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Statistical Brief on the National Agricultural Research System

of

MADAGASCAR

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Philip G. Pardey

ISNAR INDICATOR SERIES PROJECT: PHASE II
International Service for National Agricultural Research
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ISNAR INDICATOR SERIES PROJECT PHASE II

Decision making in the agricultural research policy area in either domestic, regional, or international fora can only be aided by access to reliable and comprehensive data on these systems. It is for this reason that ISNAR initiated its Indicator Series Project in 1986. The major objective of this project is to collect, process, and analyze reliable and comprehensive time-series data on national agricultural research systems (NARSs) throughout the world in order to identify and report on major trends and emerging policy issues with regard to the development of NARSs. To this end a database has been developed that contains time-series data on agricultural research expenditures and personnel for more than 150 developing and developed countries. These data provide a quantitative basis for more in-depth research policy studies by ISNAR and others.

During the first phase of the project (1986-91), the Indicator Series project team produced two major publications published by Cambridge University Press, namely:

Pardey, P.G., and J. Roseboom. (1989) *ISNAR Agricultural Research Indicator Series: A Global Data Base on National Agricultural Research Systems*, 547 pp.; and

Pardey, P.G., J. Roseboom, and J.R. Anderson, eds. (1991) *Agricultural Research Policy: International Quantitative Perspectives*, 462 pp..

The first publication is a statistical reference volume that provides system-level data on agricultural research personnel and expenditures for 154 countries. The second publication draws on the database to report on the major policy dimensions of agricultural research, with a primary focus on less-developed countries.

Phase II of the Indicator Series Project was initiated in 1992 and seeks to update the database and the policy analyses that accompany it. New ISNAR survey data are being used in conjunction with a large variety of published and "informal" reports in order to produce reliable as well as up-to-date information and statistics about the NARSs.

The country-level data are being published in a series of NARS Statistical Briefs. These briefs include more detailed descriptive information about the institutional structure of the NARS as well as a more comprehensive set of statistics than were reported in the 1989 Indicator Series volume. It is envisaged the country-level data will be assembled and analyzed in a series of regional research reports.

These statistical briefs are not official ISNAR publications; they are not edited or reviewed by ISNAR. The information and data presented have been collected and compiled with due care and all reasonable efforts have been made to ensure their accuracy. Comments, corrections, and additions to the material reported in this brief are welcomed. These briefs may be cited with due acknowledgment.

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Acronyms

CGIAR	Consultative Group on International Agricultural Research	IFCC	Institut Français du Café et du Cacao et Autres Plantes Stimulantes
CENRA- DERU	Centre National de la Recherche Appliquée au Développement Rural	INAC	Institut National d'Agronomie Coloniale
CNRE	Centre National de Recherches sur l'Environnement	IRAM	Institut de Recherches Agronomiques à Madagascar
CNRO	Centre National de Recherches Océanographiques	IRAT	Institut de Recherches Agronomiques Tropicales et des Cultures Vivrières
CTFT	Centre Technique Forestier Tropical	IRCT	Institut de Recherches du Coton et des Textiles Exotiques
DRA	Département de la Recherche Agronomique	IRFA	Institut de Recherches sur les Fruits et Agrumes
DRD	Département de la Recherche-Développement	IRHO	Institut de Recherches pour les Huiles et Oléagineux
DRFP	Département de la Recherche Forestière et Piscicole	IRSM	Institut de Recherche Scientifique de Madagascar
DRR	Département de la Recherche Rizicole	ISM	Institut des Sciences Marines
DRT	Département de la Recherche Technologique	ISNAR	International Service for National Agricultural Research
DRZV	Département de la Recherche Zootechnique et Vétérinaire	LBC	Laboratoire de Biochimie
ESSA	Ecole Supérieure des Sciences Agronomiques	LBV	Laboratoire de Biologie Végétale
FIFA- MANOR	Fiompiana sy Fambolena Malagasy Norveziana	LPV	Laboratoire de Physiologie Végétale
FOFIFA	Foibem-Pirenena Mombra ny Fikarohana Ampiharina Amin'ny Fampanandrosoana ny eny Ambanivohitra (see CENRADERU)	LRI	Laboratoire des Radioisotopes
FTE	Full-Time Equivalent	MRSTD	Ministère de la Recherche Scientifique et Technologique pour le Développement
IEMVT	Institut d'Élevage et de Médecine Vétérinaire des Pays Tropicaux	NARS	National Agricultural Research System
		ORSTOM	Office de la Recherche Scientifique et Technique Outre-Mer

1. Introduction

The primary purpose of this brief is to provide statistical and institutional details on the development and current status of the public agricultural research system in Madagascar. This information has been collected and presented in a systematic way in order to inform and thereby improve research policy formulation with regard to the Malagasy NARS. Most importantly, these data are assembled and reported in a way that makes them directly comparable with the data presented in the other country briefs in this series. And because institutions take time to develop and there are often considerable lags in the agricultural research process, it is necessary for many analytical and policy purposes to have access to longer-run series of data.

