On average, grantees produced 3.3 IFS supported publications, including one especially productive grantee that received three grants and produced 32 IFS supported publications (Table 22).

The average number of total publications and IFS publications per grantee for the years before and after the first grant are provided in Figure 11. Figure 10 indicates that grantees’ peak in publication production generally occurs between three and six years after their first grant. A similar peak in IFS supported publication is noted between four and five years after the first grant.

Figure 12 shows the break-down of all publications by type. The most common type of publication was a journal article, followed by a full paper in a conference or seminar proceedings.

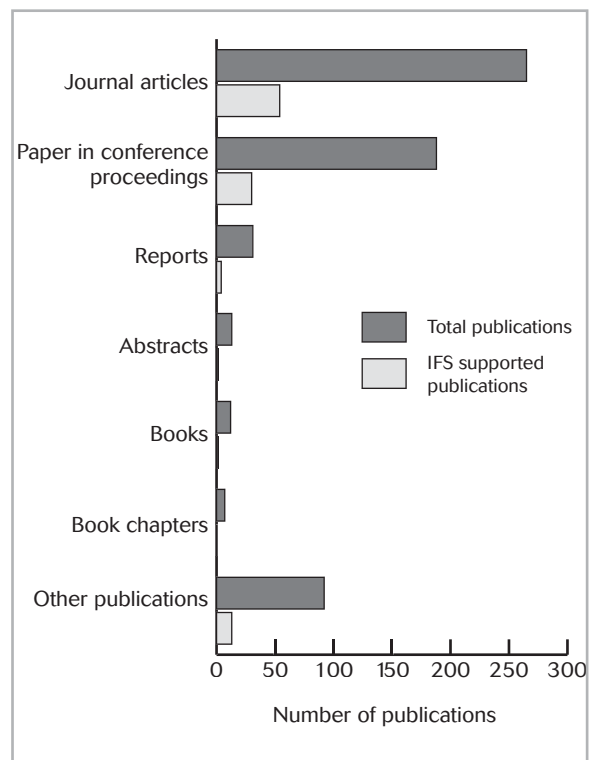


Figure 12
IFS supported publications and other publications by type

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

| Periodical title | Place of publication | ISI journal? | No of grantee publications |
|---|----------------------|--------------|----------------------------|
| Tanzania Veterinary Journal | Tanzania | | 24 |
| University of Dar es Salaam Science Journal | Tanzania | | 13 |
| Bean Improvement Cooperative (BIC) | Unknown | | 12 |
| Phytochemistry | United Kingdom | Yes | 9 |
| Tanzania Veterinary Bulletin | Tanzania | | 8 |
| Phytopathology | USA | Yes | 6 |
| Plant Disease | USA | Yes | 6 |
| Plant Foods for Human Nutrition (also <i>Qualitas Plantarum</i>) | The Netherlands | Yes | 6 |
| Planta Medica | Germany | Yes | 6 |
| Veterinary Parasitology | The Netherlands | Yes | 6 |
| International Journal of Food Sciences and Nutrition | United Kingdom | Yes | 5 |
| Acta Tropica | The Netherlands | Yes | 4 |
| Bean Research | Unknown | | 4 |
| Journal of Ethnopharmacology | Ireland | Yes | 4 |
| Preventive Veterinary Medicine | The Netherlands | Yes | 4 |
| Tanzania Journal of Science | Tanzania | | 4 |
| Tropical Animal Health and Production | The Netherlands | Yes | 4 |
| Tropical Grasslands | Australia | Yes | 4 |
| Veterinary Record | United Kingdom | Yes | 4 |
| "Acta Pathologica, Microbiologica et Immunologica Scandinavica (APMIS)" | Denmark | Yes | 3 |
| Acta Veterinaria Scandinavica | Denmark | Yes | 3 |
| Journal of Applied Animal Research | India | Yes | 3 |
| Journal of the Marine Biological Association of India | India | | 3 |
| Journal of Thermal Analysis and Calorimetry | The Netherlands | Yes | 3 |
| Pakistan Journal of Scientific and Industrial Research | Pakistan | | 3 |
| Scandinavian Journal of Immunology | UK | Yes | 3 |

Table 23

Journals in which IFS grantees in Tanzania have published three or more articles

7.2.2 Journal article productivity

After segregating the publications by type, it was found that the publication lists contained 265 journal articles (44% of all publications) published in 108 different journals. A total of 26 journals had three or more articles by IFS grantees (Table 23). Grantees credited 54 journal articles directly to IFS support (this represents slightly more than one half of all IFS supported publications).

Slightly more than one-half of all journal articles (n=134) were published in a group of 59 journals that appear in the ISI master list³⁴. As discussed above, 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.

Eleven grantees credited IFS support for 30 of the 134 articles published in mainstream scientific journals (see Table 24). Of these 11 grantees, eight had received more than one IFS grant, two had received only one IFS grant and their files had since been closed, and one grantee was still active in the first granting period, and eligible for a renewal. These results indicate that grantees that received more than one grant were more likely to publish their research in international mainstream jour-

| Research | ISI Journal | Non-ISI Journal |
|-------------------|-------------|-----------------|
| IFS supported | 30 | 24 |
| Not IFS supported | 104 | 107 |

Table 24:

Journal articles: ISI and IFS support

34 <http://www.isinet.com>

nals than were grantees that only received one IFS grant.

In Section 7.1 it is mentioned that 988 publications with Tanzanian authors or co-authors appeared in international mainstream journals during the period from 1991 to 1997. A majority of these articles were not in IFS research areas, but nevertheless over 9% of all mainstream journal articles produced during the period had IFS grantees as authors or co-authors (Figure 13). The prominence of IFS grantees in Tanzanian science publishing indicates that IFS grantees are overrepresented among the cadres of international mainstream authors in Tanzania.

Meanwhile, IFS grantees also continue to publish results in local journals. While publications in local journals are less important for the career advancement of scientists in Tanzania (see Chapter 9), they are important outlets for disseminating research results that are relevant to a limited, local audience. It is clear that the Tanzania Veterinary Journal, the University of Dar es Salaam Science Journal, and the Tanzania Veterinary Bulletin are important local journals for IFS grantees (see Table 23).

7.2.3 Co-authorship and collaboration

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

teams. Of the 54 journal articles that grantees gave credit to IFS for supporting, 44 were co-authored. Co-authorship was the norm for all articles produced by IFS grantees, only 15% had single authors.

The bibliometric survey did not have data available regarding the nationality of grantee collaborators. However, information obtained during the interviews of grantees indicates that when collaborators were not Tanzanian, the publications were often derived from a PhD thesis produced outside Tanzania and the collaborators were former PhD supervisors or colleagues.

7.2.4 Number of grants

As expected, former grantees that received multiple grants subsequently produced more IFS supported publications. Only 3 of 12 research projects (completed) that were funded with one research grant resulted in publications. Meanwhile, 12 of 15 research projects that received renewal grants resulted in publications published, and 10 of those projects published 3 or more items. Does this mean that one grant is not very useful in Tanzania, or does it mean that IFS does a good job of supporting only the most productive grantees with renewal grants? While the answer may lie somewhere in the middle, it is difficult for unproductive scientists to continue with IFS support beyond the first grant given that renewal applications are rigorously reviewed by IFS Scientific Advisors.

7.3 Conclusion

Ranking 8th in Africa, Tanzania's scientific production is equivalent to a group of seven countries (including Algeria, Côte d'Ivoire, Cameroon, Ethiopia, Senegal and Zimbabwe) regularly producing between 70 and 200 papers a year. Yet relative to the size of its population, it lags behind other medium-size or large African countries in science publication. This is likely due to the difficulties reported in preceding chapters and the challenges that the science community faces in recruiting new scientists from among the country's youth. As is the case in research funding, mainstream science publication in Tanzania is highly dependent upon relationships with European and North American collaborators. International links represent both an opportunity and a risk; communication with international research communities is a potentially

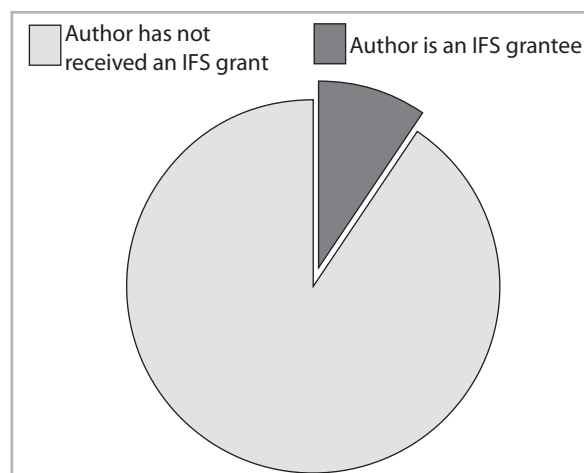


Figure 13
Authorship of mainstream journal articles from Tanzania and IFS grantees (1991-1997)

powerful means of boosting the productivity of a small national science community, but unequal relationships that evolve between unequal partners may lead to increased dependency.

In this chapter we see that the most common type of publication by Tanzanian scientists that have participated in the IFS programme is a co-authored journal article. Of these, a small majority are published in international mainstream journals, while the others are published in local journals. We also see that IFS support for research projects is credited for the production of, on average, slightly less than one-fifth of each scientists' publication record. This is a very positive result indicating that Tanzanian

grantees continue to be productive and to publish after the IFS support is terminated.

The publication trends among IFS grantees in Tanzania that are documented in this chapter suggest that IFS support has had a positive impact on the productivity of grantees. IFS grantees are, on average, among the most productive scientists in Tanzania. Furthermore, data from the 1990s suggest that Tanzanian grantees participate in the production of nearly 10% of all Tanzanian mainstream science publication. This is indeed a strong representation, given that less than one half of Tanzanian international mainstream publication occurs in research areas that are supported by IFS.

8. IFS research project completion

During the period 1974-2000, there have been 34 completed IFS research projects. Out of the 34 grantees conducting these projects, 22 were awarded one grant (64.7%), eight were awarded two grants (23.5%) and four were awarded three grants (11.8%).

Research projects are expected to have durations of between one and three years. In reality, however, the projects belonging to grantees in Tanzania tend to be longer. Of the 22 single grant projects, one was completed in two years and the remaining 21 were completed in a period of time ranging from four to eleven years (mean = 6.4 years). Grantees that received renewal grants were more often more timely in the completion of their projects, though some still extended far beyond the projected time period. The eight grantees with one renewal took between two and twelve years (mean = 6.6 years), and the four grantees with two renewals completed their projects after between eight and 15 years (mean = 11 years). The tendency for projects to exceed their expected duration, especially for grantees with a single grant, is not unique to Tanzanian grantees, but also extends to grantees in other regions (see Gaillard et al, 2001 and Gaillard and Furó Tullberg, 2001).

Box 10 Closing grantees' files:

Reasons for closing grants:

- Project was never started
- Project was completed with a final report
- Renewal application was not approved
- Project terminated (can be positive, eg the grantee received another grant, was promoted to another position)
- Project completed, no final report will be submitted by grantee
- Grantee is deceased
- Project transferred to another grantee

Several factors can explain why projects take longer than was initially projected (eg difficulty in obtaining supplies, administrative difficulties, difficult research conditions). In addition, the IFS staff prefers to close a grantees file upon receipt of a final report (see below). However, final reports are delinquent with some frequency, thus causing files to be kept open long after the actual project has been completed. A recent response to the problem from the IFS Secretariat is to further encourage grantees to submit a final report by offering them a diploma upon receipt and acceptance of a report, and also by initiating a mentorship program that will provide support for grantees to write an article for publication upon completion of their project. Such articles can in part substitute for a final report.

However, interviews made it clear that in several cases grantees had not submitted a final report, though he or she had published articles that could partially substitute for a final report. As was documented in Chapter 6, grantees live in a context where a scientists salary is insufficient for supporting a family, and where time must be wisely invested in activities that can contribute to earning a livelihood. Hence, it is likely that final reports are not sent to IFS because there is little incentive to spend time writing them.

There are several standard reasons for closing a grantees' file (ie "closing a grant") at the IFS Secretariat (see Box 10). In Tanzania, roughly one third of the grantees did not get their renewal application approved, another third completed the project and handed in a report, and the last third did not send in a report (Figure 25). The frequency of the latter is considered unsatisfactory by the IFS Secre-

| Reason for closing Tanzanian grants | Grants closed |
|-------------------------------------|---------------|
| Renewal application not approved | 12 |
| Closed without report | 11 |
| Completed with report | 11 |
| Total | 34 |

Table 25
Closed Tanzanian projects

tariat, and measures are being taken to reduce the number of files closed without a report.

Of the 12 renewal applications from Tanzanian scientists that were not approved, eight projects were not approved because the scientific approach was unsatisfactory (lack of innovation, unsound methodology). In four cases the applicant was judged to be too senior and established to qualify for further support.

Out of the 34 grantees in Tanzania that have had their files closed upon the completion of their project, 23 handed in a final report. Final reports to IFS are evaluated by the relevant Research Area's Scientific Advisory Committee (SAC). Quality assessments were available for 20 reports. As shown in Table 26, seven of the nine MSc-holders produced a report that was deemed satisfactory or good, while five out of nine PhD-holders performed as well.

Out of 20 former grantees that turned in a final report, four took their degree in Tanzania, and 14 elsewhere (Table 27). The ones having studied in Tanzania did not produce any poor reports, while half of the ones that studied abroad handed in poor reports. The sample examined is, however, very small, making generalisations difficult.

| Report quality | BSc | MSc | PhD |
|----------------|-----|-----|-----|
| Good | 1 | 3 | 2 |
| Satisfactory | 0 | 4 | 3 |
| Poor | 1 | 2 | 4 |
| Total | 2 | 9 | 9 |

Table 26

Quality of the final report by degree held at the time of the first grant

| Report quality | Tanzania | Abroad |
|----------------|----------|--------|
| Good | 2 | 4 |
| Satisfactory | 2 | 5 |
| Poor | 0 | 7 |
| Total | 4 | 14 |

Table 27

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

9. Grantee advancement and mobility

The MESIA Project is an important tool for IFS for keeping track of the activities of grantees following the completion of their IFS supported project. In this chapter the academic and professional advancement of current and former grantees in Tanzania is documented, as well as the circulation of grantees within Africa and further abroad. Information regarding the advancement and movement of former grantees is essential for the evaluation of the impact of IFS support on the careers of young scientists and for the strengthening of capacity in developing countries.

9.1 Academic progression

Information on the academic progression of 30 former grantees was available for this MESIA study (summarised in Figure 14). Two grantees remained at the level of BSc during their grant, nine at the level of MSc and 12 at the level of PhD (naturally the grantees holding PhDs when they applied could not earn a supplementary academic title). One grantee progressed from BSc to PhD during her IFS granting period (she was awarded three IFS grants), and six from MSc to PhD. After completion of the IFS grant, three grantees holding MScs were awarded PhDs. These are very positive achievements that can be attributed to IFS support to

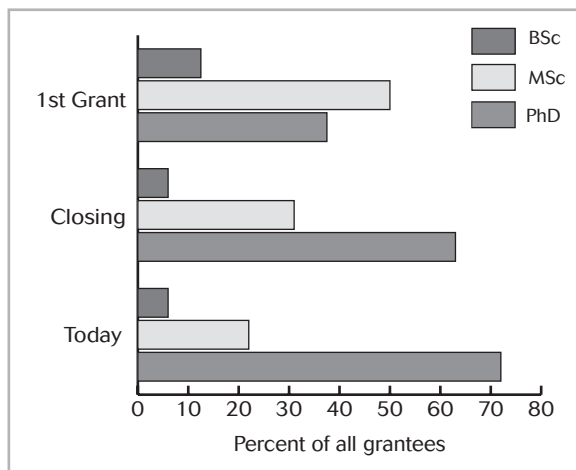


Figure 14
Academic progression of grantees

the extent that the academic degree were obtained based upon the IFS supported research projects.

Box 11

IFS grantees, science leaders

An explicit objective of the IFS Granting Programme is to identify and support promising young scientists that will likely become the science leaders of the future in their country. During the course of the MESIA Impact Study, correspondences, interviews and tracer studies revealed that IFS had been successful in this regard in Tanzania. Positions held now or in the past by IFS grantees included:

- Minister of Education and Culture, Tanzania
- Director of COSTECH
- Chief Academic Officer, University of Dar es Salaam
- Director of Postgraduate Studies, University of Dar es Salaam
- Dean, Faculty of Agriculture, Sokoine University of Agriculture
- Director General, National Museum of Tanzania
- Director, Tanzania Food and Nutrition Centre
- Director, Tanzanian Fisheries Research Institute
- Director, Agricultural Research Institute Mbeya
- Director, Livestock Production Research Institute, Mpwapwa
- Director, Agricultural Research Institute Uki-riguru
- Director, Miombo Afforestation Centre for Research in Environmental Sciences and Training (MACFOREST)
- General Manager of Tanzania Cotton Lint and Seed Board
- Country Liaison Officer, African Development Foundation
- Coordinator, Sustainable Cities Programme Tanzania

Three grantees have also reported post-doctoral visits. One grantee had two post-docs, one in Sweden and another in Kenya. The two other post-docs were carried out in Germany and Japan.

9.2 Promotion

IFS has been successful at identifying and supporting the scientists that later become science leaders in Tanzania. IFS support contributed to grantees being promoted to positions of leadership in universities, research institutes, and in at least one case, politics (see Box 11). An objective of the MESIA project, is to learn from grantees which factors are most important for advancing to positions of leadership.

The MESIA Questionnaire asked Tanzanian scientists to rate the importance of eight different criteria for the promotion of scientists in their country. Between seven and ten grantees at universities, and eleven grantees at research institutes answered the question. Some clear differences were apparent between the responses of these two groups. The differences are likely attributable to the differing missions of the two types of institution (see Chapter 2), and the different levels of education of the employees. As was discussed in Chapter 2, upwards of 60% of the staff at major universities in Tanzania hold PhDs, while less than 20% of staff at National Agricultural Research Institutes under MoAC do so.

Regardless of place of employment, award of research grants was generally considered an unimportant factor with respect to promotion (Figure 15). Publication in local journals was more often considered “very important” by grantees in universities than those in research institutes, but there was not a great deal of consensus within either group (Figure 15). Contribution to development (Figure 15) and contribution to the institution (Figure 16) elicited widely varying responses, but they were rarely regarded as “very important”.