NARSs vary markedly in their institutional structure and these institutional aspects can have a substantial and direct effect on their research performance. To provide a basis for analysis and cross-country, over-time comparisons, the various research agencies in a country have been grouped into five general categories; government, semi-public, private, academic, and supranational. A description of these categories is provided in table 1.

Table 1: *Institutional Categories*

Category	Description	Examples
Government	Agencies directly administered by government.	Research department within a ministry
Semi-public	Agencies not directly controlled by government and with no explicit profit making objective.	Research institute under a commodity board
Private	Agencies whose primary activity is the production of goods and services for profit.	Agricultural machinery or chemical company
Academic	Agencies that combine university-level education with research.	Faculty of agriculture
Supranational	Agencies whose mandate covers more than one country.	CGIAR institutes

Note: Adapted from OECD (1981).

The concept of a NARS used throughout this report includes only those institutes that can be classified as government, semi-public, and academic agencies. Where it is useful to do so, private and supranational research agencies have been discussed, but for reasons of comparability they are not included in the NARS data reported here. More detailed information on the definitions and concepts used in this brief is provided in appendix 2.

Section 2 provides a brief description of the institutional development and current structure of the NARS. Section 3 presents a statistical overview of the longer-run investment trends in agricultural research along with a more detailed look at contemporary investment orientations. The appendices provide further descriptive details and present the basic research personnel and expenditure data in disaggregated fashion. For general background information and statistics on Madagascar we refer to appendix 1.

2. Agricultural Research Institutions

2.1 Historical Evolution¹

In 1868 a treaty between the Merina Kingdom and France gave the French control over the northwest coast of Madagascar. In 1890 the British recognized Madagascar as a French protectorate, but it was not until 1896 that the French effectively gained control of the whole island. At the turn of the century France set up a system of experimental gardens throughout its colonies, modeled after the British system of botanical gardens linked to Kew Gardens near London. In a similar vein a Jardin Colonial was established at Nogent-sur-Marne near Paris in 1899 as the metropolitan center for the jardins d'essais located throughout the French colonies. This was followed by the establishment of the Ecole Supérieure de l'Agriculture Tropicale in 1902 on the same location as the Jardin Colonial. The garden and the school were merged in 1921 to become the Institut National d'Agronomie Coloniale (INAC).

In Madagascar, a number of jardins d'essais (experimental gardens) were established between 1896 and 1905 at locations such as Nanisana, Ivoloïna, Manangara, and Fort Dauphin (Angladetie 1988). In 1904 a cotton testing station was also established at Marovoay.

With the introduction of more sophisticated research methods after World War I, the jardins d'essais evolved into experiment stations which, in contrast with the diverse botanical collections of the gardens, often focussed on only a few crops. Over time the Maravoay station became specialized in rice, the station at Lac Alaotra (established in 1922) in rice and cassava, and the Ivailona station in coffee and vanilla, two of the country's major export crops. By 1930 central laboratories for agricultural chemistry and phytopathology had been established at the old jardin d'essais at Nanisana near Tananarive. These laboratories were incorporated into the Institut Pasteur de Tananarive in the 1930s, to which was added a phytogenetic laboratory and a central service for agricultural hydrology. The institute continued to provide these research-support services until after World War II.

During the period leading up to World War II, all of the country's experiment stations and laboratories reported directly to the local colonial government. INAC's role at this time was limited to providing scientific backstopping from its headquarters in France to these Malagasy research facilities. Following the War, France began to reorganize its tropical agricultural research activities into a series of commodity institutes with headquarters in France and numerous research stations located throughout its (former) colonies. Under this new structure the emphasis was placed on cross-country commodity research managed by the metropole. These French institutes did not commence operations in Madagascar until the late 1950s, while some did not initiate research in Madagascar until after the country gained independence in 1958.

Meanwhile, in 1950, the local agricultural research activities were reorganized into a service d'études et de recherches agronomiques (agronomic research service), a service de défense des cultures (plant protection service), and a service antiacridien (locust control service). The service d'études et de recherches agronomiques comprised a group of central laboratories that were formerly part of the Institut Pasteur, as well as the plant improvement service, and the experiment stations at Alaotra, Ivoloïna, Marovoay, and Bealahana. The plant protection

1 The information presented in this section draws largely from FOFIFA (n.d.), UNESCO (1970), ORSTOM (1976), Ramalanjaona (1967), ORSTOM (1976), Angladetie (1988), and IRAT (1990).

service conducted some phytopathological research, while the locust control service had a research center at the Betioky station.

With political independence, the management of the local research stations was delegated to IRAT,² IRCT, IRFA, IFCC, IRHO, and CTFT through a series of bilateral agreements. This situation continued until 1974 when the Malagasy Government assumed direct control of the country's agricultural research agencies and established the Centre National de la Recherche Appliquée au Développement Rural (CENRADERU or FOFIFA in Malagasy). Some collaboration with the French institutes continued but at a substantially lower level of intensity.

Veterinary research in Madagascar got underway with the establishment of the Veterinary Services in 1907. The first veterinary laboratory was established at Mahamasina in the early 1920s. Between 1925 and 1950, livestock experiment stations were opened at Befanamy, Ambovombe, Antsirabe, Moraharivo, Mahabo, and Kianjasoa. After 1950, the station at Kianjasoa developed into one of the country's two main livestock research centers. The other center was established at Miadana in 1956. In 1934, the veterinary laboratory at Mahamasina was integrated into the Institut Pasteur. The laboratory was relocated to Ampandrianomby in 1955 and renamed Laboratoire Central de l'Élevage "Joseph Carougeau."

Between 1961 and 1974 the management of all livestock and veterinary research in Madagascar was delegated to IEMVT, including the veterinary laboratory that was formerly part of the Institut Pasteur. IEMVT's activities were taken over by the Département de Recherches Zootechniques et Vétérinaires (DVRZ) of FOFIFA in 1974.

Although many exotic tree and fish species were introduced into Madagascar in the 19th and 20th centuries, formal forestry and fisheries research did not begin until the early 1950s when a research section was established within the Service des Eaux et Forêts. Research in forestry and fisheries was strengthened with the establishment of CTFT in 1961 and the subsequent delegation of forestry and inland fisheries research to CTFT. With the creation of FOFIFA in 1974, CTFT's activities were absorbed into this new organization.

ORSTOM began operations in Madagascar in 1946 as the Institut de Recherche Scientifique de Madagascar (IRSM). IRSM was subsequently renamed the Centre ORSTOM de Tananarive. Its research, which was relatively basic in its orientation, involved many disciplines, ranging from biology and entomology to anthropology and history. Over time, ORSTOM gradually moved toward a portfolio of research that focussed heavily on agriculturally related topics. In 1974, the management of ORSTOM's activities in Madagascar was placed under the Direction de la Recherche Scientifique et Technique (DRST). ORSTOM's activities in Madagascar were nationalized in 1977 and its facilities and research programs at Tananarive were taken over by the newly established Centre National de la Recherche de Tsimbazaza (CNRT). CNRT, which was administered by the Ministère de l'Enseignement Supérieur et de la Recherche Scientifique, comprised five departments, namely hydrology, medical entomology, geophysics, human sciences, and botany. In 1983 the center was abolished and the departments of hydrology, medical entomology, and a part of the human sciences department were transferred to the Ministère de la Recherche Scientifique et Technologique pour le Développement (MRSTD), the geophysics department was merged with the Centre National de Recherche

2 In 1940, INAC's research and training activities were administratively separated. The research activities were grouped within an agency named Section Technique d'Agronomie Tropicale, which in the 1950s was merged with ORSTOM. In 1960, this section, whose mandate had been reduced to food crops only, formed the basis for the creation of IRAT.

Industrielle et Technologique, and a the remainder of the human sciences department, the zoological and botanical park, and entomological and botanical collections remained with the Ministère de l'Enseignement Supérieur.

ORSTOM's technical assistance to Madagascar declined sharply after 1974 and virtually ceased in 1977. Only some ad hoc collaboration in the area of hydrological research was continued. Since 1984, however, collaboration with ORSTOM has been revived and several collaborative projects are presently underway, in particular with CNRE and CIDST, and, to a lesser extent, with CNRO.

In 1988, the Centre National de Recherches sur l'Environnement (CNRE) was created within MRSTD. CNRE absorbed the former CNRT departments attached to MRSTD and covers a wide range of research activities, of which only 10% is of direct relevance to agriculture. The center collaborates closely with ORSTOM.

Oceanographic research, including a substantial marine fisheries research component, began in 1953 with the establishment of a research station at Nosy-Bé by ORSTOM. With the nationalization of ORSTOM's research activities and facilities in 1977, this station became the Centre National de Recherches Océanographiques (CNRO). CNRO is part of MRSTD.

As a consequence of the "nationalization" of research in 1974, the number of French nationals involved in agricultural research dropped dramatically from about 100 in 1973 to less than 10 by the late 1970s. At the time of nationalization, the number of national researchers was still quite small and very few were educated above BSc level. This severely curtailed many agricultural research projects and programs. In addition, the exodus of French researchers was paralleled by a contraction in the financial contributions coming from France.

FOFIFA is currently the main agricultural research organization in the country. It was created in 1974 as a semi-autonomous institute under the Ministère du Développement Rural. In 1977, FOFIFA was attached to the new Ministère de la Recherche Scientifique et Technique which, in that same year, was absorbed into the Ministère de l'Enseignement Supérieur et de la Recherche Scientifique. Five years later, in 1982, the institute was moved back to the renamed Ministère de la Production Agricole et de la Reforme Agraire. Since 1983, FOFIFA has been administered by the Ministère de la Recherche Scientifique et Technologique pour le Développement (MRSTD).

Initially FOFIFA included four research departments: Département de la Recherche Agronomique (DRA), Département de la Recherche Zootechnique et Vétérinaire (DRZV), Département de la Recherche Forestière et Piscicole (DRFP), and Département de la Recherche Technologique (DRT). A Département de la Recherche-Développement (DRD) was created within FOFIFA in 1984, while the Département de la Recherche Rizicole (DRR) was separated from DRA in 1989. FOFIFA's mandate, however, has remained unchanged since 1974.