Noteworthy differences are found in grantees’ rating of seniority, strategic social relations, publications in international journals and contribution to teaching. Seniority and strategic social relations were usually described as “not important” by grantees in universities, while at the same time regarded to be “very important” in research institutes (Figures 15 and 16). Meanwhile, university employees were nearly unanimous in declaring that publications

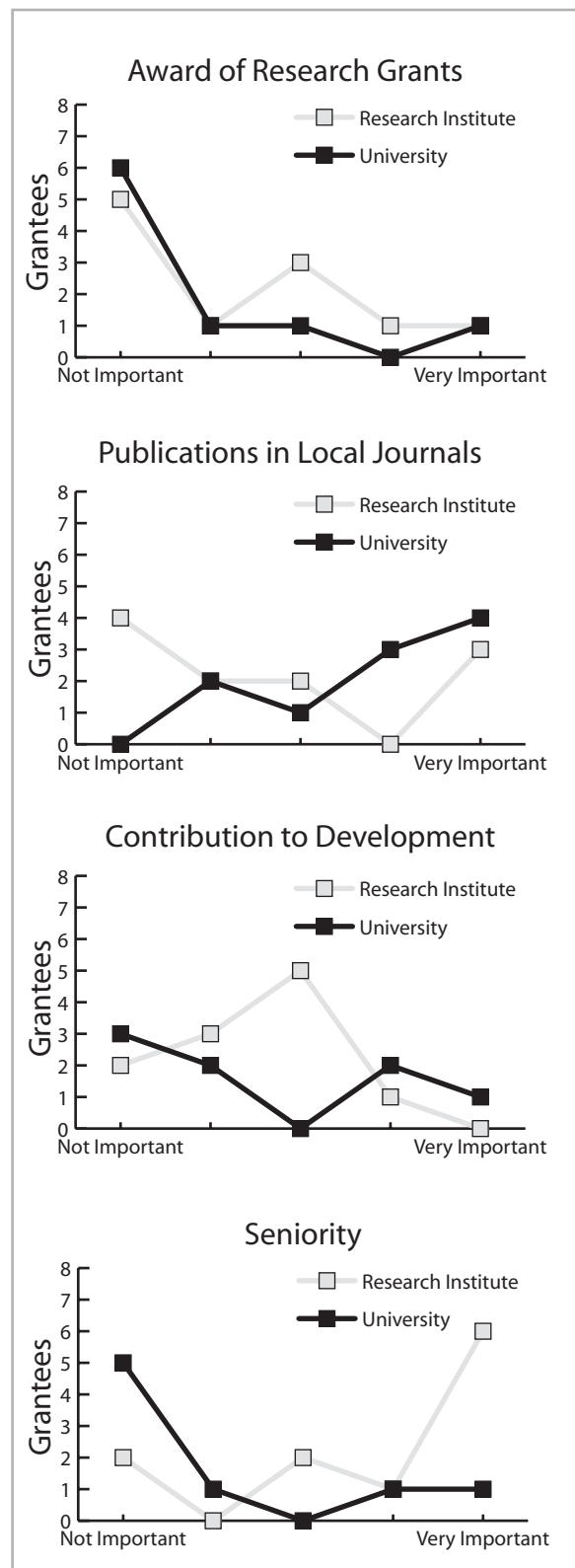


Figure 15
Importance of criteria for the promotion of scientists in Tanzania (part 1)

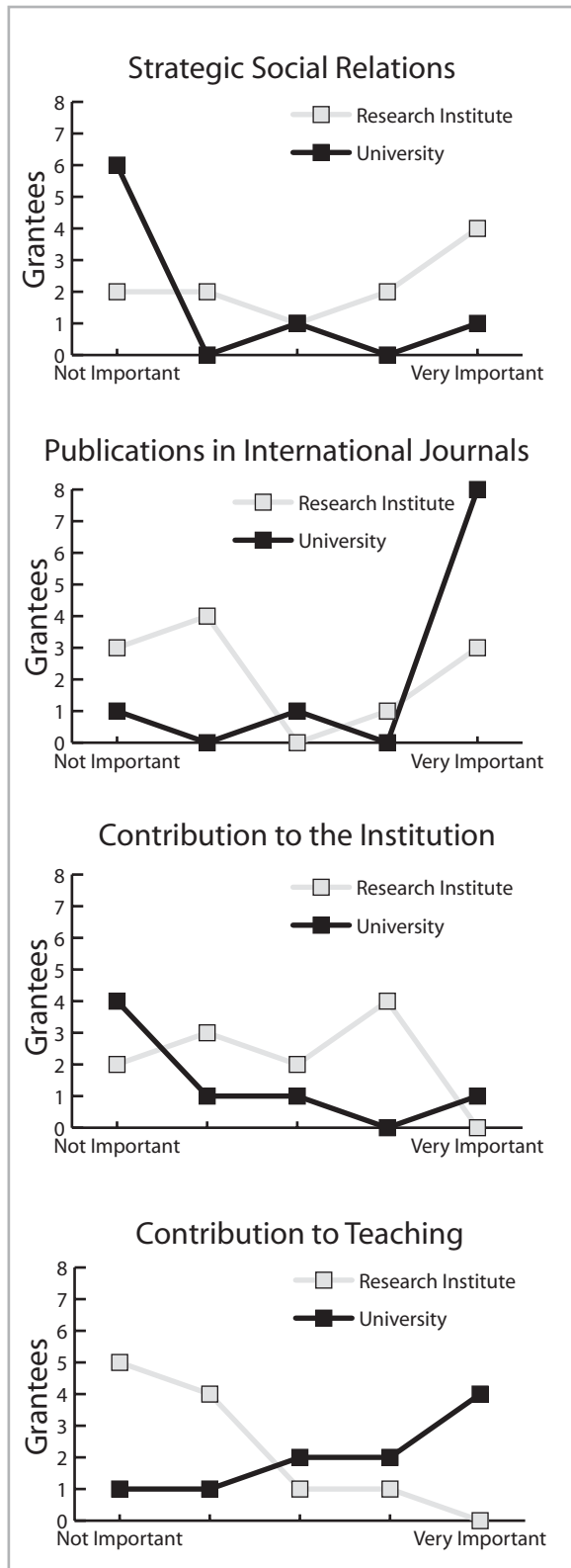


Figure 16
Importance of criteria for the promotion of scientists in Tanzania (part 2)

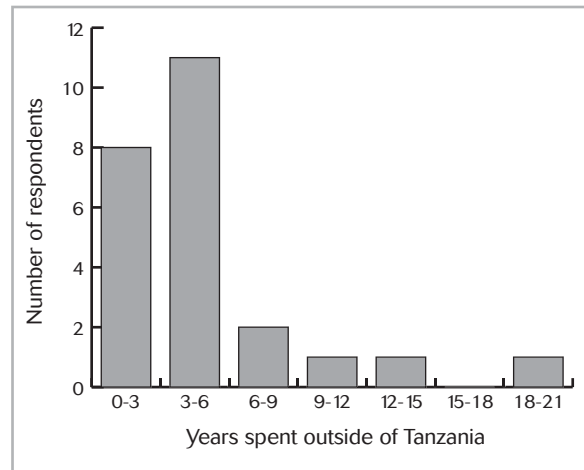


Figure 17
Years spent outside Tanzania for higher education and training

in international journals was “very important” and often believed that contribution to teaching was an important factor, while employees at research institutes were less likely to respond so positively (Figure 16).

9.3 Mobility

Questions 12 and 13 of the MESIA Questionnaire asked grantees to report on the amount of time that they have spent outside of Tanzania for higher education and training (including postdoctoral studies and academic visits), and the total time they have spent abroad for all reasons during their lifetime. Their answers reveal that Tanzanian grantees spend very little time outside of Tanzania for non-academic reasons. Grantees spent an average of 4.6 years abroad for academic reasons (see Figure 17 for the distribution), and 4.9 years abroad in total. This is almost identical to the figures obtained for IFS grantees in Africa as a whole (Gaillard and Furó Tullberg, 2001).

During the IFS grant period, grantees sometimes travel internationally for further training and education. Respondents to the questionnaire and interviewed grantees reported visiting foreign laboratories for periods of one month to one year. (four visits to Sweden, three to Denmark, two to Belgium and the USA, and one to Canada, Great Britain, the Netherlands and the Philippines). Five so-called “sandwich” PhDs coincided with IFS granting periods, two in Sweden, and one each in Great Britain, the Netherlands and the USA. Other PhD studies during the IFS grant have taken place in Germany, Nigeria, Norway, Sweden and the USA (two).

At the time that a grantee is conducting an IFS sponsored research project, they are expected to be attached to a university or research institution in a developing country. After completing their IFS research projects, grantees have found new positions both locally and internationally (see Box 12). The foreign jobs are usually still in Eastern or

Box 12

Regional circulation rather than brain drain

Capacity for the production and utilisation of scientific knowledge is understood by IFS to be one of the many prerequisites for local and regional development. Hence, one of the primary goals of IFS is to reduce brain drain by providing incentives and means for scientists to remain in their country and to contribute to the building of a critical mass of local scientific expertise. Of the 57 IFS grantees in Tanzania, nine left their country permanently or for a considerable portion of their scientific career. However, it is insufficient to classify all nine cases as cases of brain drain. It is easily argued that most of these individuals are not examples of brain drain, but in fact have circulated regionally. Furthermore, these latter individuals became science leaders for other developing countries, and in most cases for Southern Africa. The list below indicates where the nine grantees went, and, when the information is available, what positions they held in those places.

1. International Center for Agricultural Research in the Dry Areas (ICARDA), Syria
University of Nebraska, USA
University of Tennessee, USA
2. Canada
USA
University of Liège, Belgium
3. Saudi Arabia
Returned to Tanzania
4. Namibia, University of Namibia, Pro-Vice Chancellor for Academic Affairs and Research
Namibia, UNDP/UNOPS Regional Project Coordinator
5. Namibia, University of Namibia, Dean of the Faculty of Science
6. Malawi, Southern Africa Root Crops Research Network, Coordinator
7. Malawi, SADC/GEF/Biodiversity Conservation Project
Returned to Tanzania
8. Zambia
9. Zimbabwe, Zimbabwean Department of Research and Specialist Services, Director

Southern Africa. We know of Tanzanian grantees taking positions in Ethiopia, Kenya, Malawi (two), Namibia, Zambia and Zimbabwe (see Box 13). Other countries where grantees have found work include India, Saudi Arabia, Syria, Canada and the USA (two). As is noted in Chapter 6, the reasons for moving are often related to low salaries and dissatisfaction with the opportunities for research. The feelings expressed by one grantee in a conversation with an IFS staff member, are probably not uncommon. The grantee explained that he:

“feels he is overworked with teaching and administration and has very little time (and reward) for conducting research. The lack of young scientists in his department is a limiting factor, and to face the heavy teaching load, the University has to find part timers. He is more and more thinking of leaving the university, but has not yet decided. He would consider working for an international NGO where he already has contacts, but he is worried that he would permanently lose his position at the university.”

For grantees that remain in Tanzania, it should be noted that circulation between the different centres under the Ministry of Agriculture seems to occur quite frequently (at least five cases), often disrupting the grantees' work. Meanwhile, grantees employed at the university tend to remain there.

A small but tangible number of IFS grantees, while remaining in Tanzania, have accepted employment opportunities offered by foreign foundations, NGO or international organisations or created their own consultancy firms (see Box 14). This perceptible

Box 14

Professional changes within Tanzania

Parastatal Organisation:

General Manager of Tanzania Cotton Lint and Seed Board

NGOs

Country Liaison Officer, African Development Foundation (ADF)
Sustainable Cities Programme, -Tanzania

Development Project:

Livestock project funded by Austria

Consultancies:

Consultant (biodiversity)
Consultant, UNICEF
MACFOREST

Box 13
Being an African

Although a resident in Namibia, Prof Mshigeni considers Tanzania as his permanent home. He cannot think otherwise: "You see, Tanzanians are very much tied to their homes. You will be surprised, I have not even applied for permanent residency in Namibia, even though I own a house here, as I do in Tanzania. I think of myself as a permanent resident in each African country. Therefore I feel I don't have to apply for permanent residency. I am African. Africa is mine! For many years now I have been thinking that way, in the context of our entire continent. I am encouraged by what our African Governments are continuing to say: African unity. I have, for example, both a Tanzanian Passport and an East African Passport. I wish we had an OAU Passport too! That is coming, but perhaps not in my lifetime".

Prof Mshigeni goes to Tanzania about four times a year. "It is very close to Namibia", he said, and he does not feel he has left Tanzania: "with e-mail connection, the distance between Tanzania and Namibia has collapsed into nothingness. I think all our scientists should have a sense of belonging to all our African countries. In my mushroom drive for Africa for example, through the UNDP grant, I shall use mushroom experts from Ghana, Zimbabwe, Tanzania, Ethiopia, etc, bringing them together, to have a common vision towards disseminating the technologies to all our people, in various countries. If we think of Africa that way, we almost have the critical mass we need to change Africa. I am sensitising African Governments to give us matching funds, to supplement what UNDP is giving. I want to show what commitment, determination, and clear goals can do with appropriate financial support".

trend is characteristic of what we found elsewhere in Africa (Gaillard and Furó Tullberg, 2001). It suggests that, while scientific research has not disappeared, its mode of production is being radically altered with a progressive shift from academic research to consultancy and development. While just a few IFS grantees do it on full time employment basis, interviews suggest that many of them are employed on a part-time contract basis and more sporadically by development institutions, small NGOs and consultancies.

9.4 Conclusion

This chapter points to key differences between grantees working at Tanzanian universities and Tanzanian research institutes. At the former publication and teaching are highly valued as benchmarks justifying promotion. Meanwhile, at research institutes social relations and seniority were more important.

This chapter also shows that Tanzanian scientists that have participated in the IFS small grants programme are mobile, both in terms of professional promotion, professional changes and international

circulation. Of 18 grantees that could attain a higher degree, seven did so as grantees and three did so following the completion of their IFS sponsored research projects. Grantees also went abroad with frequency for the purpose of studying, completing a post-doctoral position, or for employment. On average grantees reported spending over four years abroad for training and education. While grantees reported time spent in both developing countries and rich industrialised countries, they more often went to the latter for education and less often for employment.

Overall, it is an encouraging result that very few grantees are true cases of "brain drain". Out of 55 grantees, seven had left and remained outside Tanzania and of those only two had left Africa (USA and Canada). The remaining five are part of a regional circulation of scientists, and are located mainly in Southern Africa. Most of these grantees have kept strong links to Tanzania. While supporting grantees to become established in their early careers as scientists in Tanzania, it is believed that IFS support was a contributing factor explaining why most Tanzanian grantees are still active in the Tanzanian scientific community today.

10 Factors constraining research and an assessment of IFS support

It is essential for the success of IFS that the organisation has an understanding of what the needs of grantees in Tanzania 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' own evaluation of the difficulties that they face while conducting scientific research in Tanzania, and their evaluation of the quality of the support that IFS provides. Results are based upon both the questionnaire survey and interviews of grantees.

10.1 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 sixteen categories (n=69) and one miscellaneous group (n=5). Figure 18 shows that lack of funding, equipment constraints, lack of time, and lack of library facilities and lack of transportation were the most important constraints limiting grantees' research in Tanzania. One should note that grantees usually

attributed their lack of time to too many teaching or administrative tasks.

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). Figures 19 and 20 on the following page display the results.

The most serious and obstructive obstacles to grantees' research are largely related to the availability of equipment (see Equipment Repairs, Purchasing Equipment, and Access to Equipment in Figure 20). The availability of technicians and time (in contrast to the findings above) were much less often prohibitive constraints.

10.2 Relative importance of IFS support

In an effort to understand the importance of IFS support to grantees' research, they were asked to indicate whether or not they would have been able

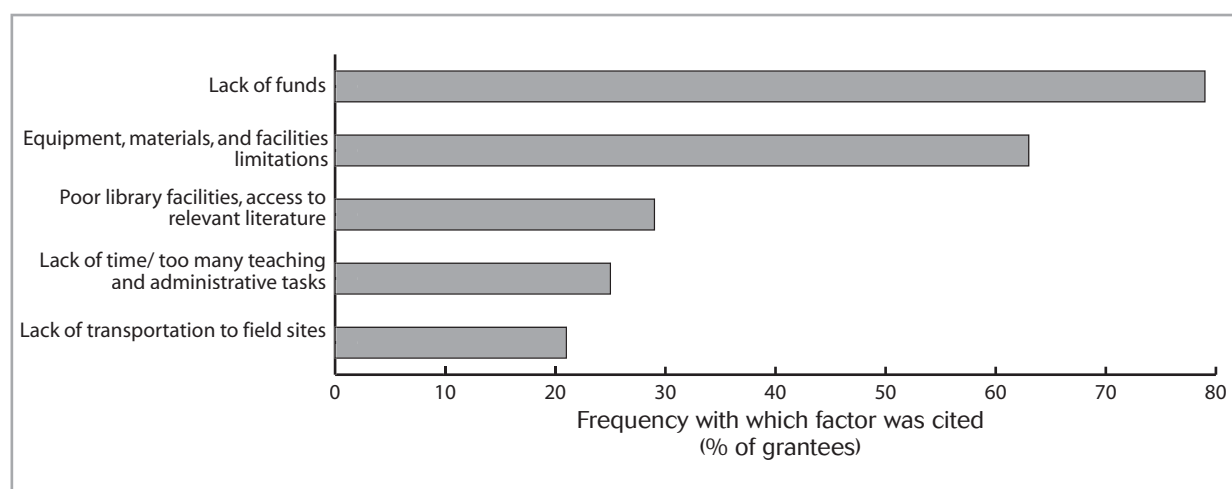


Figure 18
Factors most limiting grantees' research in Tanzania (Q35)

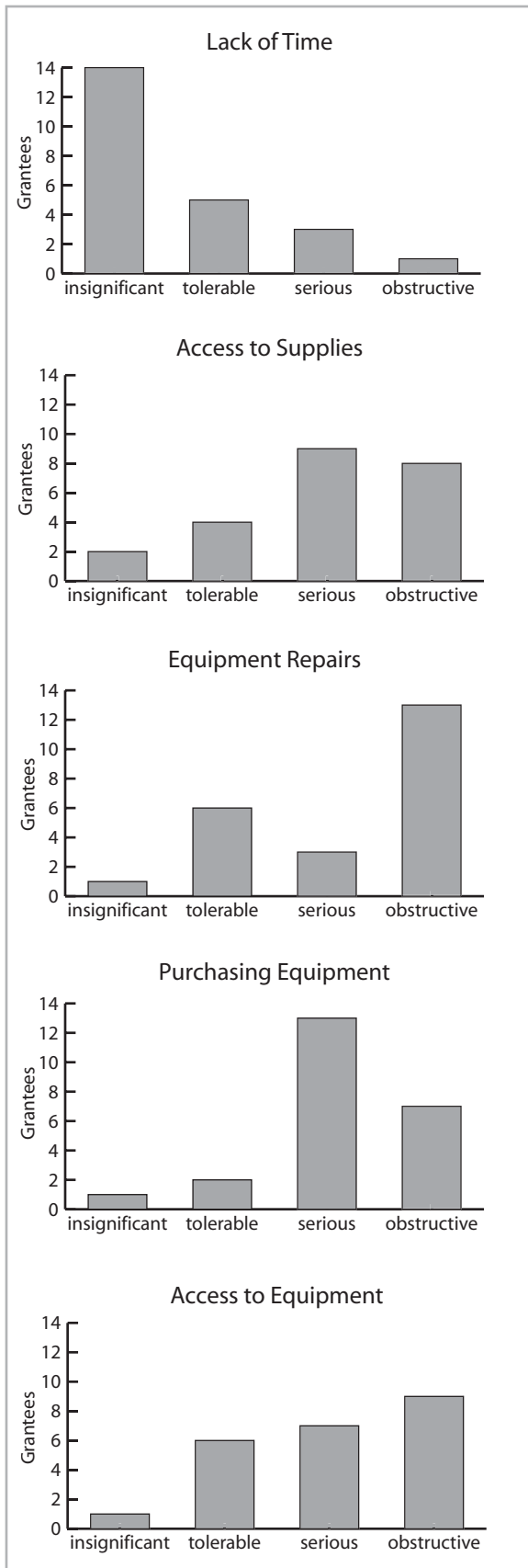


Figure 19
Obstructiveness of specific difficulties to grantees in their work as researchers (part 1)