In 1972, a bilateral agreement between Norway and Madagascar led to the creation of FIFAMANOR, an institute designed to promote improved production practices for wheat, potatoes, and milk. In addition to an extension program, FIFAMANOR has also maintained a small research unit for the past two decades that focusses mainly on wheat, potatoes, and forages. FIFAMANOR is part of the Ministère de l'Agriculture.

The Ecole Supérieure des Sciences Agronomiques (ESSA), established in 1962, is the major academic institute in Madagascar concerning agricultural research. Some agriculturally related

research is also conducted by the Laboratoire de Radio-Isotopes (established in 1965), the Laboratoire de Physiologie Végétale (1972), the Laboratoire de Biologie Végétale, and the Laboratoire de Biochimie, which are all part of the Université d'Antananarivo. The latter three laboratories together form the Service de Biologie Végétale et Biochimie of the Faculté des Sciences. In addition some marine fisheries research is conducted by the Institute des Sciences Marines at the Université de Tuléar, previously known as the Station Marine de Tuléar and established in 1961.

2.2 Present Structure

FOFIFA is the dominant agricultural research agency in Madagascar. In 1991 it accounted for 80% of the country's research capacity in terms of full-time equivalent researchers (table 2). Its research mandate includes most research aspects related to crop and livestock production, forestry, and inland fisheries.

Since 1989 FOFIFA has comprised of six research departments: DRA, DRZV, DRFP, DRT, DRD, and DRR. FOFIFA does research at its headquarters located near Antananarivo and at eight regional research centers. In addition there are four research stations and five sub-stations linked to these regional research centers. A further regionalization and decentralization of FOFIFA's research is presently being undertaken by the National Agricultural Research Project (NARP).

CNRO comprises three research departments (namely fisheries, marine biology, and oceanography), a statistical unit, and support services. Most of the research staff are located at headquarters at Nosy-Bé. The statistical unit is located at Antsiranana and there are also two maregraphic stations at Taolagnaro and Nosy-Bé.

CNRE comprises four research departments, namely environment and phytogenetic resources, natural ecosystems, human geography, and environment and the quality of life. Only a small proportion (10%) of CNRE's research activities are of direct relevance to agriculture.

FIFAMANOR consists of five departments: research, extension, livestock development, social development, and administration. Research is executed at three stations located at Mimosa, Armor, and Tsiafajavona. No researcher is permanently based at Tsiafajavona.

The academic component of the Malagasy NARS is quite small, available personnel data suggesting it represents less than 10% of the country's research capacity. ESSA is the principal academic agency in the agricultural sciences and consists of five departments: agronomy and plant sciences, animal science and husbandry, forestry, agro-industries and food science, and social sciences.

The present organizational structures of most of the country's institutes are provided in diagrammatic form in appendix 3.

3. NARS Statistics

Questionnaire responses were received from FOFIFA, CNRO, CNRE, FIFAMANOR, and ESSA and combined with data and information from sources cited at the conclusion of this brief. Because of insufficient time-series data LPV, LBV, LBC, LRI, and ISM were omitted from the NARS statistics presented here. These five entities taken together probably account for

Table 2: Overview of Present NARS Structure, 1991

Institutional category	Executing agency			Research focus	Staffed research sites ^a	Number of researchers			
	Supervising agency	Name	Acronym			National	Expats	Total	FTE
Public	Ministère de la Recherche Scientifique et Technologique pour le Développement	Centre National de la Recherche Appliquée au Développement Rural	FOFIFA	crops, livestock, forestry, fisheries	17 (12)	131	26	157	157.0
		Centre National de Recherches Océano-graphiques	CNRO	marine fisheries	3 (2)	11	2	13	13.0
	Ministère de l'Agriculture	Centre National de Recherches sur l'Environnement	CNRE	soils, water, medical plants, mangroves, farming systems	1 (1)	35	5	40	4.0
		FIFAMANOR	FIFA-MANOR	crops and livestock	3 (2)	7	2	9	9.0
Academic	Université d'Antananarivo	Ecole Supérieure des Sciences Agronomiques	ESSA	crops, livestock, forestry, socio-economics, food, agro-industries	1 (1)	34	5	39	11.7
		Laboratoire de Radio-Isotopes	LRI	crops	1 (1)	2	2	4	1.0
	ditto, Faculté des Sciences	Laboratoire de Physiologie Végétale	LPV	crops	1 (1)	3	1	4	1.0
		Laboratoire de Biologie Végétale	LBV	crops	1 (1)	na	na	na	na
Université de Tuléar, Faculté des Sciences	Laboratoire de Biochimie	LBC	biotechnology (?)	1 (1)	na	na	na	na	
	Institut des Sciences Marines	ISM	marine fisheries	1 (1)	4	1	5	1.3	
<i>Total</i>					30 (23)	227	44	271	198.0

Source: 0999.

Note: Data in square brackets are inferred or constructed by authors.^a Staffed with researchers and/or technicians. Bracketed sites are staffed with researchers.

an additional 3% of the country's agricultural research personnel. Also not included, because of lack of information, are CNRT and its successors. Although CNRT's predecessor, ORSTOM de Tananarive, constituted a substantial component of Madagascar's agricultural research capacity during the time it was in operation (1946-77), CNRT and its successors do not seem to have conducted much agriculturally related research. Given the lack of institutional continuity after the ORSTOM facilities were nationalized in 1977, combined with the fact that FOFIFA was given primary responsibility for agricultural research in 1974, it is reasonable to assume that these omissions do not meaningfully affect the overall statistical picture presented in this brief. More detailed institutional data are provided in appendices 5 and 6.

The expenditure data presented here are based as much as possible on the actual expenditures as reported by the various institutes. However, institutes most likely underestimate the degree of donor support if they only have information about the donor funds that are channeled through their accounting system. Most importantly they often underreport or fail to report the salaries and supplements paid directly to expatriate researchers. To correct for this problem in the Malagasy data, we constructed an implicit cost series for expatriate researchers and where necessary added this to the expenditures reported by the various institutes (appendix 2).

3.1 Long-term development

The development of Madagascar's NARS over the past 30 years was heavily influenced by the nationalization of the system in the mid-1970s. This process of nationalization was far from smooth as collaboration with the French institutes was abruptly terminated as a result of strained political relations between the two countries. This constituted a significant setback in the development of Madagascar's NARS. As shown in table 3, both the number of researchers as well as the amount of research expenditures fell precipitously during the 1970s. While the number of researchers began to recover during the 1980s, expenditures continued to decline as a

Table 3: *NARS Researcher and Expenditure Series, 1961-91*

	1961-65	1966-70	1971-75	1976-80	1981-85	1986-90	1991	Annual growth rate ^a
								%
Researchers (FTEs)	77.9	102.8	93.9	69.0	104.6	161.5	194.7	2.2
Expenditures (million 1985 Malagasy Francs per year)	4946.2	6185.2	5491.1	3909.7	2996.3	3292.9	3514.6	-2.4
Expenditures (million 1985 PPP dollars ^b per year)	21.998	27.509	24.421	17.388	13.326	14.645	15.631	-2.4
Expenditures per researcher (1985 PPP dollars per year)	281,000	267,000	264,000	265,000	129,000	91,000	80,000	-4.5
Number of econ. active agr. population (millions)	2.4	2.6	2.9	3.2	3.5	3.8	4.0	1.8
Researchers per million econ. act. agr. population	31.8	38.9	33.1	21.6	29.8	42.2	48.2	0.4
AgGDP (million 1985 PPP dollars)	2461	2407	2423	2382	2520	2883	3076	0.6
Expenditures as a % of AgGDP	1.18	1.53	1.18	0.72	0.52	0.53	0.57	-4.1

Source: See appendices 5 and 6.

Note: Includes FOFIFA and predecessors, CNRO and predecessor, CNRE, FIFAMANOR, ESSA, and ORSTOM de Tananarive until 1976. Not included in these time series are the academic institutes except for ESSA. Consequently the number of FTE researchers reported here for 1991 is lower than in table 2.

^a Least squares growth rate for the 1961-91 period.

^b For information about "PPP dollars" see appendix 2.

result of the country's poor economic performance and has only recently shown signs of improvement. But even by 1991, agricultural research expenditures in real terms were only just over one-half the level that prevailed in the late 1960s.

Because of the contraction that occurred in the 1970s, the longer-run average annual growth in research staff (2.2% per annum) and expenditures (-2.4% per annum) have been low compared with other African countries, which achieved corresponding rates of growth of 6.8% and 4.7% respectively during the period 1961-85. Another notable feature of the longer-run pattern of development is the dramatic decline in expenditures per researcher.

Until the mid-1970s, the number of researchers per million economically active agricultural population as well as expenditures as a percentage of AgGDP were well above the corresponding African averages. In the 1970s, however these intensity ratios dropped to levels in Madagascar that were more in line with the respective regional averages.

3.2 Human Resources

Degree and Nationality Status of Researchers

Table 4 presents a more detailed, long-run overview of developments concerning the country's agricultural research staff. Since FOFIFA represents a major component of the NARS, its pattern of development may be considered representative of developments of the system as a whole. Following the nationalization of the agricultural research system in 1974, the number of expatriate researchers declined dramatically. Prior to 1974, however, the research entities taken over by FOFIFA were staffed mainly by French researchers. Initially these French researchers were replaced by national researchers, most of whom were trained only to the BSc level. Over time the education levels of national researchers improved although the percentage of researchers with a PhD is still comparatively low. After the exodus of expatriate researchers in the 1970s, their numbers have increased markedly over the past 6 to 7 years in line with increased donor support.