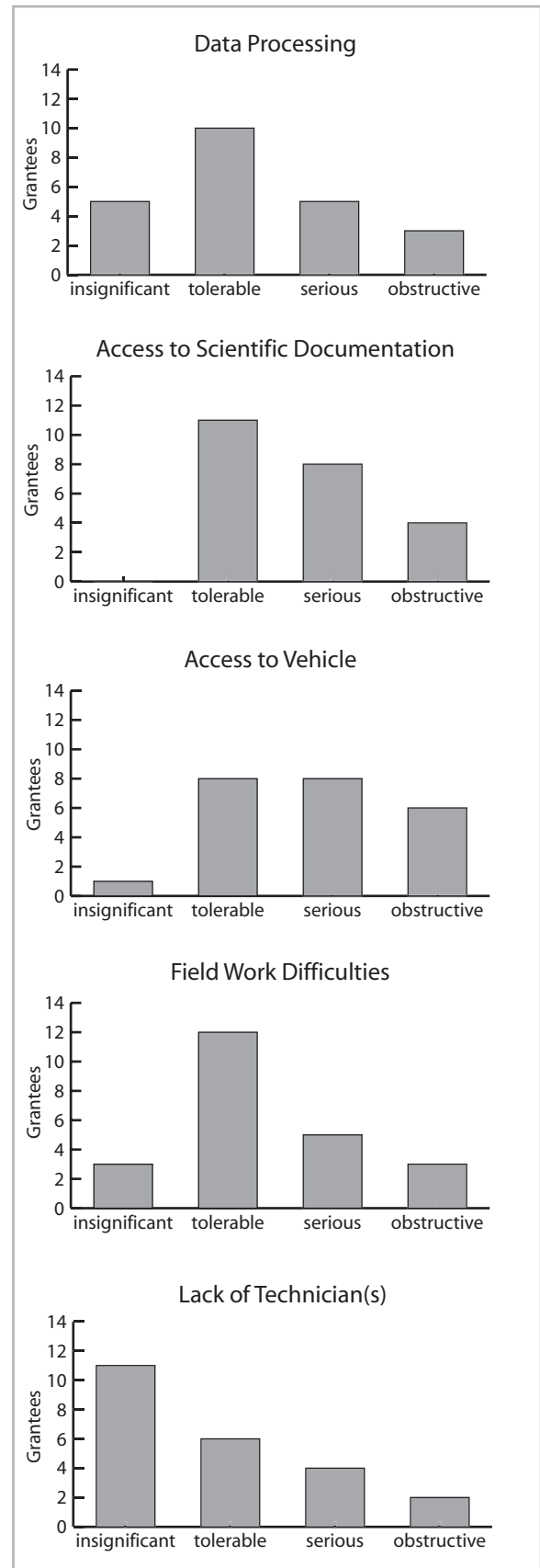


Figure 20
Obstructiveness of specific difficulties to grantees in their work as researchers (part 2)

to continue their research without IFS funding. Most of the respondents (13 of 22) would not have been able to carry out their research without the support of IFS (Figure 21). The remaining respondents would have been able to carry out research, but not on the same scale, or in the same form. These responses illustrate a situation much different than in other countries and regions. In Mexico, only 16% of grantees responded that without IFS support they would not have been able to carry out their research (Gaillard et al, 2001). In Africa in general, only 23% were dependent upon the IFS support to carry out their research (Gaillard and Furó Tullberg, 2001). In Tanzania, rather than playing a catalytic role (as in Mexico where IFS support helped to shape and improve projects, but was not a prerequisite for carrying out research), IFS support is of primary importance in determining grantees' opportunities to carry out research. This finding further supports the description in Chapter 3 of Tanzania's scientific community as dependent on foreign 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 most grantees in Tanzania, it appears that IFS does have a positive effect on funding opportunities. Of 21 respondents, only three reported that it did not become easier to find research support following their IFS grant. Ten reported that it had

become easier to find support from their institution. Five found it easier to access national support, and eleven found it easier to access international research support. Eighteen of 22 grantees reported that it had become easier to obtain scientific and technical assistance from their institution.

The provision of networking opportunities is a form of support that IFS values highly, but is difficult to quantify for donors and evaluators. Thus it is encouraging that 22 of 23 respondents believed that IFS had provided them with new opportunities to collaborate with new scientific partners, and all thirteen former grantees responded that they had continued to collaborate with those partners after the conclusion of their grant from IFS. The following grantees' evaluation of IFS support in this regard was typical:

"The research grants that I received from IFS played a very critical role in my career advancement. IFS grants gave me a very good foundation by introducing me to key researchers who motivated my progress, from them I could see the new possibilities on how and how far I can reach. I learned a lot from the interaction. I was able to attend international meetings and make presentations, in these I met more researchers and gained confidence over time."

10.3 An assessment of IFS support

To assess the IFS mode of work and support, grantees in Tanzania 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: unacceptable (1), poor (2), satisfactory (3), good (4), or excellent (5). Though some of the activities are not directly central to the mandate of IFS (eg assistance in the publication of research results³⁵) and some have been discontinued (eg maintenance of research equipment³⁶), the comparison of the different activities can help to identify activities that deserve strengthening and areas that are problematic for grantees.

Grantees scored IFS highly in almost all categories, and dissatisfied grantees were very few (see Figure 22 and Table 28). Categories that scored very high, with ten or more commenting that the service was

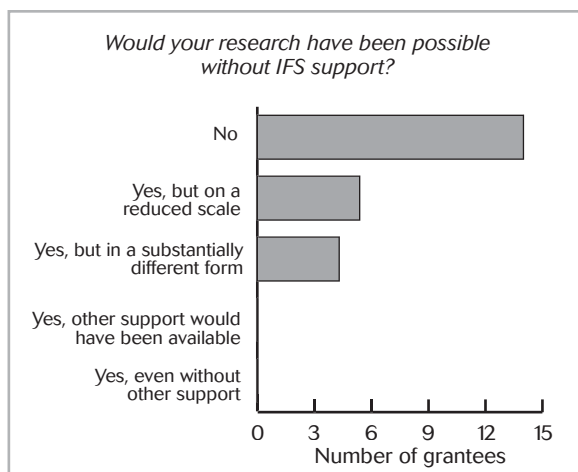


Figure 21
Importance of IFS support to grantees' research

35 This supporting service is, however, being instated following the conclusions and recommendations of earlier MESIA Reports.

36 Reinstatement of this supporting service is currently under consideration, partially in response to information obtained through MESIA.

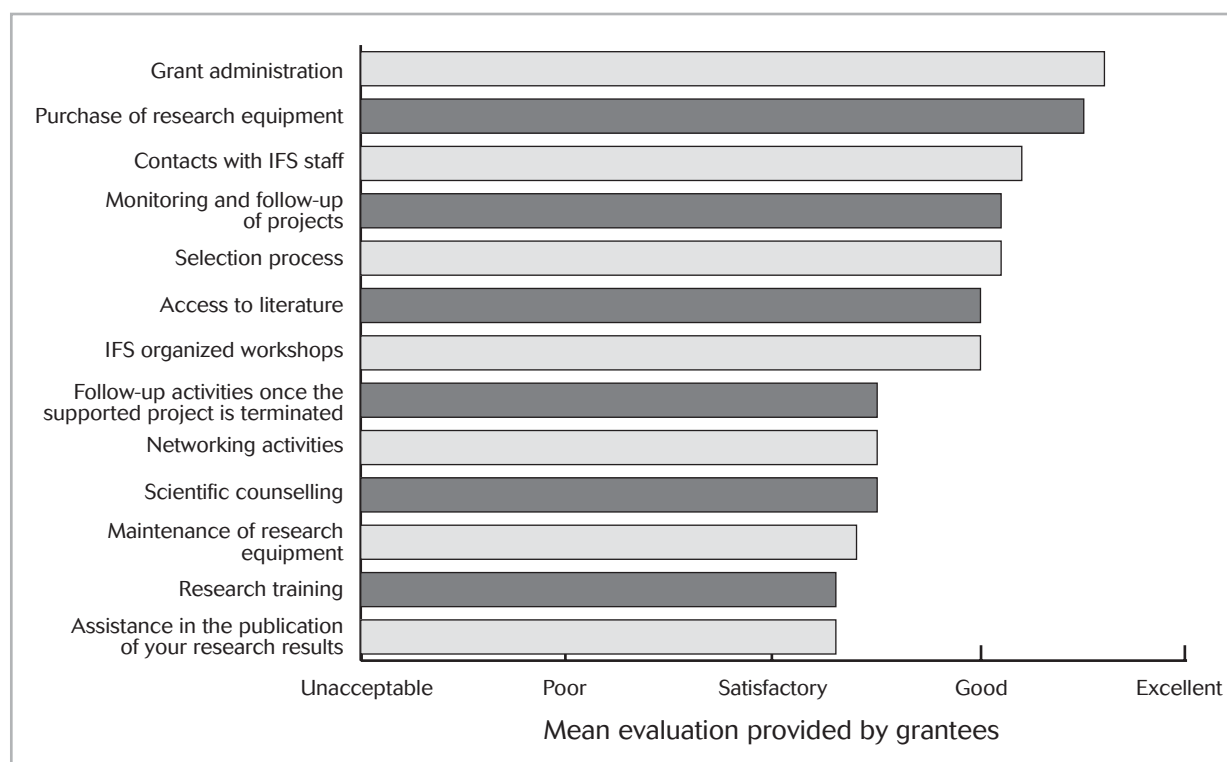


Figure 22
Grantees' mean assessment of the IFS mode of work and support (Q55)

| Services | No. of Grantee Responses | | | | |
|---|--------------------------|------|--------------|------|-----------|
| | Unacceptable | Poor | Satisfactory | Good | Excellent |
| Grant administration | 0 | 0 | 3 | 4 | 16 |
| Purchase of research equipment | 0 | 0 | 2 | 7 | 14 |
| Contacts with IFS staff | 1 | 1 | 4 | 4 | 13 |
| Selection process | 1 | 1 | 4 | 6 | 11 |
| IFS organized workshops | 1 | 2 | 2 | 7 | 10 |
| Access to literature | 0 | 1 | 4 | 10 | 8 |
| Monitoring and follow-up of projects | 0 | 0 | 5 | 8 | 8 |
| Follow-up activities once the supported project is terminated | 1 | 3 | 7 | 1 | 7 |
| Networking activities | 1 | 2 | 10 | 3 | 6 |
| Scientific counselling | 1 | 2 | 8 | 6 | 4 |
| Research training | 1 | 4 | 6 | 7 | 3 |
| Maintenance of research equipment | 0 | 4 | 7 | 6 | 3 |
| Assistance in the publication of your research results | 2 | 2 | 6 | 6 | 3 |

Table 17
Grantee assessments of the IFS mode of work and support (Q55)

excellent included “grant administration”, “selection process”, “contacts with IFS staff”, “purchase of research equipment”, and “IFS organised workshops”. While no category was less than satisfactory for the majority of grantees, some complaints regarding “maintenance of equipment”, “research training”, “assistance in publication of research results”, and “follow-up activities once the supported project is terminated” draw attention. These are also issues that arose in a recent external evaluation of IFS (Thulstrup et al, 2001), and to a large extent are already being addressed by the IFS Secretariat (see IFS Medium-Term Strategic Plan 2002-2004, available at www.ifs.se).

10.4 Conclusion

Grantees’ responses make a strong case for the continuation of IFS support in Tanzania. The questionnaire study indicates that the majority of grantees would not have been able to conduct research without the IFS grant, IFS support strengthened grantees’ position within their own institution, and it made them more effective at finding subsequent funding. Grantees’ evaluation of IFS funding was very positive. Services that received mixed evaluations (eg assistance in the publication of research results) are the same services that are being reviewed and strengthened by the IFS Secretariat.

11 Science, society and grantees' career goals

How do grantees in Tanzania value science, and how do they perceive their role in society? How do they evaluate the Tanzanian government's attitude towards research, and what are their future career goals? Using information obtained from the questionnaire study and interviews with grantees in Tanzania, this chapter attempts to briefly answer these questions.

Grantees in Tanzania were given 11 statements concerning the role of science and scientists in society and were asked to assign a score from 1 (meaning that they disagreed completely with the statement) to 5 (indicating complete agreement) to each statement. Table 29 summarizes their responses. Grantees were in overwhelming agreement with the statement: "science contributes to development". The work of Prof Keto Mshigeni, an early IFS grantee and now an IFS Scientific Adviser, is an example of the role that science can play in national development (see Box 15).

That science leads to development had much more support than the statement that "science should firstly produce knowledge". Grantees responses indicate that most believe primary responsibility for setting research agendas lies with clients and researchers themselves. The only statement to provoke strong disagreement from a large group of grantees was that "research topics are set by sponsors".

Despite the difficulties encountered by researchers in Tanzania, 13 of 24 responding grantees have a national scientific career as their career goal (see Figure 23). In comparison, only 43% of grantees in Africa as a whole reported that they would pursue a national scientific career as their career goal. Meanwhile, in Mexico, a country with a strong incentives programme for researchers, 83% chose this as their career goal.

| Value Statements | No. Grantees responding: | | | | | Mean |
|---|--------------------------|---|--------------|---|------------|------|
| | Disagree 1 | 2 | Neutral 3 | 4 | Agree 5 | |
| Science contributes to development | 0 | 0 | 0 | 2 | 22 | 4.9 |
| Scientific knowledge is universal | 0 | 2 | 1 | 7 | 13 | 4.3 |
| Science is public knowledge | 1 | 0 | 4 | 3 | 13 | 4.3 |
| Science should mainly lead to useful innovation | 2 | 2 | 0 | 6 | 14 | 4.2 |
| Research problems are set by clients | 2 | 0 | 6 | 6 | 9 | 3.9 |
| Researchers are free to choose their own research topics | 2 | 1 | 6 | 5 | 10 | 3.8 |
| Science should firstly produce knowledge | 1 | 2 | 8 | 2 | 10 | 3.8 |
| Researchers should have entrepreneurial and managerial skills | 1 | 4 | 2 | 8 | 8 | 3.8 |
| Researchers should produce goods for a competitive market | 1 | 3 | 10 | 3 | 7 | 3.5 |
| Research topics are set by sponsors | 10 | 3 | 5 | 3 | 3 | 2.4 |
| Research topics are set by employers | 6 | 5 | 11 | 1 | 0 | 2.3 |

Table 18
Grantee responses to eleven value statements (Q34)

37 Interestingly, Chapter 9 shows that contribution to development is not an important criteria for the promotion of scientists in Tanzania.

A national scientific career goal is followed by careers with foreign or international organisations and with national development programmes. The former was much more common in Tanzania than it was in Africa in general, where less than 3% of grantees report such a goal (Gaillard and Furó Tullberg, 2001). One grantee that had already moved to an internationally funded NGO explained his decision as “mainly due to low salary (USD 70), shortage of funds for research,” and as a result idleness that has a negative effect on ones skills and competence. At the NGO he now earns USD 600 per month and has the financial resources he needs to pursue his research. The relative importance of careers in national development programmes is complementary to grantees’ belief that science should contribute to development (see above).

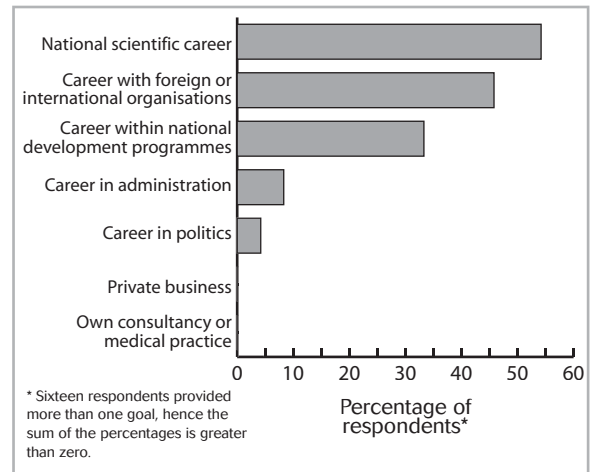


Figure 23
Future career goal of IFS grantees

Box 15

Science for development: the Tanzanian seaweed industry

Keto Mshigeni was born in the Kilimanjaro region of Tanzania at 1600 meters above sea level, and grew up in a farming family far from the coast. Hence, there was little reason to suspect that Mshigeni would eventually become one of the founders of Tanzania's modern seaweed industry.

Nevertheless, the magnetism and dynamism of a professor of phycology, the late Professor Erik Jaasund, at what was then the University of East Africa, led Mshigeni to the sea and a keen interest in aquatic plants. Towards the end of his BSc studies, he learned that Tanzania's coastal village communities were harvesting and exporting species of the seaweed genus *Eucheuma* to France, Denmark, and the United Kingdom, and that in Europe the seaweed was boiled to extract a gel (carrageenan) with a wide range of industrial applications. However, the harvest of this natural resource was unsustainable due to the destructive methods employed by harvesters on the Tanzanian coast.

With the help of a Rockefeller Foundation Scholarship in 1970, Mshigeni went to the University of Hawaii to begin PhD work on *Hypnea*, a seaweed genus that is found in both Hawaii and Tanzania. The choice of *Hypnea* was an interesting one because the taxonomy of the genus was in a being debated, the ecology and the population dynamics were little understood, and its phycocolloids were not yet characterised.

Upon returning to Tanzania with a PhD in 1974, Mshigeni decided to return his focus to *Eucheuma*. A search for funding resulted in an application to the International Foundation for Science and, in 1976, he received his first grant. The project, Research on potential sources of the industrial phycocolloids agar, carrageenan and algin in Tanzania, led to the determination of phycocolloid yields in a wide variety of Tanzanian seaweed, and to the generation of valuable information on their biomass and ecology.

On the basis of the findings emanating from his funded research, Professor Mshigeni was able to secure a research grant from the US Agency for International Development that enabled him to publish a seaweed farming manual in Kiswahili to train extension workers and to establish pilot *Eucheuma* aquaculture projects in three Tanzanian villages. During implementation, Mshigeni also benefited from financial support from a number of commercial enterprises in Tanzania and in the Philippines. This work laid the foundation for today's seaweed industry in Tanzania. With export earnings of over USD 10 million and employment for more than 40,000 Tanzanians (mostly women), seaweed aquaculture has significantly alleviated poverty along the Tanzanian coast.

The success of Mshigeni's work has earned him honours that included the CIBA-GEIGY/African Academy of Sciences Prize for Agricultural Biosciences and the Boutros Boutros Ghali Prize. His success has also meant that Mshigeni continues to be a dynamic force in science, education, and development in Africa. After serving as the Founding Director of Postgraduate Studies at the University of Dar es Salaam and establishing sustainable postgraduate programmes, he assisted in the planning of the Faculty of Agriculture and Natural Resources at the University of Namibia. Mshigeni remained in Namibia and became Pro-Vice Chancellor for Academic Affairs and Research.

More recently, Mshigeni became involved in the Zero Emissions Research Initiative (ZERI) and he is now the founding UNESCO/UNU Chair for promoting the zero emissions concept in Africa. ZERI analyses materials that are usually discarded as waste, often polluting the environment, with the aim of transforming them into new, value-added products.

12. Conclusion and recommendations

The history of higher education and research institutes in Tanzania is of a recent origin. The first university, the University College in Tanganyika, was established in 1960, one year prior to independence from the United Kingdom. The first national effort to co-ordinate research and development came soon after, with the establishment in 1968 of the Tanzanian National Science Research Council (UTAFITI).

Today there are three public universities and an increasing number of private universities in Tanzania as well as a large number of research institutes that are either affiliated to COSTECH and/or the sectorial ministries (primarily Agriculture and Health). The relative wealth of physical facilities and the strong core of well-trained researchers that exist in Tanzania are a valuable resource for the country that can be used to further scientific and economic development. The availability of these resources has made it possible for Tanzania to maintain and even increase its position relative to other African science communities in recent years. Nevertheless, as will be discussed in the following paragraphs, scientific capacity in Tanzania is still underutilised and threatened by a persistent lack of resources to maintain, renew and improve both physical resources and human capacity.

With an estimated total population of 20,000 students in institutions of higher learning in the year 2000, Tanzania has a low student enrolment given its physical facilities and the number of teaching and supporting staff. Productivity as measured by the number of publications in mainstream journals is also low given the size of the national scientific community. Furthermore, the existing productivity is highly dependent on international collaborations. Meanwhile the impact of research activities on development has so far remained limited. Recent strategic plans, however, advocate a more client oriented role for the universities and the research institutes, acknowledging at the same time

the need to better link research to the development and transfer of technologies.

Despite recent reforms aiming at reorganising and improving the situation both in the higher education and the research institutes sectors, a general feature of the Tanzanian S&T system remains the lack of national financial resources resulting in deteriorating facilities, insufficient and poorly maintained scientific equipment, a sharp reduction in the number of scholarships, freeze on recruitment during the 1990s, under-paid staff and, overall, marginal activities in the field of research. Funding from the Tanzanian government for S&T activities is approximately 0.22% of GNP; it is exhausted once the (very low) salaries and other related costs are paid. Without external financial support and numerous microprojects, very little research would be conducted in Tanzania. This dependency upon foreign funding in Tanzania is one of the highest in Africa.

The inadequacy of national funding also affects the Tanzanian scientific community by causing changes in the modes of scientific production and the characteristic of scientific professions. Although the Tanzanian scientific community can be characterised as relatively highly trained (a high proportion of scientists have a PhD, particularly in universities), its critical ageing due to the lack of recent recruitments seriously threatens the renewal of Tanzanian science capacity. Given the low salaries, Tanzanian research scientists are unable to survive on their salaries alone. They derive a large share of their disposable income from various allowances and activities, among which farming, business, and increasingly, consultancy activities are important. Not surprisingly, internal mobility (for better-paid positions outside the national research system) and regional mobility (mainly to neighbouring countries or countries of the SADC region) is important. These are all factors that likely con-

tribute to low overall research outputs in a country with a well qualified core group of scientists.

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 Tanzanian scientific community today. Thus, the results obtained should be of interest not only to IFS but to anybody who is interested in the development and the strengthening of scientific activities in Tanzania, in particular, and in the developing world in general.

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

In the following section some of the main findings of this report are highlighted, followed by a second section that puts these findings in perspective and discusses the extent to which they call for an adaptation and revision of the IFS mode of work in Tanzania.

12.1 Highlights of the main findings

Tanzania was one of the very first countries to be visited at the inception of IFS activities in the mid 1970s. Soon afterward, the Tanzanian National Science Council (UTAFITI) joined as a member organisation, the first IFS research grants for Tanzanian scientists were approved, and the first President of UTAFFITI, the late Professor Chagula joined the IFS Board of Trustees. The University of Dar es Salaam (UDSM), the only fully-fledged university at that time, proved to be very active and highly successful as an IFS grant recipient during the first decade of IFS activities. In the more recent past, nearly 30% of all applications for IFS support have been submitted by researchers from the Sokoine University of Agriculture (SUA), closely followed by research institutes from the Ministry of Agriculture. During the last decade, the success rate of applicants from Tanzania (19%) has been slightly greater than that for Africa (15%) and Asia (17%), but lower than that for Latin America (30%). During the same period, applications were received from scientists in not less than 45 Tanzanian institutions. Overall, success rates, impacts and outputs were found to be higher at the main institutions that have a critical mass of scientists (eg UDSM, SUA, COSTECH

research institutes, Mpwapwa Livestock Production Research Institute) than the smaller, more marginal and isolated institutions.

12.1.1 Impact of IFS support

We can conclude that IFS had a number of positive impacts on the careers of its grantees in Tanzania. The publication trends among IFS grantees in Tanzania suggest that IFS support has had a positive impact on the productivity of grantees. IFS grantees are, on average, among the most productive scientists in Tanzania and contributed during the 1990s to a sizeable share of all Tanzanian mainstream science publications. Results from the bibliometric study also show that they continue to be active as scientists and to publish after IFS supported research projects are completed.

IFS also contributed significantly to the academic progression of Tanzanian grantees to the extent that advanced academic degrees were largely based upon the IFS supported research projects. Interviews also confirmed that, in several instances, IFS also had a positive impact on the institutional promotion and contribution to the internationalisation of the careers of the grantees, and opened doors to additional funding opportunities. In a few cases, we were also able to show that IFS support led to significant economic development, as in the case of seaweed cultivation in Zanzibar. Lastly, it is believed that IFS support contributed to the grantees' establishment as scientists in Tanzania, thus contributing to reducing the likelihood of brain drain.

12.1.2 Mobility and brain drain

International mobility for research training and higher education is high in the population of IFS grantees in Tanzania, but most of them returned home immediately or very soon after they received their highest degrees. The decision to get established and remain in Tanzania cannot, of course, be attributed to one factor only. However, we strongly believe that the IFS support was a contributing factor explaining why most of the IFS grantees are still active in Tanzanian scientific community today, 28 years after the first grant was given to a Tanzanian scientist. A tangible number, while remaining in Tanzania, have however moved from academic research to consultancy and development-oriented contract-based positions on a full time

or part time basis. Out of 55 grantees, seven had left and remained outside Tanzania, and of those only two had left Africa (USA and Canada). While the latter two are clear cases of "brain drain", the remaining five are part of a regional circulation of scientists, and are located mainly in Southern Africa. Furthermore, most of them have kept strong links to Tanzania and may eventually return.

12.1.3 The IFS grant and overall research funding

As shown in chapter three, national investment in S&T activities is at a very low level in Tanzania and, without foreign support, Tanzanian universities and research institutes could support very little research. Although a number of national research grant schemes have been recently established, most of them are experiencing severe budgetary constraints and their impact, so far, remains limited.

To the extent that the eligibility criteria can be fulfilled (in particular age criteria - see below), an IFS grant remains a very attractive and necessary source of research funding for Tanzanian scientists. As illustrated during the interviews, the IFS grant does also constitute a valuable catalyst not only for the establishment of the IFS grantees' careers, but also for attracting additional funding.

12.1.4 The IFS grant and other support

Lack of (or difficult access to) funding, equipment, transportation and scientific literature are reported as being among the most important constraints to grantees' work in Tanzania.

Meanwhile, the majority of grantees in Tanzania reported that IFS support was a necessary enabling factor for their research activities. Nevertheless, the impact study carried out in Tanzania highlighted a number of activities that need to be strengthened or reactivated. Most of these activities are related to scientific training, counselling and networking, purchasing and maintenance of research equipments, access to information including scientific publications, as well as follow up activities including the assistance with publication and implementation of research results (see section 12.2).

12.2 Revisiting IFS work in Tanzania

The results and discussion presented in this study suggest several revisions of the IFS mode of work. Some issues have also been extensively discussed within the IFS Secretariat and at several IFS governance meetings. They are presented below.

12.2.1 Establishment of a Tanzanian association of IFS grantees

Accumulated experience shows that former IFS grantees can play a very significant promotional role for IFS, assist potential applicants to prepare good quality research grant applications, and contribute overall to improved follow-up and networking activities. Priority will be given during the present Medium-Term Strategic Plan (2002-2004), to establish national associations of IFS grantees in countries, such as Tanzania, participating in the IFS Regional Initiative for Sub-Saharan Africa.

Discussions have been initiated with former IFS grantees at UDSM and it is foreseen that a Tanzanian Association of IFS grantees will be created in early 2003.

12.2.2 Age criteria

Very few recruitments took place in the public sector in Tanzania during the 1990s, thus threatening the replacement of the ageing Tanzanian scientific community. As a consequence, it is already difficult to find potential applicants below 40 years age in Tanzania. During the field trip carried out in Tanzania for this impact study, several information seminars were given at universities and research institutes. With a few notable exceptions, all scientists participating at these seminars were more than 40 years old. On average, the age of postgraduation is also often postponed due to the scarcity of fellowships and it is more and more frequent that Tanzanian scientists are getting their PhD (and even sometimes their MSc) after 40 years of age.

This calls for a more flexible interpretation of the age limit. This was discussed at several IFS governance meetings during 2001 and 2002. The recommendation proposed at the recent Executive Committee (EC) meeting reads as follows: "...if forty or older, eligibility for first grant could be extended to maximum five years after the highest degree has been awarded". Regarding female applicants, the

EC also concluded “special consideration may be given to female applicants” in the context of the sub-regional programmes in Africa. This should lead to an increased number of applications from Tanzanian scientists.

12.2.3 Final report submission

As reported in chapter 8, final reports are delinquent with some frequency and a tangible number are of poor quality.

It was also found that, in several cases, final reports had not been sent to IFS because there was no incentive to spend time writing a report, in a context where time must be wisely invested in activities that can contribute to earning a livelihood. At the same time, the same grantees had published articles that could substitute for a final report.

A possible measure to reduce the number of files closed without a report would be to accept published papers as a substitute for a final report. In addition, IFS could introduce a number of incentives for submitting good quality final reports including the provision of a travel grant to present the research results at an international conference, or a small grant to organise the presentation of research results and their development impact to strategic and local stakeholders (see 12.2.9).

12.2.4 The IFS research grant

While the present size of the IFS grant is probably adequate in most cases, more than one grant is needed in Tanzania to get started, and to become well enough established to access additional funding opportunities.

The results of the questionnaire indicate that most grantees in Tanzania work in multidisciplinary teams. While it is clear that the IFS focus on the individual researcher is a key strength of the IFS Programme, one may argue that IFS should consider supplementing its programme with support for groups of individuals working in collaboration (several individuals getting a grant for the same project or at the same laboratory or department). This would be a particularly useful option for groups of researchers that require access to expensive pieces of equipment. Furthermore, support for multidisciplinary collaboration would strengthen

individual capacity for responding to research problems that demand multidisciplinary solutions.

12.2.5 Supporting activities in Tanzania

In the long range, given the increasing emergence of research grant schemes at the national and regional level, we believe that the other supporting activities provided by IFS are even more important than the cash component of the grant. IFS long-term comparative advantage lies in its other supporting activities. Results presented in chapter 6 indicate that a large portion of grantees in Tanzania are scientifically isolated in their institutions and that the demand for IFS support for accessing literature, scientific networking, international communication and participation in conferences is high. These services should be strengthened among IFS activities. Support for the purchase and maintenance of equipment is also strongly desired by Tanzanian scientists. An appropriate framework for addressing these needs is the Regional Initiative for Sub-Saharan Africa that was initiated by IFS in 2002. In the case of Tanzania, these supporting activities should be organised in close partnership with regional institutions such as the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), the African Academy of Sciences (AAS) and specialised networking organisations such as the Natural Products Research Network for Eastern and Central Africa (NAPRECA).

12.2.6 Salaries and research incentives

Chapter 6 also shows that Tanzanian grantees' basic salaries as scientists are not sufficient to support themselves and their families, and that they need to supplement their basic salaries with extra jobs providing significant shares of their incomes. It is clear that for scientists in Tanzania time is both scarce and valuable, and the incentive to conduct research (in the absence of a stipend or honorarium) is often at a disadvantage when compared to incentives to spend extra time on consultancies or business.

In order to maximise its impact, IFS should consider providing a small honorarium to grantees in combination with the IFS grant. Alternatively, IFS might consider requesting COSTECH or the grantees' institution to provide a research honorarium for the length of the IFS supported project.

12.2.7 National and mainstream science

As shown in chapter seven, IFS has made a positive contribution to Tanzanian grantees' overall scientific production, as well as their publication in mainstream journals. Journal articles are published in nearly equal numbers in mainstream and in local journals. This dual publishing strategy led both to an increased international visibility of the grantees's work and to strengthening local journals. This should be continued.

12.2.8 Sharing IFS acquired knowledge with national research grant schemes

Over the last decades, IFS has accumulated extensive knowledge on how to manage a research grant scheme at an international level. The national research grant schemes briefly described in chapter five and the research grant schemes being established at the regional or continental level (eg by ASARECA, or the Forum for Agricultural Research in Africa (FARA)) may find the IFS experience useful for their own programmes.

To facilitate the sharing of knowledge between organisations and the development of new strategies for supporting research through small grants programmes, IFS plans to organise a workshop on "how to operate a competitive research grants scheme" during 2003 together with managers of national research grants schemes and senior official from national and regional coordinating bodies. Representatives from national research grant schemes in Tanzania should be invited. Another possible way of sharing knowledge would be to exchange staff members for short periods on an ad hoc basis.

12.2.9 Science for development

The main objectives of MESIA are to assess the effect that the IFS grant and other forms of support provided by IFS have had on the academic and institutional career of the grantees (see MESIA Report No 1). Assessing the impact of grantees' research on development would require a different set of indicators that will be developed in the future (see IFS Workplan 2003). Consequently, except in the interviews (see Appendix 4), very little is reported on the extent to which the results of the grantees' research have been disseminated and implemented in this publication. In one case, we

know that the grantee's work supported by IFS laid the foundation for today's seaweed industry in Tanzania with export earnings of over USD 10 million and employment for more than 40,000 Tanzanians (mostly women). In other cases, outstanding scientific results have been obtained and published but to the best of our knowledge they have not contributed to development.

We believe that the interface between IFS grantees and potential end-users of research results could be greatly improved if a dialogue with potential end-users and other stakeholders (e.g. farmers, industry, researchers, policy makers) could take place already when the scientists are designing their research proposals. Currently, applicants to IFS are asked to explain the relevance of their research projects to local and regional social and economic conditions. Evaluators of research proposals to IFS should also consider the extent to which researchers have communicated with stakeholders when they determine whether or not to recommend a project. Grantees that successfully complete an IFS research project should be provided with financial support to present their results to stakeholders and end-users in a public forum. This and other ways of promoting the dissemination of research results will be included in IFS mode of work and routines in the future to ensure that the research results obtained by the IFS grantees have a greater impact on development (see IFS Workplan 2003).

12.2.10 Supporting fragile national science research infrastructures

This report demonstrates that the difficulties and obstacles to the creation of a strong and sustainable research community in Tanzania are great. They are much greater than in a number of other countries supported by IFS, especially many of the middle-income countries (as identified by the World Bank) in Latin America and Asia (see MESIA Report No.3 - IFS Impact in Mexico). The large differences in national science capacity between countries such as China, India, and Mexico, and countries in Sub-Saharan Africa justify a regional approach to providing research support that focuses activities on countries with fragile national science research infrastructures.

Given the scarcity of national funding for research support, we strongly believe that the survival of a robust Tanzanian scientific community that can be a driving force in Tanzanian development will con-

tinue to depend heavily during the coming years on foreign-based programmes. The results presented here also show that well targeted support to young scientists at the beginning of their research career in a comparatively weak scientific environment can be instrumental in retaining them in their national scientific communities and effectively contributing to national research capacity building.

Meanwhile, Tanzania should be encouraged to increase its support to S&T activities and begin to recruit the new generation of scientists that will be the backbone of the national science community in the years to come. In the long range, sustainable development of the endogenous S&T capacities can only take place if a strong political will and the necessary economic resources are ensured at the national level to make it happen.

One small step towards increasing the resources available to researchers in Tanzania while increasing national involvement in research support might be for IFS to work in closer collaboration with COSTECH and the national institutions. In one model of collaboration, IFS would fund the majority of the research grant and provide a range of supporting services while a national body would cover local costs in grantees' budgets. In a typical grant, approximately 30% or USD 3,000 of the grant is used for local travel, temporary employment of field assistants and workers, consumables available on the local market, etc. If a national organisation were to supplement the IFS grant with USD 3000, such a contribution would increase the size of the research grant to a maximum of USD 15,000 and increase the impact of Tanzania's limited resources for supporting research.

References

- Arvanitis R, R Waast and J Gaillard. 2000. Science in Africa: A Bibliometric Panorama Using PASCAL Database. *Scientometrics*. 47(3):457-473.
- Bhagavan M R. 1992. *The SAREC Model: Institutional Cooperation and the Strengthening of National Research Capacity Building*. Stockholm: SAREC.
- Carlsson J. 1995. *The University, its Faculties and Departments. Toward an Integrated Approach to the Support to Higher Education and Research*. Paper for SAREC seminar on Support to Research and Training for Research in the Social Sciences and Humanities at African Universities. Värnamo: 3-4 May 1995.
- COSTECH. 1996. *Research Grants Manual*.
- COSTECH. 1998. *Priority Areas of Research and Development in Tanzania*.
- Gaillard J. 1994. "North-South Research Partnership: Is Collaboration Possible between Unequal Partners?" *Knowledge and Policy*. 2(2): 195-228.
- Gaillard J and B Schlemmer. 1996. "Chercheurs du Nord, chercheurs du Sud: itinéraires, pratiques, modèles - un essai d'analyse comparative", in R. WAAST (ed.), *Les sciences au Sud: états des lieux*. Paris: ORSTOM Editions, Collection Sciences Hors Occident au XXème siècle, 113-135.
- Gaillard J. 2000. *Monitoring and Evaluation System for Impact Assessment (MESIA), Conceptual Framework and Guidelines*. Stockholm: IFS. 38 pages.
- Gaillard J and A Furó Tullberg. 2001. *Questionnaire Survey of African Scientists*. Stockholm: IFS. 92 pages.
- Gaillard J, J Russell, A Furó Tullberg, N Narvaez-Berthelemot, and E Zink. 2001. *IFS Impact in Mexico: 25 years of support to scientists*. Stockholm: IFS. 152 pages.
- Gaillard J and R Waast. 1999. "L'aide à la recherche en Afrique Sub-Saharienne: comment sortir de la dépendance ? Le cas du Sénégal et de la Tanzanie". *Autrepart* (13):71-89.
- Gaillard J, M Hassan and R Waast. 2002. Africa in *UNESCO World Science Report*.
- International Foundation for Science. 2001. *Medium-Term Strategic Plan 2002-2004*. Stockholm: IFS.
- Moravcsik M J. 1985. *Strengthening the Coverage of Third World Science: the Bibliographic Indicators of the Third World's Contribution to Science*. Deliberations, conclusions, and initiatives of an ad hoc international task force for assessing the scientific output of the Third World. Philadelphia.

Ministry of Science, Technology and Higher Education. 2000. *Some Basic Statistics on Higher Learning in Tanzania*. Dar es Salaam: MSTHE.

NORAD. 1999. *Norwegian Research Support to Developing Countries: The Case of Tanzania*. Oslo: NORAD. 157 pages.

Research News. *Research and Postgraduate Studies Newsletter*. Morogoro: Sokoine University of Agriculture. Vol.8 (2), December 1998.

Shija J K. 1996. *The High Price of Excellence in Tanzania: A Personal Voyage*. Dar es Salaam: DUP. 88 pages.

Sida Research Council. 2000. *Memorandum: Continued Research Co-operation between Sweden and Tanzania 2001-2003*. Stockholm: Sida-SAREC.

Teferra D and P G Altbach, eds. In press. *African Higher Education: An International Reference Handbook*. Bloomington, Indiana: Indiana University Press.

Thulstrup E W, A M Cetto, T A Freyvogel and M Touré. 2001. *Mobilising Scientists for Development: A Precious Mission in a Changing Context*. Stockholm: IFS. 63 pages.

URT (The United Republic of Tanzania). 1998. *Financial Sustainability of Higher Education in Tanzania*. Dar es Salaam: MSTHE, 141 pages.

Widstrand C. 1992. *Tanzania: Development of Scientific Research and SAREC's Support 1977-1991*. Stockholm: Sida-SAREC.

Widstrand C. 1996. *The University of Dar es Salaam and Swedish Support to Capacity Building*. Stockholm: Sida-SAREC.