Table 4: *Educational and Nationality Status of Researchers*

Institution	Researcher status	1971-75	1976-80	1981-85	1986-90	1991
		<i>(full-time equivalents)</i>				
FOFIFA	Nationals					
	PhD	0.0	1.8	3.5	8.9	12.0
	MSc	0.8	13.2	21.9	54.9	81.0
	BSc	13.6	35.5	47.5	41.2	38.0
	Subtotal	14.4	50.5	72.9	105.0	131.0
	Expatriates	46.0	4.6	7.7	23.4	26.0
	<i>Total</i>	<i>60.4</i>	<i>55.1</i>	<i>80.6</i>	<i>128.4</i>	<i>157.0</i>
ESSA	Nationals					
	PhD	na	na	3.8	6.6	7.8
	MSc	na	na	3.1	2.8	2.4
	BSc	na	na	1.0	0.4	0.0
	Subtotal	na	3.4	8.0	9.8	10.2
	Expatriates	na	2.8	3.0	2.9	1.5
	<i>Total</i>	<i>4.7</i>	<i>6.2</i>	<i>11.0</i>	<i>12.7</i>	<i>11.7</i>

Source: See appendix 6.

Although no data were available, it is reasonable to assume that ESSA was staffed mainly by expatriate faculty prior to 1974. By contrast with the degree profiles of FOFIFA, the faculty at ESSA mainly hold higher degrees and an increasing number are trained to the doctoral level.

Gender

In 1991, 31% of the researchers at both FOFIFA and CNRO were women and at ESSA the corresponding figure was 21%. FIFAMANOR reported they do not employ any female researchers. Overall, about 30% of the agricultural researchers in Madagascar are women. Compared with many other African countries this is a relatively high percentage.

Staff Composition

Table 5 provides a detailed breakdown of each institute's total permanent staff. The number of technical support staff per researcher ranges between 0.5 and 1.0. FOFIFA's technical support per researcher ratio has trended down noticeably since the mid-1980s. The number of other support staff at FOFIFA was also reduced significantly during this period. This reduction in support staff may well reflect an attempt by government to correct for the excess job creation practices of the past as well as the severe budget constraints facing public-sector institutions.

Table 5: *Staffing Structure*

Staff Category	FOFIFA			CNRO	CNRE	FIFAMANOR	ESSA
	1986-90	1991	1992	1991	1991	1991	1991
	<i>(number of personnel)^a</i>						
Research	128.4	157	153	13	40	7	34
Support							
Technical	101.4	91	87	12	20	6	na
Administrative	47.2	43	43	23	na	3	na
Other	907.8	753	708	33	na	14	na
Subtotal	1056.4	887	838	68	na	23	76
<i>Total</i>	<i>1184.8</i>	<i>1044</i>	<i>991</i>	<i>81</i>	<i>na</i>	<i>30</i>	<i>110</i>

Source: 0999.

^a In the case of CNRE and ESSA total personnel are not the same as full-time equivalent agricultural research staff (see appendix 6).

3.3 Financial Resources

Expenditures

Table 6 provides a breakdown of the agricultural research expenditures by various institutional categories. This table includes a specific line for bilateral research expenditures as the Malagasy NARS was almost completely managed by French research institutes until 1974, whereafter this type of bilateral support ceased to exist. This resulted in a dramatic drop in total expenditures. After 1974, the share of the government institutes in total public research expenditures has been rather constant. It has fluctuated between 91-94% of total agricultural research expenditures, leaving a modest 6-9% for the academic sector.

Table 6: *Agricultural Research Expenditures*

Institutional category	1961-65	1971-75	1981-85	1986	1987	1988	1989	1990	1991
	<i>(millions 1985 PPP dollars per year)</i>								
Government	9.816	12.555	11.912	11.873	12.978	11.482	16.151	14.977	14.692
Academic	0.758	1.376	1.414	1.078	1.269	1.102	1.274	1.043	0.939
Bilateral ^a	11.424	9.754	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<i>Total</i>	<i>21.998</i>	<i>24.421</i>	<i>13.326</i>	<i>12.952</i>	<i>14.247</i>	<i>12.584</i>	<i>17.425</i>	<i>16.019</i>	<i>15.631</i>

Source: See appendix 6.

^a Bilateral funds comprise the expenditures by ORSTOM, plus 50% of the expenditures of the research stations that were integrated into FOFIFA in 1974 and which, until that year, were managed by French research institutes on a cost-sharing basis (50% Madagascar and 50% France).

Factor Mix

Table 7 identifies a number of major cost categories and reveals markedly different cost structures across the various institutes as well as significant fluctuations in cost shares over time within an institute. To a large extent these variations seem to reflect shifts in donor support. It is also noteworthy that salary costs for expatriate researchers (which we assume, in the absence of evidence to the contrary, are paid directly by the donors) increased markedly during the 1980s, reflecting a modest increase in the number of expatriate researchers working in the Malagasy NARS. FOFIFA's local personnel costs trended downwards between 1986 and 1989 due to a considerable reduction in support staff as well as an erosion of the real salaries of local research staff.