Appendix 1: The questionnaire

Questionnaire for IFS Grantees in Africa

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: _____ Middle name: _____ First name: _____ (underline the name under which you publish) | 2. Name and address of your home institution: _____ _____ _____ |
| 3. E-mail address: _____ | |
| 4. Citizenship: _____ | 5. Sex: <input type="checkbox"/> male <input type="checkbox"/> female |
| 6. Year of birth: 19 ____ | 7. Civil status: <input type="checkbox"/> single <input type="checkbox"/> married <input type="checkbox"/> 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/Licence | | | | |
| MSc/Maîtrise/Ingénieur | | | | |
| PhD/thèse de 3ème cycle/Docteur Ingénieur | | | | |
| Post-Doc/Doctorat d'Etat | | | | |

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

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

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

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

II Career

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

| Position | Employing institution | Country | Starting date | % of re-search time |
|----------|-----------------------|---------|---------------|---------------------|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

15. 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) | | |

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

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

18. In which institutional framework do you work today?

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

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

| | Advantage | Disadvantage |
|------------------------|--------------------------|--------------------------|
| Salary scale | <input type="checkbox"/> | <input type="checkbox"/> |
| Career development | <input type="checkbox"/> | <input type="checkbox"/> |
| Job security | <input type="checkbox"/> | <input type="checkbox"/> |
| Social benefits | <input type="checkbox"/> | <input type="checkbox"/> |
| Retirement | <input type="checkbox"/> | <input type="checkbox"/> |
| Others (specify) _____ | <input type="checkbox"/> | <input type="checkbox"/> |

20. 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
21. 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
22. Specify the nature of your extra jobs
- | | |
|--|--|
| <input type="checkbox"/> Teaching | <input type="checkbox"/> Farming |
| <input type="checkbox"/> Own consultancy or medical private practice | <input type="checkbox"/> Somebody else's consultancy or medical private practice |
| <input type="checkbox"/> Own private business | <input type="checkbox"/> Somebody else's business |
| <input type="checkbox"/> Other (specify) _____ | |
23. 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
24. Have you 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

25. Since the beginning of your research career, have you substantially changed your scientific orientation/research subjects? Yes No
26. What is your main field of science at present, e.g., agronomy, zoology, parasitology, etc.?

27. To carry out your research activities, do you usually work alone or with other scientists?
 Alone With other scientists
28. Whenever you work with other scientists do you usually work in monodisciplinary or multidisciplinary research teams? monodisciplinary multidisciplinary
29. 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 African countries |
| 1 | 2 | 3 | 4 | 5 | Scientists in Europe |
| 1 | 2 | 3 | 4 | 5 | Scientists in USA or Canada |
| 1 | 2 | 3 | 4 | 5 | Scientists in Asia or Latin America |
| 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) _____ |

30. 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 of conferences

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

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

33. 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 |
|------------------------------|-----------------------|------------------|------------------------|-----------------|
| Within your country | | | | |
| In Africa* | | | | |
| In Europe | | | | |
| In USA or Canada | | | | |
| In Latin America & Caribbean | | | | |
| In Asia | | | | |

*Except your own country

**Except IFS

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

V Main Factors holding back your research work and evaluation

35. What are, according to you, the three main factors holding back your research work in order of importance?

1. _____
2. _____
3. _____

36. Certain recurring difficulties have been listed below. 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) _____ | | |

37. 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

38. 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) _____ | | |

39. Is your research work evaluated regularly? Yes No

40. If yes, by whom? _____

VI Research Funding

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

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

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

43. 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 |

VII Relative importance of IFS support and future research goal

44. 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) _____

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

- | | Yes | No |
|---|--------------------------|--------------------------|
| 1. Additional funding from your institution | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Additional funding from a national funding institution | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Additional funding from an international institution | <input type="checkbox"/> | <input type="checkbox"/> |
- If yes to 3, give name _____

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

- Yes No

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

- Yes No

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

- Yes No Not applicable

49. 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) _____

50. 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, including 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: Grantees interviewed for this report

| Name | Institution |
|-------------------------|-------------|
| Jiddawi, Narriman Saleh | IMS |
| Shayo, Constantine | LPRI |
| Shirima, Eligy | LPRI |
| Gwakisa, Paul Simon | SUA |
| Kassubu, Ayub Ahmad | SUA |
| Matovelo, Jayro A | SUA |
| Monica, Lyomo | SUA |
| Mtambo, Nkumbukwa M A | SUA |
| Mugula, Jovin K | SUA |
| Munyanziza, Eson | SUA |
| Nchimbi, Susan | SUA |
| Ndabikunz, S M | SUA |
| Bwathondi, Philip O.J. | TAFIRI |
| Lorri, Wilbald | TFNT |
| Mulokosi, Generose | TFNT |
| Mrema, Frank | TFRI |
| Ak'habuhaya, Jonathan | TPRI |
| Elia, Frank | UDSM |
| Nkunya, Mayunga H H | UDSM |

Appendix 3: Acronyms and abbreviations

| | |
|----------|---|
| ADR | Animal Disease Research Center |
| 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) |
| CAMARTEC | Center for Agriculture Mechanisation and Rural Technology |
| CARC | Collima Agro-specific Research Center |
| COSTECH | Tanzanian Commission for Science and Technology |
| DANIDA | Royal Danish Ministry of Foreign Affairs |
| DFID | Department for International Development |
| DRT | Directorate of Research and Training |
| GTZ | Deutsche Gesellschaft für Technische Zusammenarbeit |
| HRC | Horticultural Research Center |
| IFS | International Foundation for Science |
| IHRDC | Ifakara Health Research and Development Centre |
| ISI | Institute for Scientific Information |
| KCMC | Kilimanjaro Christian Medical College |
| MESIA | Monitoring and Evaluation System for Impact Assessment |
| MIU | Mikocheni International University |
| MMC | Muhimbili Medical Center |
| MoAC | Ministry of Agriculture and Cooperatives |
| MSc | Masters of Science |
| MSTHE | Ministry of Science, Technology and Higher Education |
| MUCHS | Muhimbili University College of Health Sciences |
| NARPL1 | National Agricultural and Livestock Research Project |
| NFAST | National Fund for the Advancement of Science and Technology |
| NIMR | National Institute of Medical Research |
| NIMR | National Institute of Medical Research |
| NLH | Agricultural University of Norway |
| NORAD | Norwegian Agency for Development Cooperation |
| NUFU | Norwegian National Committee for Development Related Research and Education |
| OUT | Open University of Tanzania |

| | |
|------------|---|
| PMU | Programme Management Unit |
| R&D | Research and Development |
| S&T | Science and Technology |
| SAC | Scientific Advisory Committee |
| SCI | Science Citation Index |
| SDC | Swiss Development Cooperation |
| Sida | Swedish International Development Cooperation Agency |
| Sida-SAREC | Swedish International Development Cooperation Agency, Department for Research Cooperation |
| SLU | Agricultural University of Sweden |
| SPAAR | Special Programme for African Agricultural Research (discontinued) |
| SUA | Sokoine University of Agriculture |
| TAFORI | Tanzanian Forestry Research Institute |
| TARP II | Tanzanian Agricultural Research Plan II |
| TFNC | Tanzania Food and Nutrition Centre |
| TIRDO | Tanzania Industrial Research and Development Organisation |
| TPRI | Tropical Pest Research Institute |
| TRIT | Tea Research Institute of Tanzania |
| TTRI | Tse-Tse and Trypanosomiasis Research Institutes |
| UAC | Uyole Agricultural Research Center |
| UARC | Uyole Agricultural Research Center |
| UCLAS | University College of Lands and Architectural Studies |
| UDSM | University of Dar es Salaam |
| UTAFITI | Tanzanian National Science Research Council |
| VRTC | Viticulture Research and Training Center |
| WHO | World Health Organisation |
| ZARF | Zonal Agricultural Research Fund |

Appendix 4: Selection of transcribed interviews

Interviews appearing in this appendix:

| | |
|------------------------|-------|
| Philip O.J. Bwathondi | p. 83 |
| Frank M E Elia | p. 85 |
| Paul Simon Gwakisa | p. 86 |
| Narriman Saleh Jiddawi | p. 87 |
| Margaret Mmbaga | p. 89 |
| Keto E. Mshigeni | p. 91 |
| Mkumbukwa M A Mtambo | p. 97 |
| Mayunga H.H. Nkunya | p. 98 |

Philip O.J. Bwathondi,

Tanzanian Fisheries Research Institute (TAFIRI)

Project title: Aquaculture of *Siganids Siganus oranium* in Tanzania

Prof. Bwathondi is one of the first ten scientists in Tanzania to become an IFS grantee. He was awarded his first grant in 1978 at 31 years of age and shortly after he obtained his PhD from the University of Aberdeen. At the time that he prepared his first research grant application to IFS he had just been promoted to Lecturer at the University of Dar es Salaam (UDSM). He had published two papers in international peer-reviewed journals (one deriving from his MSc thesis on the biology of lobsters in Tanzania and one from his PhD thesis on trout parasitology). In addition, he had also published one short research note, also on fish parasitology, in the University of Dar es Salaam Scientific Journal. Apart from the contacts made during his stay at the University of Aberdeen for his PhD (1974-1976) and at Duke University (USA) where he attended an international training programme in Marine Sciences in 1977, his international contacts were very limited. The IFS grant was the first international support and recognition he had received. Interestingly, he lists the IFS support under Research Experience in his CV, directly after his MSc and PhD work.

Retrospectively, the IFS support to Prof Bwathondi's research work on the culture of *Siganids* in Tanzania could be considered as an archetypal example of the IFS model. In addition to the characteristics described above, he received three grants

between 1978 and 1986 (each research period being between 1-3 years) and submitted renewal applications as well as progress and final reports satisfactorily. He is very grateful for the IFS support which, according to him, had a strong impact on his career development in Tanzania and his participation in regional (and to a lesser extent international) research networks and programmes.

During the first years of his research career, Prof Bwathondi taught Zoology, Marine Biology, Fisheries and Parasitology at the UDSM, rising from Tutorial Assistant in 1971 to Lecturer in 1977, at which time he applied for his first IFS grant. He was then promoted Senior Lecturer in 1978 (the year he obtained the first IFS grant), and later to Associate Professor and then Professor. As far as administrative positions are concerned, he rose from Officer in Charge of Kunduchi Biological Station of the UDSM in 1977, to Acting Director of the Institute of Marine Sciences of the UDSM in 1980, and Director General of the Tanzania Fisheries Research Institute (TAFIRI) in 1983 (a presidential appointment). Being DG of TAFIRI, he supervises 230 employees (of whom 30 are researchers) in 4 centers. He is also a Member of two Boards of Directors: the Tanzanian Commission for Science and Technology (COSTECH), and the National Environment Management Council.

Prof Bwathondi's rapid promotion is in great part due to the fact that, since he received his first IFS grant in 1978, he has been actively involved in research activities and invited to present papers at numerous workshops and conferences. The first of

these conferences was the Aquaculture workshop organized by IFS in 1979 in Abidjan, Côte d'Ivoire, at which he presented his first paper on rabbit fish (*Siganus canaliculatus*) cultivation. He also participated in the 2nd IFS Aquaculture meeting organized in Kisumu, Kenya, in October 1985 to which he presented two papers: one directly related to his IFS supported work and another one which is a review of aquaculture activities in Africa. During the period of IFS support between 1978 and 1986, he presented papers at not less than 13 workshops and conferences (out of which six took place in Tanzania, two in Kenya, one in Uganda, one in Zimbabwe, one in Sudan, one in Côte d'Ivoire and one in the Netherlands). Since the IFS support to his work on Siganids cultivation terminated, he has attended an additional 13 workshops and conferences mainly in Kenya and Tanzania and mainly related to inland fisheries of Lake Victoria, activities for which he received support from the European Union (DG XII/INCO-DC) and the World Bank. Many of his papers presented at workshops and conferences were published in proceedings.

For the rest of his scientific production, the majority of his articles are published in one local scientific journal: The University of Dar Es Salaam Science Journal (9 articles out of 14). Two appeared in two marine science journals published in India, one derived from his PhD thesis was published in *Parasitology*, and one review article on the potential of marine polyculture in Tanzania was published in *Atlantica*. Most of his published papers in scientific journals (with the exception of the two published with MSc and PhD work) were prepared and published between 1978 and 1986 when he was an "active" IFS grantee. Four of them are directly related to the IFS project. A large majority of his scientific production is single-authored. It is also noteworthy that his scientific articles, whenever co-authored, are co-authored with Tanzanian scientists. Although he went many times to the Netherlands in the framework of an INCO-DC supported project, he never published with a Dutch scientist, nor did he publish with any other foreign scientist. This may partly explain why he has relatively few works published in peer-reviewed international journals. He also produced a number of reports one of which was published and circulated by IFS as a small booklet with the title "The culture of rabbit fish *Siganus sp.* in Tanzania". Other reports include a review on the fishery of crustacea and molluscs in Tanzania prepared for NORAD (1984), a survey on the state of Lake Victoria fisheries published in the FAO fish report (1989), a report

on the gillnet selectivity for Nile perch for IDRC (1991), and a report on a programme to harmonize national legislation and review means of strengthening fisheries, extension, monitoring and enforcement in Lake Victoria prepared as a consultant for the World Bank (1995).

As he became more established, Prof Bwathondi no longer published papers in scientific journals (his latest paper was published in USDM science journal in 1986, the last year of his IFS third and last grant). As illustrated above, he tended (most often following requests from regional or international organizations and donors) to prepare review reports on Tanzanian or regional issues (e.g. inland fisheries in lake Victoria) which were often presented at conferences in Tanzania or in the region. In 1999 he was involved in two projects sponsored by the European Union (DG XII / INCO-DC) and the World Bank.

Prof Bwathondi who is advising the Tanzanian government on prawn and freshwater fish farming has also been very active in teaching and counselling students at USDM. He introduced fishculture at the USDM as a Master programme as early as 1979. He has supervised a number of MSc and PhD students, two of which have become IFS grantees.

For different reasons, his research work on the cage cultivation of *Siganids* was never implemented. When he started the first experiment at Kunduchi beach, he experienced a lot of thefts and fouling problems of the cages by bivalves. The former was less frequent when he moved to Zanzibar, but the latter persisted. The cost of the cages is also relatively high. Another reason is that the fish was still in abundance in the wild during the late 70's and 80's so that people were not really challenged to invest and cultivate the rabbit fish. With a total annual production of 10-20 tons for all species (mainly tilapia), fishculture is not developed at all in Tanzania. As the stock of *Siganids* has decreased dramatically since the late 80's and in particular during the recent years, Bwathondi's opinion is that it may be time to re-start cage culture experiments possibly in Mafia (a village on the coast) where women are involved in fisheries.

Despite having the salary and benefits of a senior public servant in Tanzania, Prof. Bwathondi recognized the necessity for him to complement his salary with additional incomes. Additional sources of incomes are business, invitation to conferences and to a much lesser extent consultancies. A great

share of his income has been (or still is) used for the education of his children (5 daughters and three sons). In the early 1980s he was tempted to leave the country for “greener pastures”. That was the time when many of his colleagues were leaving for Kenya, Namibia, Swaziland, Lesotho.etc. But that was also the time when he got promoted as Director General of TAFIRI.

In summary, the IFS support given to Prof Bwa-thondi had a significant impact on the develop-

ment of his research career in Tanzania. It also came at the right time in his research career development. Partly due to his participation to IFS organized workshops, he got a greater regional and continental exposure and was consequently invited to prepare and present papers to a number of additional workshops and conferences. His enhanced knowledge in aquaculture and fisheries was also instrumental in training and counselling a number of Tanzanian students, as well as in advising the Tanzanian government.

Frank M E Elia

Department of Botany of the University of Dar es Salaam

Project title: Genetic variability in quality characteristics of common bean (*Phaseolus vulgaris L.*) seeds

Following a diploma in education obtained in 1970 in Dar es Salaam, Frank Elia started his career as a secondary school teacher (1970-79). While teaching he enrolled for a BSc in education at the University of Dar es Salaam (UDSM) that he obtained in 1978. He started his career at the UDSM in 1979 as Tutorial Assistant in Botany, became Assistant Lecturer in 1981 and started to work on his MSc (in Botany) while lecturing. He was promoted to Lecturer in August 1984, soon after obtaining his MSc (1983). In September 1989, he was invited to attend a Bean Research Workshop at Sokoine University of Agriculture in Morogoro where he met Prof. F.M. Hosfield (a U.S. scientists from Michigan State University - MSU) who invited him to spend 13 months at MSU. After several stays, he obtained a PhD in Crop Science and Plant Breeding from the MSU in 1996. His stays and PhD in the U.S. were supported by the Bean Research Programme (CRSP/USAID). Before leaving to the States, he was appointed Senior Lecturer and he became Head of the Department of Botany and Microbiology of the Faculty of Sciences (UDSM) upon his return.

Mr Elia applied to IFS during 1988 (i.e. before establishing his contact with Prof Hosfield). He got the IFS grant in June 1989, just a few months before leaving to MSU. Not surprisingly and logically the subject of the IFS project entitled “Genetic variability in quality characteristics of common bean (*Phaseolus vulgaris L.*) seeds” was closely related to the

PhD thesis entitled “The inheritance of Cooking time, Chemical and Agronomic traits in seeds of dry bean (*Phaseolus vulgaris L.*)”. The IFS project was in fact the main part of his field work in Tanzania for his PhD thesis. The IFS grant was also awarded on the condition that he would establish contact and collaborate with the Regional Programme on Beans in Southern Africa based in Arusha and cosponsored by the Southern Africa Development Coordination Conference (SADCC) and CIAT, which he did. His main contact in Arusha was Dr. J.B. Smithson, bean breeder.

The IFS supported research project was done based on eight cultivars adapted to Morogoro climatic conditions. The main character studied was cookability as measured by the time taken to make or render the seeds eating soft.

According to Mr Elia, the IFS support was an “eye opener” and the starting point of his research career and was very helpful for embarking on PhD studies. The IFS grant also helped him to get promoted from Lecturer to Senior Lecturer in 1989. At the same time he felt that the IFS support was missing a very important component: an honorarium that would compensate for the very low salaries they get at UDSM. In comparison, support that he received from the Rockefeller Foundation carried a small honorarium (USD 700 over a period of 13 months) which to him made a big difference. The fact that very few scientists from the Faculty of Sciences at UDSM apply for an IFS grant is, according to him, due to two main factors: the ageing of the staff (the youngest are today in their 40’s) and the lack of incentives in the form of an honorarium. The ageing problem is also a limiting factor for benefiting from other schemes. Frank Elia mentioned

DAAD's PhD fellowships for which the age limit is today 32 years old (it used to be 28 years old). When he left to the U.S. for his PhD, he was already over 40 years old.

Frank Elia likes the academic life but he has to face a lot of constraints given his low salary at the University (he is married with three children) which, according to him, limit his academic and scientific outputs. His list of publications, with twelve references including his two theses (MSc and PhD) is clearly divided in two periods:

- 1) 1983-1987: 6 papers on the biology and growth of Bambarra groundnut derived from MSc thesis published in the *Tanzanian Journal of Science* and in the *Trop. Grain Legume Bull.* (Nigeria) as a sole author or with Tanzanian co-authors.
- 2) 1996-1998: 4 papers on cooking time and storage of the dry bean (*Phaseolus vulgaris*) derived from his IFS project and PhD work/thesis published in the *Tanzanian Journal of*

Science (2) and in American journals, out of which one mainstream journal, the *J. Amer. Sci. Hort. Sc.*, together with American co-authors.

He has attended ten meetings, out of which 7 were in the U.S. while he was working on his PhD. The remaining three all took place in Morogoro, Tanzania.

Since his return from MSU he has felt that teaching and administration consume the largest part of his time, and that he has very little time (and reward) for conducting research. The lack of young scientists in the department is also a limiting factor. One solution to these limitations that he has considered is to work for an international research institute in another developing country, but at the same time he is afraid of losing his position at the University. His university would give him a maximum of two years of leave of absence after which he would be dismissed. This is what has happened to a number of his former colleagues, among them two former IFS grantees.

Paul Simon Gwakisa

Department of Veterinary Microbiology and Parasitology, Faculty of Agriculture, Sokoine University of Agriculture

Project title: A study of the development of resistance to ticks in indigenous Zebu cattle

Among the 21 Tanzanian scientists I interviewed in Tanzania, Professor Paul Simon Gwakisa is the only one who did all his postgraduate studies in Moscow. Altogether, he spent nine years in Moscow. When he came back from Moscow the first time in 1983 with a MSc in Animal Husbandry from the Peoples' Friendship University of Moscow, he was unable to find a job in Tanzania. He eventually decided to write to his MSc supervisor in Moscow and got a second invitation and a fellowship for PhD studies in immunogenetics at the Institute of Experimental Veterinary Medicine in Moscow. He came back to Tanzania with a PhD in immunogenetics in 1986. Finally he was invited to an interview for a position in one of the research pro-

grammes in the Ministry of Agriculture and Cooperatives. The interview went very well but one of the panel members, felt that his talents would be better used at Sokoine University. He pursued the academic position at Sokoine University and by July 1987 he succeeded to get a permanent position at Sokoine as a Lecturer.

From 1989 to date, Prof. Gwakisa has been engaged in establishing his research laboratory at SUA using immunological and molecular techniques. His laboratory has on the average a staff of 2 technicians and 2 - 4 graduate students, with whom he has transferred, developed and applied different techniques. The laboratory at present routinely uses polymerase chain reaction - based techniques as well as ELISA and hybridization techniques for various objectives in different research projects, which have emphasis on livestock genetic diversity, tick resistance, endemic stability and immunity to tickborne diseases. These techniques enabled the advancement of the IFS supported project

on resistance to ticks in indigenous Zebu cattle for which he received a grant in 1996. Prof. Gwakisa acknowledges inputs of the International Livestock Research Institute (ILRI) based in Nairobi, Kenya in building up the research capacity in his laboratory.

Prof. Gwakisa got a post-doctoral research fellowship (1989-1990) at the International Laboratory for Research on Animal Diseases (ILRAD), Nairobi, Kenya, under the supervision of Alan Teale with whom he has published a few papers. He then made two shorter stays at ILRAD and ILRI (January-February 1993; March-April 1996). The collaboration with ILRAD (today ILRI) has been very important for him and for his post graduate students over the last 10 years. Thanks to his contacts at ILRAD/ILRI, he has developed an impressive collaborative network including scientists in Sweden, Australia, Belgium, USA and Japan. He was an invited guest researcher at the Department of Animal Breeding and Genetics (SLU, Uppsala) from September 1993 to May 1994, a visiting scientist at Tuskegee University, Alabama, USA, from April to June 1995, and a visiting scientist at CSIRO at the Molecular Animal Genetics Center at the University of Queensland, Brisbane, Australia, from April to May 1996. When I met him in Morogoro, he was just coming back from a three months visit to Japan.

After coming back from his last stay at ILRI he applied to IFS and got his first IFS grant in 1996 (USD 12,000). Previous to the IFS support, he was awarded a grant from FAO (USD 8,000 in 1993) and from ACIAR-Australia (USD 12,000 in 1995). Concomitantly with the IFS grant, he also received funding from Sokoine research scheme supported by NORAD (USD 15,000 in 1996).

Narriman Saleh Jiddawi

Institute of Marine Sciences, University of Dar es Salaam

Project title: Spat settlement of the oyster, *Saccostrea culcullata* on Zanzibar

Born in Zanzibar, Narriman Saleh Jiddawi's grandparents are of Saudi Arabian origin (She is the 4th generation). Her great grandfather migrated to Zanzibar from Saudi Arabia in around 1880. He

His main avenue of research has always been the elucidation of the animal immune system's functions, and the understanding of genetic controls of the immune responses. Currently, with support from ILRI, ACIAR, IFS and NORAD, the effect of tick infestation are being studied. Research outputs have been in the form of postgraduate theses supervised by Paul Gwakisa (2 PhD and 6 MSc or MVM) as well as (as of 2002) 30 publications published in international and national journals.

Dr Gwakisa would like to work for an international organization for a few years because he feels he could achieve much more during a short period of time. However, following such an appointment, he would plan to come back to Tanzania to train more postgraduate students and contribute to the development of his country.

The IFS support has had - together with other supports from ILRAD, FAO, ACIAR and NORAD - an enabling impact on his research work and career. However, when he applied to IFS he had already, during and following his post-doctoral research fellowship at ILRAD, developed a rather extensive network of international contacts that he has nurtured with great cares. From July 1999 Prof Gwakisa is also the head of department of Veterinary Microbiology and Parasitology in Sokoine University. He accounts at least 50% of his time in administrative matters and the other 50% to teaching and active research. That may partly explain why his contacts with IFS have been rather loose and why he had not applied for a renewal grant after the first grant was awarded.

was shipping goods from Zanzibar to Saudi Arabia. Her father was the Chief Customs Officer until the early 1980s when he retired. Her husband is a migrant architect from Norway who has established, together with a Swedish associate, a timber plant that processes coconut wood (SCANZA). She finished and submitted her PhD a few weeks before the interview and was proud to tell me that she will be among the first five women from Zanzibar to get

a PhD (she successfully obtained her PhD from the University of Dar es Salaam in September, 2000).

Dr Jiddawi first studied Zoology and Botany at the University of Dar es Salaam (UDSM) where she had Professor Mshigeni and Professor Bwathondi as teachers (both of them are among the first IFS grantees in Tanzania; see separate interviews). After obtaining her BSc in Dar es Salaam in 1980, she began her career as science teacher in Zanzibar and was also a sportswomen where she was awarded the best sports women in Tanzania in Table Tennis in 1982. She was also the Coastal Towns women champion in 1984. Her first positions at UDSM were tutorial assistant (1982-84) and assistant research fellow (1985-90). In 1986 she got a fellowship from the British Council to pursue MSc studies in Fisheries Management at the University of Wales (UK). She obtained that degree in 1987 and, following her return from UK, she was encouraged by Prof Bwathondi and Prof Mshigeni to apply for an IFS grant. This she did, and she was rewarded with an IFS grant in 1988 for a project entitled: "Spat settlement of the oyster, *Saccostrea culcullata* on Zanzibar".

Although Dr Jiddawi's field of expertise is mainly fisheries, fish biology and fish population dynamics, she is also very much interested in Aquaculture. It was mainly Prof Bwathondi who encouraged her to work on oyster cultivation after he observed a lot of them attached to his experimental cage for rabbit fish. A Canadian scientist, Dr Steve Goddard, visiting the Institute in Zanzibar, also thought that it would be a good idea to start cultivating oysters in Zanzibar.

Soon after she obtained the IFS grant, she was invited by NORAD to the University of Norway for a 9 month practical training course and library research on fisheries biology, followed by a 3 months training course on fisheries management in Malta in 1990, and a 4 months training course on Marine Fisheries at the University of Ghent in 1991. In reality, she did not start the IFS project before 1992. At that time, she had a lot of practical problems and constraints, among them transportation problems. 1992 was also the year she was promoted to Associate director of the Institute of Marine Sciences in Zanzibar for three years (1992-95) and the year she started her PhD studies, not on the cultivation of oysters but on marine fisheries related problems: "Study on the age, growth, reproductive biology and fishery of Indian Mackerel (*Rastrelliger kanagurta*) in Zanzibar". Completing

the PhD, for which she got a grant from CIDA and guidance from Canadian scientists from the University of British Columbia, took much more time than she had expected. Altogether she spent 12 months at the University of British Columbia during two semesters (1995 and 1996-97). She thought that she would be able to finish her PhD during 1995, but it took her another three years to get it completed. At the same time she was also involved in other activities including the preparation of two video films, including one on women involvement in fishing activities.

Dr Jiddawi felt that IFS was very helpful to promote her academic abilities, to challenge her to prepare a research proposal, to look for scientific contacts and up to date literature. She is now conducting aquaculture experiments on Chanos chanos and oysters together with colleagues from IMS at Makoba, in Zanzibar. However, to carry out research work in Tanzania under IFS is somehow difficult and, she strongly suggested that IFS should think of introducing field allowances (as is done by some other granting schemes) in the framework of the IFS grant.

Dr Jiddawi submitted two reports to the IFS, one in 1995 and one more recently with a renewal application. She was clearly very disappointed by the IFS decision not to renew her IFS grant for a second period. Even if the results of the first research period were not as promising as had been hoped, she felt that she could have been given a second chance and, above all, more encouragement. She was also disappointed by the limited scientific advice she received from IFS, and felt that the final decision not to renew the grant was rather abrupt. Dr Jiddawi intends to continue the work on fish and oyster cultivation in collaboration with other scientists from IMS under the MASMA grant through Western Indian Ocean Marine Science Association (WIOMSA) as well as integrating seaweed farming and oysters in one farm (She is seeking financial support for this). She might also be interested to resume Prof Bwathondi's project on the cage cultivation of the rabbitfish. With the success of seaweed cultivation in Zanzibar (see Mshigeni's interview), she felt that people are becoming much more interested in aquaculture activities.

Dr Narriman Jiddawi has attended more than 20 workshops and conferences since she received the IFS grant (19 since the beginning of her career, and only one with IFS support). These conferences and workshops were mainly in Tanzania and in the

region (Kenya, Mauritius, Seychelles, and Namibia) but also in Norway, Belgium, Sweden, Netherlands Oman and Canada during her stays abroad. Support came from many different sources including FAO, NORAD, UNESCO, CIDA, SADC, Sida-SAREC, EU, and ICLARM. Most of the 24 references listed in her list of publications are either proceedings of conferences or reports mainly published in Tanzania. She has edited one fisheries proceeding together with a fishery specialist from the Pacific Lab. Nanaimo Mr R. Stanley and has one brief peer-reviewed journal article published in *Ambio* in 1998 with foreign co-authors. In 2002 she reported two new co-authored publications in the newly established *WIOMSA Bulletin* and one on marine fisheries in Tanzania in *Ambio*.

Retrospectively, the IFS support came at an appropriate time in her research career but her involvement in a number of other activities limited the time that she could devote to the IFS project. The

fact that her IFS project was not related to the subject of her thesis also presented a challenge.

Apart from conducting research one of her favourite activities is to give lectures on marine living resources of Tanzania to foreign visiting students as well as to take them for field trips related to the lectures.

Although Dr Narriman Jiddawi would like to pursue her career in Tanzania, she also mentioned several times during the interview that if she gets better opportunities elsewhere where she could be of assistance she may consider pursuing her career abroad. In a follow-up contact with Dr Jiddawi in 2002 she said that she was very proud to be the first person to start oyster culture experiments in Tanzania and hopes that oyster culture will prove to be an alternative activity among the coastal people just like seaweed farming is now.

Margaret Mmbaga

TSU Nursery Crop Research Station, Tennessee State University, USA

Project title: Studies on rust disease of beans and cowpeas in Tanzania: epidemiology and disease control

Dr Mmbaga is one of the first grantees of IFS. She learned about IFS thanks to an IFS official who toured different developing countries to promote the Foundation when it was being launched. At the time, in 1974, she had just finished her first degree and started her graduate studies at the University of Dar es Salaam. She felt lucky because she did not know anything about IFS or research funding and was barely ready for IFS support. At the time, she could only qualify for \$500 support for scientific literature and opportunities to attend international meetings and establish contacts with scientists in her field. She kept in contact with IFS when she was doing her PhD in the USA. The Foundation approved two travel grants which enabled her to go to two international meetings held in the USA as an IFS grantee. Immediately after finishing her PhD degree, she returned to Tanzania and spent the first year identifying her research area, and then applied for an IFS research grant which may qualify

as her first full grant, although it in practice was her second grant, obtained in 1982, from IFS for a project entitled "Studies on rust disease of beans and cowpeas in Tanzania: epidemiology and disease control". In total, Dr Mmbaga was successful in obtaining 4 grants from IFS, however the last one was never used because of her departure to the International Centre for Agricultural Research in the Dry Areas, ICARDA (in Syria), an institution that does not qualify for IFS grants.

Dr Mmbaga did not find the reporting requirements of IFS very demanding. Instead, she found them useful in that they helped her to focus on the extent to which her research objectives were met and on the next step to take. She found IFS grants very satisfactory and important in her career development. She received two grants from national programs but found that the IFS grants had better requirements for accountability. Also the foreign currency from IFS was advantageous in that when converted to local currency, \$10,000 could do a lot. In addition, any purchase from outside eliminated the foreign currency limitation. The only other comparable individual grant she received in foreign currency was from CIAT and she did not use it because she left Tanzania at the time it was to

start. In addition, she participated on a multidisciplinary USAID grant which was also quite satisfactory.

Dr Mmbaga notes that the IFS research grants played a critical role in her career advancement. They gave her a very good platform to stand on by introducing her to key researchers who contributed to her progress as a scientist. She learned a lot from interacting with these researchers, to see new possibilities and how far she could reach and how to get there. She was able to attend international meetings and make presentations, and there met more researchers and gained in confidence over time. Another impact of the IFS grant was the improvement of the immediate working environment thanks to research facilities purchased by IFS.

IFS helped Dr. Mmbaga to participate in seminars and conferences and gave her the opportunity to publish. Its support led to advancement in her academic and institutional career, the training of a new generation of scientists, the advancement of their respective research fields and the formation of research groups and research networks. Being an IFS grantee contributed indirectly to improve her promotion opportunities, her ability to get additional funding and other awards and forms of recognition by helping her to get the publications she needed for promotion and career advancement. She gained national recognition as an active researcher. The IFS grant applications taught her the art of writing research grant applications, which she improved over time. This in turn helped her to become more competitive in other grant applications after she left Tanzania. She feels particularly proud to have secured a \$2 million grant from ICARDA and later a \$300,000 USDA grant that she is still using in the USA.

Compared to other research grant schemes, Dr Mmbaga believes that IFS support is stronger because its focus on the development of young scientists from developing countries. IFS grant reviews provide good contacts, suggest points for improvement, and encourage young scientists to address research problems that have practical applications to their country. By doing that they push scientists to focus on applied research or even if it is basic research, think of its future application in developing countries. This is important because a lot of scientists are trained in developed countries and often may have had a PhD in research topics that may not be directly applicable to their country but is

good science in the country of training. IFS research grants encourage the young scientist to sit back and think on how best to use what he or she has learnt to address a problem area that is of economic significance to his or her home country.

Meanwhile, Dr Mmbaga also points to a weaknesses of the IFS research grant scheme. The amount of financial support is small and is often not adequate to purchase sophisticated equipment for high level research that is available in other parts of the world. Ability to do that would help scientists in developing countries to attract more collaborators from developed countries.

In spite of the small size of the grant, Dr Mmbaga is of the opinion that the current system of IFS grants seems to work well and that support to individuals rather than to institutions should continue. This helps to reduce the unfair distribution of funds to individuals who are socially connected but not quite inspired for research. Purchase of equipment and access to literature, scientific advice and conference participation are all very important. Regional seminars are very encouraging to younger scientists and possibly in such meetings local institutions should receive an open invitation for their scientists to attend the meeting and learn more about IFS and research opportunities from IFS grantees. This will attract new IFS research grant applicants and encourage individuals to think more about research. It may also help the young scientists to find mentors among IFS grantees.

The main outputs from Dr Mmbaga's IFS supported projects have been publications, acquisition of research techniques, research contacts and overall advancement in research productivity. Furthermore, results from her research in Tanzania have been applied to the bean research programme of the University of Nebraska, and partly to the bean rust programme at USDA Beltsville. Selections of bean rust resistance from Tanzanian bean lines have been used to define non-specific resistance associated with adult plants. Since Dr Mmbaga moved to a different research crop, first to chickpea and now to woody nursery crops, she has lost touch with the bean research in Tanzania. The collaboration she plans with Tanzanian scientists has to merge with her current research. It will thus involve integrated pest management and the use of pesticides as well as the development of alternatives to traditional pesticides that include plant extracts, detergents, bicarbonate salts, and horticultural oils. This would likely involve the Tropical

Pesticide Research Institute and the Sokoine University of Agriculture as well as the Botany Department in Dar es Salaam. She will try to get a grant from the United States Agency for International Development (USAID) for this purpose.

Thinking back to her early career in Tanzania, Dr Mmbaga remembers that the weak economy made it very hard for scientists to find funds and do research. The task of making ends meet took time away from research and presented very hard choices for scientists. While in Tanzania, Dr Mmbaga, herself, found it hard to support her family on an associate professor's salary; in fact, she ran a small business on the side that provided her with more income than being a researcher. However, the business activities took time from science. In order to achieve the professional level she desired and at the same time maintain a decent standard of living, she eventually chose to leave Tanzania. Furthermore, she felt that in another research environment she would find more exposure to new information and acquire new technology in her field of research.

Currently, Dr Mmbaga goes back to Tanzania every 3 or 4 years to see her family. She has maintained ties with her department at the University of Dar es Salaam and visits her friends and colleagues there when she is in Tanzania. She has plans to set up a joint research project with her old department, but it is difficult in the present circumstances, since she is not working on a crop that would be of economic interest to Tanzania.

In the future, Dr Mmbaga wishes to remain a scientist, and when the opportunity arises, she may move to administration in higher education or to a research-oriented organization. When her children are all at college, she may even look into international research organizations as a research scientist, and she dreams of returning to Tanzania one day, possibly after retirement. She is making very good progress career-wise and her immediate family is more or less settled in the USA, but she still has her siblings and other close relatives in Tanzania, so she will continue to belong to two worlds. She thinks that one way of bringing these worlds closer together would be to get involved in research collaboration with her old home institution.

Keto E. Mshigeni

Pro-Vice Chancellor for Academic Affairs and Research at the University of Namibia

"Research on potential sources of the industrial phycocolloids agar, carrageenan and algin in Tanzania"

Since Prof. Keto Mshigeni was Pro-Vice Chancellor for Academic Affairs and Research at the University of Namibia at the time of the MESIA interviews, I was not able to interview him during my visit to Tanzania in February 1999. I however met Prof. Mshigeni several times during his multifaceted career, the last one being in Harare, Zimbabwe in April 1998 at a conference organised by the New York Academy of Sciences. The interview therefore started in a very free and non-structured manner in Harare in 1998. It then continued through e-mail communication. I would hereby like to acknowledge with many thanks Prof. Mshigeni's willingness to respond in great detail to my repeated messages and to apologise for my insistence and deter-

mination which made me learn that Mshigeni's surname in his mother tongue (Ki-Pare) means "leave him alone". Fortunately or unfortunately, he is hardly left alone. Most of the text below is drawn from a chapter of a book published in March 2000 commemorating 10 years of education in Namibia (since the independence on March 21, 1990), from Prof. Mshigeni's lecture for the AAS/CIBA Prize for Agricultural Biosciences 1993 Award entitled "Africa's Seaweed Resources: A Neglected Treasure with Potential for Alleviating Rural Poverty" as well as from several e-mail messages exchanged with Prof. Mshigeni. -J Gaillard

Keto Mshigeni was born in 1944 in the Kilimanjaro region of Tanzania at 1600 meters above sea level and raised in a farming family far away from the coastal zones. Thus, nothing in his childhood predestined or influenced the selection of seaweeds as his main and primary field of specialisation.

During his secondary school years at Tabora School (in western Tanzania), Keto Mshigeni was influ-

enced and inspired by research-oriented school-teachers. The first one had “a contagious interest in the insect world” that he shared with his students. The second one was “constantly carrying a pair of binoculars and was crazy about birds”. During his fourth year of secondary school at Tabora and with the encouragement and guidance of his biology teacher, Mr John Reynolds, he carried out his first piece of research on polygamous bishop birds. By the time he was completing his final year at Tabora school, he had made thorough observations on some 45 nests of the Bishop bird and thanks to original findings subsequently earned two top regional school awards in East Africa (the Swynerton-Butt competition Prize for High Schools based at Makerere University, Kampala, Uganda; and the Commonwealth Development Corporation Prize in Nairobi, Kenya).