Table 7: *Expenditures by Cost Category*

Institute	Cost category	1976-80	1981-85 ^a	1986	1987	1988	1989	1990	1991
		<i>(percentages)</i>							
FOFIFA	Personnel (local)	65.6	53.0	38.7	27.6	28.3	20.0	na	na
	Personnel (expat)	3.6	10.2	23.4	19.7	33.2	23.0	na	na
	Personnel (total)	69.2	63.2	62.2	47.2	61.5	43.0	na	na
	Operating	25.6	23.8	30.2	25.8	31.1	54.1	na	na
	Capital	5.1	12.9	7.7	26.9	7.5	2.9	na	na
	<i>Total</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>na</i>
CNRO	Personnel (local)	na	13.6	17.3	16.0	14.1	12.6	32.7	33.8
	Personnel (expat)	na	9.6	18.0	19.6	18.4	13.5	32.8	36.5
	Personnel (total)	na	23.2	35.3	35.6	32.5	26.2	65.5	70.3
	Operating	na	61.7	49.3	44.5	52.0	59.6	30.3	29.7
	Capital	na	15.1	15.3	19.9	15.5	14.2	4.2	0.0
	<i>Total</i>	<i>na</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>100</i>
FIFAMANOR	Personnel (local)	na	14.4	9.9	10.8	10.2	9.1	12.3	14.1
	Personnel (expat)	na	20.3	14.8	15.6	15.5	23.5	20.0	26.3
	Personnel (total)	na	34.7	24.7	26.3	25.7	32.6	32.3	40.3
	Operating	na	42.5	35.4	43.3	32.6	29.4	31.7	39.6
	Capital	na	22.9	39.9	30.4	41.7	38.0	36.0	20.0
	<i>Total</i>	<i>na</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>100</i>

Source: 0999.

^a For CNRO and FIFAMANOR the percentages in this column relate to 1985 only.

Source of Funds

On average FOFIFA, CNRO, and FIFAMANOR received between 40-60% of their funds from donor sources during the years 1985-91 (table 8). The share of government funding varies markedly between institutes and within an institute over time (ranging between 14% and 64%). All three organizations report some income from sales. Funding through sales of agricultural produce has been a minor but non-negligible source of funds for FOFIFA and CNRO, and a substantial source of income for FIFAMANOR. FOFIFA's contract income comes mainly from public sources and is related to seed multiplication and vaccine production.

Table 8: *Source of Funding*

Institute	Source of funding	1985	1986	1987	1988	1989	1990	1991
		<i>(percentages)</i>						
FOFIFA	Government	45.1	56.5	60.2	39.9	34.4	35.4	28.6
	Sales	7.2	4.0	3.0	4.5	3.6	3.0	0.7
	Donor support	47.7	39.5	36.8	55.6	62.0	61.6	60.2
	Contracts	28.0	12.9	15.6	22.4	10.2	13.4	10.5
	<i>Total</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>100</i>
CNRO	Government	46.0	59.5	57.6	34.1	29.7	61.5	63.5
	Sales	0.3	0.5	4.6	1.4	1.2	0.1	0.0
	Donor support	53.8	40.0	37.8	64.5	69.1	38.4	36.5
	<i>Total</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>100</i>
FIFA- MANOR	Government	21.3	14.0	32.3	20.5	23.4	26.6	30.4
	Sales	35.5	31.3	21.8	22.2	11.4	13.0	17.2
	Donor support	43.2	54.7	45.9	57.2	65.2	60.3	52.3
	<i>Total</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>100</i>

Source: 0999.

In 1989/90, the Government of Madagascar and the World Bank reached agreement to initiate a seven-year National Agricultural Research Project (NARP) aimed at upgrading FOFIFA. The objectives of the NARP are: (a) to support ongoing priority research programs with the emphasis on improving research quality and adaptability and on research-extension linkages; (b) institutional strengthening of FOFIFA; (c) human resources development, education and training; (d) rehabilitation of the research infrastructure; and (e) coordination of external assistance. The estimated total project costs are US\$ 70.6 million. About half this budget will be provided by IDA (US\$ 24 million) and other donors (US\$ 10.4 million), the remaining half by the Government of Madagascar (World Bank 1989). Political unrest in the early 1990s, however, has slowed down the implementation of the project.

3.4 Research Focus

In 1991 35% of Madagascar's researchers focused on crop production (table 9). Rice is by far the most researched crop accounting for about half of the country's crop researchers. Coffee and vegetables each account for about 10% of the country's FTE crop researchers.

Table 9: *Research Focus, 1991*

Institute	Research orientation						Total
	Crops	Livestock	Forestry	Fisheries	Natural resources	Other	
	<i>(full-time equivalents)</i>						
FOFIFA	60.7	17.6	29.6	2.7		46.4	157.0
CNRO				13.0			13.0
CNRE					4.0		4.0
FIFAMANOR	6.0	3.0					9.0
ESSA	1.4	2.1	2.7			5.5	11.7
LPV ^a	1.0						1.0
LRI ^a	1.0						1.0
IMS ^a				1.3			1.3
Total (FTEs)	70.1	22.7	32.3	17.0	4.0	51.9	198.0
<i>Total (%)</i>	<i>35.4</i>	<i>11.5</i>	<i>16.3</i>	<i>8.6</i>	<i>2.0</i>	<i>26.2</i>	<i>100</i>

Note: The “natural resources” and “other” categories include research that could not otherwise be allocated to a specific commodity or commodity group. The natural resources category refers to unallocatable soils, land use, and water research.