Another encounter with a University Professor some years later when he was an undergraduate student at the Department of Botany of the Dar es Salaam campus (of what used to be the University of East Africa) set his path firmly into the field of biological sciences and more precisely in the study of algae. This Professor, Dr Erik Jaasund was a specialist in algae or seaweeds. According to him, it was thanks to the magnetism and dynamism of the late Prof. Jaasund who taught him phycology (the study of algae) in Dar es Salaam and took him on field trips to discover seaweeds in their natural habitats that he developed a passion for aquatic plants.

Towards the end of his BSc studies (he obtained his BSc in Botany from the University of East Africa, Dar es Salaam campus in 1969), he learned that Tanzania’s coastal village communities were harvesting and exporting species of the seaweed genus *Euचेuma* to France, Denmark and the UK and that in Europe the seaweed is boiled to extract a gel (carrageenan) with a wide range of industrial applications. In 1969, Tanzania was exporting about 500 tonnes of *Euचेuma* per annum. But the coastal villages were using destructive methods of seaweed harvesting. With a first funding support from the Norwegian Agency for Development Support (NORAD) he was able to visit coastal villages along the entire coastline of Tanzania including Zanzibar, to learn more about the distribution and biomass ecology of the various species of *Euचेuma* occurring in the country, and to understand the reproduction biology and growth dynamics of the seaweed. During the field visits he also learnt that Tanzania’s marine waters also support a wide vari-

ety of other seaweeds with potential for industry, export and other applications. These included species of genera such as *Gracilaria*, *Hypnea*, and *Sargassum*.

While reading the works of various other scientists who had published research papers on the *Euचेuma* seaweed and on seaweeds and their uses in general, the name of Professor Maxwell Doty of the University of Hawaii came out as the most outstanding scientist working on the subject. Prof. Mshigeni wrote to him summarising his observations on his work on *Euचेuma*, and expressing worries on possible overharvesting of the seaweed in Tanzania. A few months later, he was awarded a Rockefeller Foundation Scholarship which took him to Hawaii to do his Ph.D. under the supervision of Dr Doty. At the beginning of his Ph.D. studies, he got involved in the very first experiments on *Euचेuma* farming in the Philippines. There he learnt that vegetative methods of cultivating the *Euचेuma* seaweeds showed a lot of promise and that the type of environments preferred by *Euचेuma* in the Philippines, seemed to be similar to what he had observed in Tanzania. But for his Ph.D. research in Hawaii he was discouraged by Dr Doty to work on *Euचेuma* and instead decided to work on *Hypnea*, a seaweed genus whose species are represented in both Hawaii and Tanzania and which produces a gel with interesting properties with a good potential for industrial applications, and more importantly for his Ph.D. studies because of the scientific challenges it posed: the taxonomy of the genus was in a state of confusion, the ecology and population dynamics were little understood, and the phycocolloids were not characterised.

Upon his return to Tanzania in 1974 (with his Ph.D.), he decided to focus on *Euचेuma* again as a long term strategy, while doing experiments with other lesser known Tanzanian seaweeds. To undertake these research activities he looked for potential funding sources. Thanks to Prof. A.S. Msangi, then the Head of the Zoology Department and Professor Alison McCusker, then Head of the Botany Department of the University of Dar es Salaam, he discovered the existence of the International Foundation for Science (IFS), and was encouraged to apply for an IFS grant. He was awarded his first IFS grant in 1976 for a project entitled “Research on potential sources of the industrial phycocolloids agar, carrageenan and algin in Tanzania”.

He successfully received two renewal grants from IFS (in 1977 and in 1982). Prof. Mshigeni is very grateful for the IFS support, amounting in total to USD 14,350, which enabled him to

- 1) make the acquisition of relevant books and scientific journals to be up-to-date with respect to new developments in the field of phycology and seaweed cultivation;
- 2) carry out the required extensive travels to identify seaweed candidates with potential commercial values;
- 3) purchase equipment and chemicals to characterise phycocolloids from Tanzania's seaweed resources and to experiment the aquaculture potential of a number of seaweed candidates (e.g. environmental growth cabinets, salinometers and photometers);
- 4) attract and involve several students at the University of Dar es Salaam (UDSM) in his research project; and last but not least
- 5) exchange ideas and experiences with other scientists and peers or to use his own words "rub shoulder with his peers", in the framework of what he calls "academic heterosis". This was greatly facilitated by travel grants received from IFS to attend conferences, workshops and to make field visits to a number of countries including the Philippines, Brazil, Malaysia, Canada, Denmark, Norway, and Sweden.

Prof. Mshigeni acknowledges that the IFS supported visits enabled him to establish many new contacts, which proved to be vital to his work.

With the IFS support, he was able to determine phycocolloid yields of a wide range of seaweeds occurring in Tanzania including the various species of *Euचेuma* and of *Hypnea*, several species of other red seaweeds (*Rhodophyta*) and several species of brown seaweeds (*Phaeophyta*). The laboratory and field cultivation of a wide variety of seaweeds occurring in Tanzania, was also undertaken. The species investigated included several species of *Hypnea*, *Euचेuma*, *Gracilaria*, *Turbinaria*, *Ulva*, *Enteromorpha*, etc. Valuable information on the biomass, littoral and seasonal distribution ecology of the various species was also obtained.

All these research findings were published in several refereed international journals including *Botanica Marina*, *Marine Biology*, *Nova Hedwigia*, *Hydrobiologia*, etc. as chapters in books, e.g. "Marine Algae in Pharmaceutical Science" (edited by T. Levring & H.A. Hoppe), "Progress in Phycological Research" Vol.2. (Edited by D.J. Chapman & F.E. Round), and "Biology of Economic Seaweeds" (edited by I. Akatsuka); as papers in workshop, conferences and symposium proceedings and reports. In all, some 30 published texts and reports are derived from the IFS supported work. IFS is always duly acknowledged in all these publications. All these publications were instrumental in the promotion of Prof. Mshigeni, at an impressive and unusual speed, from the rank of lecturer to the rank of full Professor at UDSM in only five years.

On the basis of the first research findings emanating from his IFS-funded research, Prof. Mshigeni was able to secure in the early 1980's (during the 3rd and final IFS research period) a grant amounting to USD 87,000 from the U.S. Agency for International Development (USAID), which enabled him to publish a seaweed farming manual in Kiswahili, to train extension workers and to establish three pilot seaweed farms of the seaweed genus *Euचेuma* in three villages in Tanzania. During the implementation phase, he also benefited from financial support from a number of commercial enterprises in Tanzania and in the Philippines (GENU Products Ltd., the FMC Corporation Inc., International Shellcraft Ltd., and the Kingsway International Ltd.). One of the pilot farms was at Fumba Bay in Southern Zanzibar; another pilot farm was at Fundo Island in Western Pemba; the third pilot farm was at Kigombe, south of Tanga, along the Tanzania mainland shoreline. This laid down the basis for Tanzania's seaweed farming industry, which has now provided employment opportunities to over 40,000 villagers, mostly women, and which has significantly alleviated poverty in Tanzania's coastal village communities. In Zanzibar, this resulted in increased production from 261 t in 1990 to over 4300 t by 1996. The export earnings from *Euचेuma* seaweed sales now exceed USD 10 million, which is quite substantial by African rural village standards. It is today the first domestic export item in Zanzibar together with cloves and represents approximately a third of the total export value for this island which was so far better known for its spices than its seaweeds. Without the initial funding support by NORAD and IFS, these significant achievements would not have been possible. Currently there are active seaweed

farming activities on Zanzibar island, on Pemba island, on Mafia island, and also in various localities along the Tanzanian mainland shoreline, e.g., at Tanga, at Bagamoyo, at Mtwara, and also at Kigamboni near Dar es Salaam and the farming activities are continuing to expand.

The success of Prof. Mshigeni's work earned him several honours. In 1993 (two years after submitting his Final Report to IFS), Prof. Mshigeni was selected top Africa winner of the CIBA-GEIGY/African Academy of Sciences Prize for Agricultural Biosciences for his work on seaweeds. His acceptance lecture took place in Antananarivo, Madagascar in November 1993 at the time and place of the IFS 7th General Assembly. This is a prestigious Prize consisting of a cash award of USD 20,000 and a gold medal. It was presented by Prof. Thomas Odhiambo, the then President of the African Academy of Sciences. IFS support was gratefully acknowledged during Prof. Mshigeni's award lecture. Another Award is the Boutros Boutros Ghali Prize earned in 1994.

While continuing to work on seaweeds in Tanzania, he was also actively involved in postgraduate education and research. During the 1980's he became (and served for 10 years as) the Founding Director of Postgraduate Studies at the University of Dar es Salaam. It was his last position in Tanzania. During those years he was very active promoting seaweed farming in the country, and working with the villager communities, as well as with potential entrepreneurs on seaweed farming. He established a Postgraduate Scholarship Fund and contributed to the training of postgraduate students in his field. After ten years, he felt he had generated tangible results. The University's Postgraduate rules and regulations were in place. The annual interest earning from the Postgraduate Scholarship Fund alone could support as many as 20 postgraduate students. The coastal villagers had already assimilated seaweed-farming technologies. His former students were already lecturing at the University. So Prof Mshigeni felt he deserved a Sabbatical Leave.

This was to be his third Sabbatical. During the first Sabbatical (in 1979/80), he had gone to the University of California (Berkeley), as a Senior Fulbright Scholar. His Second Sabbatical leave (1986/87) was partly spent in Europe (British Museum, London; Natural Museum of Natural History, Paris; Botanical Museum of the University of Copenhagen, Denmark; Agardh Herbarium, Lund,

Sweden; Institute of Marine Biology, Kiel University, Germany; University of California, Los Angeles; and the University of British Columbia, Vancouver, Canada). The focus of his work was to study a wide variety of seaweeds collected from Africa since around 1850, and deposited in various seaweed herbaria, in Europe and North America. He had intended to spend his third Sabbatical in the USA, once again, but around that time, in early 1991, he was invited to attend a meeting in Maputo, Mozambique on Teaching and Research in the Biological Sciences in Africa. In Maputo, he met Dr. Shaun Russell, then Dean of the Faculty of Science, University of Namibia who invited him to come to Namibia, to help advise on potential uses of Namibia's seaweed resources. Prof. Mshigeni had heard of south-western Africa and of the newly independent Namibia before. He had also heard of the war of independence prior to March 21, 1990 and was hesitant to go to Namibia. Dr Russell, understanding his hesitation, gave him a short consultancy to visit the Namibian coast, to study the situation, and to make a decision after the visit. Prof. Mshigeni eventually accepted the invitation.

In Namibia, he found seaweeds such as *Laminaria* and *Ecklonia* to be giants, compared to the seaweeds occurring in East Africa. He was also impressed to see seaweeds such as *Porphyra*, *Gigartina*, etc., which are typical of temperate waters, yet which occur in abundance in Namibia. This is because of the cold Benguela ocean current, chilling water temperatures all the way to the border with Angola. From what he saw, he was convinced that if he spent his Sabbatical Leave in Namibia, he would learn more than if he went again to California. Therefore he accepted Dr Shaun Russell's invitation and got a consultancy grant from the Norwegian Agency for Development Support (NORAD) which enabled him to spend his Sabbatical year in Namibia.

The challenges were great and the research findings were most interesting. In the end Prof. Mshigeni decided to present his research findings through an International Workshop: The International Workshop on the Seaweed Resources of Sub-Saharan Africa, which was held in Windhoek, Namibia, in March 1992. The Workshop was attended by seaweed scientists from various countries in Africa, Latin America, Europe, North America, Japan, India, and China (including Taiwan). In the end, a Proceeding in the Form of a book was published. The workshop was sponsored by NORAD,

UNESCO, the Commonwealth Science Council, and the Government Ministry of Fisheries and Marine Resources, Republic of Namibia. Soon thereafter, Prof. Peter H. Katjavivi, Vice Chancellor of the University of Namibia, who had been invited to the closing ceremony, invited Prof. Mshigeni to serve as one of his consultants, to help with the planning process for the University of Namibia.

One of the consultancy assignments he was given was to assist with the planning process for the establishment of a new Faculty: the Faculty of Agriculture and Natural Resources. By then, his Sabbatical Leave period had come to an end and a special leave of absence was granted from the University of Dar es Salaam. After completing the planning process for the Faculty of Agriculture and Natural Resources, he was appointed Pro-Vice Chancellor for Academic Affairs and Research at the University of Namibia.

Just before, he won the 1994 Boutros Boutros Ghali Prize and went to Tokyo to collect the award, in October 1994. While in Japan he met Mr Gunter Pauli, who was then an adviser to the then Rector of the United Nations University, Prof. Heitor Gurgulino de Souza. From Mr. Pauli, he learnt about a new concept: ZERI: the Zero Emissions Research Initiative, which is a full story in itself.

ZERI looks at materials which are often discarded as waste, often polluting the environment, with a view to transforming them into new value added marketable products. For example from maize straw, rice straw, dead banana leaves, etc, mushrooms, and other value-added products can be produced. From brewery wastes, livestock feed supplements, biogas energy, oxygenerated mineralized water supporting algae, which can be a component of improved livestock feed supplements, can be produced. In Namibia, high quality, edible, and nutritious marketable mushrooms from materials that were previously considered as waste are already being produced.

The founder of the ZERI concept, who is also Director of the ZERI Foundation, Gunter Pauli, has been a close working colleague to Prof. Mshigeni during the past five years. During the past three years Prof. Mshigeni has been Chairman of UNESCO/UNU ZERI Africa, based at the University of Namibia and very busy promoting the ZERI concept in Africa.

The United Development Programme (UNDP) has just approved a grant of US\$ 1 million, for support-

ing a Regional Project on ZERI, which is directed towards poverty alleviation using ZERI principles. This, like the UNESCO/UNU ZERI Africa Chair will be co-ordinated through a Project Management Unit, based at the University of Namibia. The participating countries will include Namibia, Malawi, Zambia, Tanzania, Lesotho, etc. UNDP has also appointed Prof. Mshigeni the Project Co-ordinator, to spearhead the implementation of the ZERI vision in Africa. It is a new challenge that will cause Prof. Mshigeni to leave his prestigious present position as Deputy Vice Chancellor (Pro-Vice Chancellor) for Academic Affairs and Research. Prof. Mshigeni hopes that IFS will contribute to the success of this new enterprise through the award of grants to young people he shall identify to conduct mushroom research and master farming entrepreneurship in Africa.

With retrospect, Prof. Mshigeni thinks that he has had better opportunities in Namibia and that he has learned more since coming to Namibia than would have been the case if he had remained at his former position as Director of Postgraduate Studies in Tanzania. He also strongly feels that his being in Namibia should also be seen as brain-gain both for Namibia and for Tanzania, because he is still able to share his new experiences and his new visions with the Tanzanian community through ZERI. He also has a lot of admiration for the President of the Republic of Namibia (Sam Nujoma): "he is one of the strongest believers in the power of science and technology as an engine for people's socio-economic development and poverty alleviation. He believes that action speaks louder than words. He has established a science and technology fund for promoting science education and training in his country. He is personally actively catalyzing the establishment of a centre of excellence for marine and coastal resource development in Henties Bay, along the Namibian coast, to cater for the interests of Africa as a whole. We need such dedication and commitment from all our leaders in Africa".

Although a resident in Namibia, Prof. Mshigeni considers Tanzania as his permanent home. He cannot think otherwise: "You see, Tanzanians are very much tied to their homes. You will be surprised, I have not even applied for permanent residency in Namibia, even though I own a house here, as I do in Tanzania. I think of myself as a permanent resident in each African country. Therefore I feel I don't have to apply for permanent residency. I am African. Africa is mine! For many years now I have been thinking that way, in the context of

our entire continent. I am encouraged by what our African Governments are continuing to say: African unity. I have, for example, both a Tanzanian Passport and an East African Passport. I wish we had an OAU Passport too! That is coming, but perhaps not in my lifetime”.

Prof. Mshigeni goes to Tanzania about four times a year. “It is very close to Namibia”, he said, and he does not feel he is out of Tanzania: “with e-mail connection, the distance between Tanzania and Namibia has collapsed into nothingness. I think all our scientists should have a sense of belonging to all our African countries. In my mushroom drive for Africa for example, through the UNDP grant, I shall use mushroom experts from Ghana, Zimbabwe, Tanzania, Ethiopia, etc., bringing them together, to have a common vision towards disseminating the technologies to all our people, in various countries. If we think of Africa that way, we almost have the critical mass we need to change Africa. I am sensitising African Governments to give us matching funds, to supplement what UNDP is giving. I want to show what commitment, determination, and clear goals can do with appropriate financial support”.

To sum up, the IFS support given to Prof. Mshigeni led to research findings and related publications which no doubt had a significant impact on the development of his research career in Tanzania and internationally and he is very grateful for it. The IFS support also came at the right time in his research career development when he was 33 years old and a fresh Ph.D. holder from the University of Hawaii. Interestingly, it was not the first support he received from foreign sources. Already in his mid 20’s, when he was finishing his BSc studies, he was able to attract funding from NORAD to start surveying seaweeds in Tanzania. Obviously, Prof. Mshigeni is a very determined, goal-oriented, convincing and charismatic person able to find support for his projects in any circumstances. But he found IFS at the right time and IFS supported his work until the research results were ready to be implemented at a larger scale for which funding of another magni-

tude was necessary. Then USAID came in to support the implementation phase, which turned out to be a success story. In this project, the partnership between NORAD, IFS, USAID, the Rockefeller Foundation and a number of commercial enterprises in Tanzania and the Philippines orchestrated by Prof. Mshigeni, turned out to be exemplary. Partly due to the IFS support, he attended a number of conferences and workshops, made several study visits and got a greater international exposure and was consequently invited to prepare and present papers to a number of additional conferences. His enhanced knowledge in phycology and seaweed farming was also instrumental in training and counselling a number of students (firstly in Tanzania and then in other countries in Africa) also in his role of IFS Scientific Adviser since 1991, as well as in advising the Tanzanian and later on the Namibian government. He is currently a Fellow of the Third World Academy of Sciences (TWAS), a Fellow of the African Academy of Sciences (AAS), and Editor-in-Chief for *Discovery and Innovation* (a journal of TWAS and AAS). He has become an internationally recognised science leader now employed by the UN system to work in Namibia and considers himself as an African scientist and citizen at the service of the development of the African continent as a whole.

In addition to personal correspondences, the following sources provided information for this summary:

Mshigeni K E. 1993. *Africa's Seaweeds Resources: A Neglected Treasure with Potential for Alleviating Rural Poverty*. Lecture for the CIBA-GEIGY/African Academy of Sciences Prize for Agricultural Biosciences in Whydah, Vol.3(6), pp. 4-10.

Mshigeni K E. 1994. *Research on Natural Products and Aquaculture in Tanzania*. Paper presented at a Forum of IFS Grantees, COSTECH, Dar es Salaam, July 4-5, 1994.

Mshigeni K E. 2000. *Science Education: The Lighting of a Fire*. Published in a book commemorating 10 years of education in Namibia.

Mkumbukwa M A Mtambo

Department of Veterinary Medicine and Public Health at Sokoine University of Agriculture (SUA) in Morogoro

Project title: Epidemiological study of *Cryptosporidium* infection in cattle

After obtaining a BVM (Veterinary Medicine) from SUA in 1987, Mkumbukwa Mtambo became a Veterinary Officer under the Ministry of Agriculture and Livestock Development and posted to work at the Sokoine University of Agriculture veterinary clinic, as a clinician. During his BVM studies at SUA he received a number of best student awards (best student first year, and best student in anatomy and parasitology). In 1988, he received a scholarship from the Overseas Development Administration (ODA) for PhD studies in Veterinary Medicine at the University of Glasgow, which he successfully completed in 1992. In the meantime, he had been recruited at SUA as Tutorial Assistant (1990-1991) and Assistant Lecturer (1991-1992). When he came back to SUA in 1992 with a PhD, he was promoted to Lecturer (1992 - 1995), Senior Lecturer (1995 - 1998), and Associate Professor (1998 - 2001). In a recent correspondence he informed IFS that he had been promoted to Professor in 2001.

Soon after completing his PhD studies, at a time when a number of colleagues at SUA had already been awarded IFS grants, he heard about IFS from a Kenyan colleague. He decided to apply for a grant shortly after coming back from Glasgow. Professor Mtambo's first grant from IFS came in 1994 for a project entitled "Epidemiological study of *Cryptosporidium* infection in cattle". He had worked on the same infectious disease (cryptosporidiosis) for his PhD, but in cats and not cattle. While in Glasgow, he published three clinical observation notes on *Cryptosporidium* infection in cats in *Veterinary Record* and one more substantial journal article in *Veterinary Parasitology* with British scientists.

Very little research had been done in Tanzania on this infectious disease that provokes diarrhoea in both humans and animals. With IFS support, which was renewed in 1997, he was able to equip his laboratory and to buy several pieces of equipment, which are also being used by other colleagues.

During the first research period, results were obtained on the prevalence of *Cryptosporidium* sp. that were much lower than that reported in other areas. Infection was associated with diarrhoea in calves of less than three months of age. Preliminary studies on cross-transmission using wildlife isolates into mice, rats and rabbits were performed but none were infected. The first report was judged to be well presented and competent by the IFS scientific advisers.

Prof. Mtambo has already published some 10 papers directly derived from the IFS supported work between 1996 and 1998, mainly in mainstream international journals together with Tanzanian co-authors from his Department and with British co-authors from Glasgow (mainly Smith, Paton and Girdwood). He also published an article in *Zimbabwe Veterinary Journal* following his stay at the University of Zimbabwe where he was invited as a visiting lecturer in July-September 1995.

Prof. Mtambo has also developed an interest in medicinal plants, in particular Aloe. This plant was found to be very efficient against common bacteria and some anti-viral effects in the work done by a Kenyan PhD student under his supervision. He has been put in touch with Prof. Nkunya, Department of Chemistry, UDSM (also an IFS grantee; see separate interview) thanks to a colleague at SUA, with whom he is exchanging information on medicinal plants. The use of medicinal plants for livestock diseases is common among Tanzanian farmers. He is now working on another parasite similar to *Cryptosporidium* (*Cyclospora*) that causes severe diarrhoea in humans, and has been the subject of very little work in Tanzania.

His international collaborations have so far been with scientists in Glasgow (UK) and Danish scientists from Copenhagen. The latter has been in conjunction with a project aiming at improving the health of rural chickens in Africa for which Prof Mtambo and his other Tanzanian researchers received support from ENRECA-Danida (1996 - present). In the context of this Danida supported project he was invited to a workshop in Denmark in March 1999 and support was made available from IFS for him to stay two more weeks in Copenhagen at the Royal Veterinary and Agricultural University in the laboratory of Prof. John Elmerdahl

Olsen to update himself on recent techniques of characterisation of micro-organisms including protozoal parasites. As far as foreign funding is concerned, he is also involved with other colleagues in a study on major livestock and wildlife diseases in the Ngorongoro Conservation Area supported by NORAD.

Professor Mtambo is normally working from 7:30 to 5:00 at the University, lecturing, supervising students and doing research. He is also very active in a number of committees at SUA. He is living on the campus and often coming to his office and lab on Saturdays and sometimes Sundays to work. His wife is working as a secretary at the Faculty of Forestry and Nature Conservation.

Mayunga H.H. Nkunya

Faculty of Science of the University of Dar es Salaam

Project title: The search for Biologically Active and Other Natural Products from Tanzanian Plants and Softs Corals

Prof Mayunga Nkunya who was 47 years old at the time of the interview, is Dean of the Faculty of Sciences since July 1st, 1997. He continues to publish and to be active in research and try as much as he can to encourage M.Sc. and Ph.D. students to work in his lab. He starts his working day by going to his research lab to meet and discuss with staff and students. He listens to the problems and gives directions. He normally remains in the lab one hour and then works another hour in the chemistry department to deal with the administration of the Natural Products Chemistry Network for Eastern and Central Africa (NAPRECA) for which he is the Executive Secretary. He is also NAPRECA Chairman for Tanzania. He then normally proceeds to the Dean's office to take care of administrative and institutional issues and attend meetings for the Faculty of Sciences. He also continues to teach two courses. At lunchtime, he goes to meet his students. As soon as he can, he returns to his lab where he spends the rest of his working day. He leaves the University around 7 p.m.

Prof Nkunya admits that it is very difficult to attract young people into an academic career. In addition

Retrospectively one could say that the IFS support, that came very timely following the obtaining of his PhD in Glasgow, was enabling and greatly facilitated the set up of Prof. Mtambo's laboratory in Morogoro. At the time he got the first IFS grant, he had already established scientific contacts in UK (mainly Glasgow), where he spent 4 years for his PhD studies. Thanks to ENRECA-Danida and IFS, he was able to enlarge his network of scientific contacts in Denmark and in Africa (very soon after he obtained his first grant he was invited to an IFS organized workshop on "Parasitology Research in Africa" in Burkina Faso).

to the fact that there are no recruitment prospects, "there is no real monetary reward and students are much more money minded today to the extent that academic satisfaction is not important to them". At the time he finished his PhD in the Netherlands in 1984, he could not afford to have a car, but "today every graduate at UDSM would like to have his/her own car, and many do" according to him. There are today 105 staff members at the Faculty of Sciences out of which only 6 are women (three in biological sciences, one in mathematics, one in chemistry and one in geology). Many researchers have left the University in the recent years. In botany alone more than ten have left, but many have left also in mathematics, zoology and chemistry. Some are looking for better paid administrative positions within the government others are looking for "greener pastures".

In 1985, soon after he finished his Ph.D. at the University of Nijmegen in the Netherlands, Prof Nkunya met Prof. Lennart Prage (then IFS Scientific Secretary for Natural Products Chemistry) together with a number of IFS grantees at an IFS workshop in Addis Ababa (Ethiopia).

Although he became interested in IFS during his participation in the workshop, he does not remember why it took him nearly six years to apply for an IFS grant (his first grant was approved in 1991). Retrospectively one can certainly argue that he had already developed a number of foreign contacts

during his stay in the Netherlands and through a contact he had then with the late Prof. Pierre Crabbé (UNESCO and Chairman of the International Organization for Chemistry Development - IOCD). Thanks to him he developed a very active collaboration with the School of Hygiene and Tropical Medicine of the University of London during the late 1980s to which he sent samples for analysis. A number of papers were published in international journals through that collaboration. In addition, prior to receiving his IFS grant, Prof Nkunya also went to the University of Erlangen in Germany for three months in 1987 with a fellowship from the German Academic Program (DAAD) where he developed a strong collaboration with Prof R. Waibel. As a postdoctoral researcher, he also spent 10 months at the University of Nijmegen (Netherlands) in 1988 and three weeks at the University of Salford (USA) as a Visiting Scientist in 1989.

The year preceding the award of the IFS grant, he also received the "Best Worker Award" (Faculty of Science) from the University of Dar es Salaam. Earlier his BSC (73-76) and MSC (77-79) studies at the University of Dar es Salaam were supported by grants from the Tanzanian Government and the University of Dar es Salaam.

The IFS support played a role in Prof. Mayunga Nkunya's impressive research and academic career even though it was not the first research grant he received from foreign origin, but the third. The IFS grant was preceded by a grant from the Dutch government (NUFFIC) for research collaboration in organic chemistry with the University of Nijmegen (1986-1998) as a follow up to his Ph.D. work, and a grant by NORAD in 1988 for a project very similar to the IFS one ("Chemical studies of Tanzanian medicinal plants and soft corals").

Not surprisingly, and mainly thanks to the scientific collaborations he developed during his Ph.D. and visits abroad (The Netherlands, USA, Germany), he had already 31 references in his publication list at the time he applied to IFS for a grant. Among these 31 references, 13 are articles published in peer reviewed international journals such as Journal of Natural Products, Phytochemistry, Planta Medica and the Journal of the Royal Netherlands Chemical Society. Most of them have been published after his Ph.D. in 1984. The remaining references are papers

published at conference proceedings and in local journals.

Soon after receiving his first IFS grant, he developed a working collaboration with the Swiss Tropical Institute, today known as the Ifakara Health Research and Development Center. While he was having the biological testing of his compounds carried out at the latter institute, he was supervising two Swiss students doing their research work in his lab. Several papers were published in 1995 with Swiss scientists mainly on plants having antimalarial properties. As a Visiting Associate Professor, he was also invited to spend 5 months during 1994 with Prof. I.T.Urasa at the Department of Chemistry at Hampton University (Virginia-USA). He then got some support in 1995 from the National Institute of Health (NIH-USA) for a research training programme in Natural Products he conducted in collaboration with the same University (Hampton University) in the USA. This programme is still going on. Finally, he was awarded a grant from Sida/SAREC for a research project titled "The search for Natural Pesticidal Agents" funded in the framework of the Faculty of Science Capacity Building Support, since January 1998.

Since 1987, he supervised 27 M.Sc. and 2 Ph.D. Tanzanian students and two Ph.D. Swiss students

Today, with long lasting scientific collaborations in an increasing number of countries abroad, Prof Nkunya is an established scientist nationally, regionally (mainly through the NAPRECA network) and internationally. With more than 70 references in his publication list (most of which being published during the last 15 years in international peer reviewed journals) he is a very active and productive scientist.

In Prof Nkunya's case, given the multiplicity of supports and contacts he received during his research career both before and after the IFS support, it is very difficult to conclude on what has been the specific role of the IFS support. When he applied to IFS the first time, he was 38 years old and had received his Ph.D. seven years earlier. He was then certainly already getting established regionally and internationally. The IFS support was certainly "enabling" but the building blocks did not come from the IFS support.

5. Additional tables and figures

| Acronym | Name of Organisation |
|---------|---|
| AAS | African Academy of Science |
| AFRNET | African Feed Resources Network |
| BADC | Belgian Agency for Development Co-operation |
| DFID | Department for International Development (UK) |
| CASEC | Community Aid Small Enterprises Consultancy |
| CIAT | Centro International de Agricultura Tropical |
| CIDA | Canadian International Development Agency |
| DAAD | Germany Academic Exchange Service |
| CIFOR | Centre for International Forestry Research |
| CSID | Centre for Sustainable Development |
| CSIRO | Commonwealth Scientific Industrial and Research Organisation of Australia |
| DANIDA | Danish International Development Agency |
| ELCT | Evangelical Lutheran Church of Tanzania |
| ECEP | Environmental Capacity Enhancement Project |
| ENRECA | Enhancement of Research Capacity in Developing Countries (DANIDA) |
| EU | European Union |
| EARMESA | Farm Level Applied Research Methods for East and Southern Africa |
| FAO | Food and Agricultural Organization of the United Nations |
| FFACT | "French Food Aid Counterpart Fund (French Embassy, DSM)" |
| FINNIDA | Finnish Development Agency |
| GTZ | German Technical Co-operation |
| IAEA | International Atomic Energy Agency |
| IBSRAM | International Board for Soil Research and Management |
| IAEA | International Agricultural Engineering Association |
| ICRAF | International Research Centre for Agroforestry |
| ICRISAT | International Crop Research Institute for Semi-Arid Tropics |
| IDRC | International Development Research Centre |
| IFS | International Foundation for Science |
| IFUW | International Federation of University Women |
| ILRI | International Livestock Research Centre |
| INR | Institute of Natural Resources |
| JICA | Japanese International Co-operation Agency |
| NORAD | Norwegian Agency for Development Co-operation |
| NRS | Norwegian Research Council |

Table A1

Foreign institutions supporting research and postgraduate studies at SUA

| Acronym | Name of Organisation |
|----------|---|
| NORAGRIC | Norwegian Centre for International Agric. Development |
| NUFU | "Norwegian Council of Universities for Development, Research and Education" |
| NIRP | Netherlands Israel Research Development Programme |
| OSSREA | Organization for Social Science Research in Eastern Africa |
| REPOA | Research on Poverty Alleviation |
| SACCAR | South African Countries Centre for Agricultural Research |
| SADC | Southern African Development Co-operation |
| SASAKAWA | SASAKAWA Global 2000 |
| SIDA | Swedish International Development Agency |
| UNDP | United Nations Development Programme |
| USAID | United States of America Agency for International Development |
| USDA | United States Department of Agriculture |
| VLIR | Flemish Inter University Council |
| WFP | World Food Programme |

Table A1 (continued)

Foreign institutions supporting research and postgraduate studies at SUA

| Country | Period during which the first grant was awarded | | | |
|-----------------|---|-----------|-----------|-------|
| | 1974-1980 | 1981-1990 | 1991-2000 | Total |
| United Kingdom | 8 | 5 | 4 | 17 |
| Tanzania | 2 | 6 | 3 | 11 |
| United States | 3 | 4 | 1 | 8 |
| Sweden | 0 | 0 | 5 | 5 |
| Canada | 1 | 1 | 0 | 2 |
| Nigeria | 0 | 2 | 0 | 2 |
| Austria | 0 | 1 | 0 | 1 |
| Belgium | 0 | 0 | 1 | 1 |
| Denmark | 0 | 1 | 0 | 1 |
| The Netherlands | 0 | 1 | 0 | 1 |
| Norway | 0 | 1 | 0 | 1 |
| Russia | 0 | 1 | 0 | 1 |
| Total | 14 | 23 | 14 | 51 |

Table A3

Source country of scientists' highest degree at the time of their first grant

| Institution | City | No. of Appl. | No. of Grants |
|---|---------------|--------------|---------------|
| Universities | | 74 | 19 |
| Sokoine University of Agriculture | Morogoro | 53 | 15 |
| University of Dar es Salaam (UDSM) | Dar es Salaam | 21 | 4 |
| COSTECH Research Institutes | | 27 | 7 |
| Horticultural Research and Training Institute (HORTI) | Arusha | 1 | 0 |
| National Institute for Medical Research (NIMR) | Dar es Salaam | 1 | 0 |
| Tanzania Bureau of Standards (TBS) | Dar es Salaam | 1 | 0 |
| Tanzania Fisheries Research Institute (TAFIRI) | Dar es Salaam | 4 | 1 |
| Tanzania Food and Nutrition Centre (TFNC) | Dar es Salaam | 5 | 3 |
| Tanzania Forestry Research Institute (TAFORI) | Kibaha | 6 | 2 |
| Tanzania Industrial Research and Development Organization (TIRDO) | Dar es Salaam | 5 | 0 |
| Tropical Pesticides Research Institute (TPRI) | Arusha | 4 | 1 |
| Ministry of Agriculture Research Institutes | | 48 | 11 |
| Agricultural Research Institute Naliendele | Mtwara | 1 | 0 |
| Animal Diseases Research Institute | Dar es Salaam | 4 | 0 |
| Ilonga Agricultural Research and Training Institute | Kilosa | 4 | 1 |
| Maruku Agricultural Research Institute | Bukoba | 4 | 0 |
| Mikocheni Agricultural Research Institute | Dar es Salaam | 3 | 0 |
| Ministry of Agriculture Research and Training Centre - Uyole | Mbeya | 3 | 1 |
| Mlingano Agricultural Research Institute | Tanga | 1 | 1 |
| Mpwapwa Livestock Production Research Institute | Mpwapwa | 13 | 6 |
| Selian Agricultural Research Institute | Arusha | 2 | 0 |
| Silviculture Research Station | Lushoto | 1 | 0 |
| Tanga Livestock Production Research Institute | Tanga | 4 | 0 |
| Tanzania Agricultural Research Organization Lyamungu | Moshi | 3 | 1 |
| Tsetse & Trypanomiasis Research Institute | Tanga | 1 | 0 |
| Tumbi Agricultural Research and Training Institute | Tabora | 2 | 1 |
| Ukiriguru Agricultural Research and Training Institute | Mwanza | 1 | 0 |
| Viticultural Research and Training Institute | Dodoma | 1 | 0 |
| Others | | 28 | 1 |
| Forestry and Beekeeping Division (Min of Natural Resources and Tourism) | Dar es Salaam | 2 | 0 |
| Min of Water, Energy and Minerals / Regional Agricultural Office | Dodoma | 2 | 0 |
| Muhimbili University College of Health Sciences | Dar es Salaam | 3 | 0 |
| National Museums of Tanzania | Dar es Salaam | 4 | 1 |
| Tanzania Official Seed Certification Agency | Morogoro | 2 | 0 |
| Training and Extension, Hifadhi Ardhi Shinyanga | Shinyanga | 2 | 0 |
| 13 Other institutions each produced one application | | 13 | 0 |
| Total | | 177 | 38 |

Table A2

Home institution of applicants and grantees, 1985-2001

| Year | Research Area | | | | | | | | | Total |
|-------|---------------|----|----|----|----|----|---|---|---|-------|
| | A | B | C | D | E | F | G | H | ? | |
| 1985 | 0 | 3 | 2 | 0 | 0 | 2 | 2 | 0 | 1 | 10 |
| 1986 | 2 | 2 | 4 | 0 | 1 | 1 | 0 | 0 | 0 | 10 |
| 1987 | 2 | 4 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 8 |
| 1988 | 2 | 3 | 4 | 2 | 1 | 0 | 0 | 0 | 0 | 12 |
| 1989 | 2 | 5 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 9 |
| 1990 | 1 | 2 | 1 | 1 | 2 | 4 | 0 | 0 | 0 | 11 |
| 1991 | 1 | 4 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 9 |
| 1992 | 1 | 5 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 9 |
| 1993 | 0 | 4 | 3 | 2 | 0 | 1 | 0 | 0 | 0 | 10 |
| 1994 | 1 | 10 | 1 | 4 | 2 | 0 | 0 | 0 | 0 | 18 |
| 1995 | 1 | 3 | 2 | 1 | 1 | 2 | 0 | 0 | 0 | 10 |
| 1996 | 1 | 5 | 4 | 1 | 0 | 0 | 0 | 1 | 0 | 12 |
| 1997 | 0 | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 4 |
| 1998 | 0 | 6 | 6 | 2 | 1 | 0 | 0 | 0 | 0 | 15 |
| 1999 | 0 | 4 | 3 | 2 | 1 | 2 | 0 | 0 | 0 | 12 |
| 2000 | 0 | 9 | 5 | 5 | 0 | 1 | 0 | 0 | 0 | 20 |
| Total | 14 | 71 | 41 | 22 | 10 | 14 | 4 | 1 | 2 | 179 |

Table A4

Applications to IFS by year and Research Area

IFS MESIA Impact Studies

- Report No. 1 *Monitoring and Evaluation System for Impact Assessment (MESIA),
Conceptual Framework and Guidelines*
Gaillard J.
Stockholm: IFS, 2000. 38 pages.
- Report No. 2 *Questionnaire Survey of African Scientists*
Gaillard J. and A. Furó Tullberg
Stockholm: IFS, 2001. 92 pages.
- Report No. 3 *IFS Impact in Mexico: 25 years of support to scientists*
Gaillard J., J.M. Russell, A. Furó Tullberg,
N. Narvaez-Berthelemot and E. Zink
Stockholm: IFS, 2001. 152 pages.
- Report No. 4 *Strengthening Science Capacity in Tanzania: An impact analysis of IFS
support*
(this document)
Gaillard J., E. Zink, and A. Furó Tullberg.
Stockholm: IFS, 2002. 105 pages.



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