^a These institutes have not been included in the time-series statistics because of lack of reliable data.

About a quarter of the country’s researchers were classified in the “other” category. Slightly more than half of the researchers in this category work on farming-systems research, with other important sub-categories being socioeconomics and post-harvest technology.

Deforestation and soil erosion are amongst the most serious of Madagascar’s natural resource degradation problems. Therefore forestry research, in particular agroforestry research, is an important area of emphasis in the Malagasy NARS. A great deal of the forestry research has a natural resource research component and should perhaps be classified as such.

Bibliography

This bibliography comprises three different sets of references. The “references” section relates to references cited in the text, the “data sources” to references from which data have been extracted to construct the time series (see appendices 5 and 6), and “other references” to references that have been consulted in the process of data collection but not used.

References

Angladetie, M.A. “Trois Quarts de Siècle de Recherche Agronomique Française en Afrique Intertropicale.” *Mondes et Cultures*, Vol. 48, No. 3 (May 1988): 371-398.

Europa Publications. *Africa South of the Sahara 1992*. 21 st Edition. London: Europa Publications Ltd., 1992.

FAO. *AGROSTAT Diskettes*. Rome: FAO, 1993.

IRAT. “Historique de l’IRAT.” Document Provisoire. IRAT, Paris, Août 1990. Mimeo.

OECD. *The Measurement of Scientific and Technical Activities: Frascati Manual 1980*. Paris: OECD, 1981.

Pardey, P.G., and J. Roseboom. *ISNAR Agricultural Research Indicator Series: A Global Data Base on National Agricultural Research Systems*. Cambridge, UK: Cambridge University Press, 1989.

Pardey, P.G., J. Roseboom, and J.R. Anderson, eds. *Agricultural Research Policy: International Quantitative Perspectives*. Cambridge, UK: Cambridge University Press, 1991.

Pardey, P.G., J. Roseboom, and B.J. Craig. “A Yardstick for International Comparisons: An Application to National Agricultural Research Expenditures.” *Economic Development and Cultural Change* Vol. 40, No. 2 (January 1992): 333-349.

Roseboom, J., and P.G. Pardey. “Measuring the Development of National Agricultural Research Systems.” *Scientometrics* Vol. 23, No. 1 (1992): 169-190.

Summers, R., and A. Heston. “The Penn World Table (Mark 5): An Expanded Set of International Comparisons, 1950-1988.” *The Quarterly Journal of Economics*, May 1991.

UNESCO Office of Statistics - Division of Statistics on Science and Technology. *Manual for Statistics on Scientific and Technological Activities*. Paris: UNESCO, June 1984.

World Bank. *Staff Appraisal Report Madagascar. National Agricultural Research Project*. Washington, D.C.: World Bank, 19 May 1989.

World Bank. *World Tables Diskettes (Version 2.5)*. Washington, D.C.: World Bank, April 1992.

Data Sources (listed by source code)

0017 ISNAR, IFARD & AOAD. Survey of National Agricultural Research Systems: Unpublished Questionnaire Responses. ISNAR. The Hague, 1985.

0037 ISNAR. *Rapport au Gouvernement de la Repoblika Demokratika Malagasy: La Recherche Agricole à Madagascar — Bilan et Perspectives du FOFIFA*. The Hague: ISNAR, August 1983.

0175 Cooper, St.G.C. *Agricultural Research in Tropical Africa*. Kampala: East African Literature Bureau, 1970.

0237 World Bank. “Madagascar Agricultural Research Subsector Review.” Report No. 3188-MAG. World Bank, Washington, D.C., October 1980. Mimeo.

0266 UNESCO. *National Science Policies in Africa*. Science Policy Studies and Documents No. 31. Paris: UNESCO, 1974.

0271 Raharinosy, V., and C.P. Ravohitrarivo. “Planification et Programmation de la Recherche à Madagascar (La Recherche Agricole).” Paper presented at the Workshop on Improving Agricultural Research Organizations and Management: Progress and Issues for the Future, ISNAR, The Hague, 8-12 September 1986.

0532 UNESCO Field Science Office for Africa. *Survey on the Scientific and Technical Potential of the Countries of Africa*. Paris: UNESCO, 1970.

0589 Kassapu, S. *Les Dépenses de Recherche Agricole dans 34 Pays d’Afrique Tropicale*. Paris: Centre de Développement de l’OCDE, 1976.

0654 Office de la Recherche Scientifique et Technique Outre-Mer (ORSTOM). *Rapport d’Activité 1967*. Paris: ORSTOM, 1969.

0888 International Association of Universities. *International Handbook of Universities and Other Institutions of Higher Education*. Paris, various years.

0979 FAO. *Directory of Agricultural Education and Training Institutions in Africa*. Rome: FAO, 1984.

0999 ISNAR “Survey of National Agricultural Research Systems: Unpublished Questionnaire Responses.” The Hague, 1992. Mimeo.

- 1135 Ministère de la Recherche Scientifique et Technologique pour le Développement. *Situation de la Recherche en 1984. Perspectives 1985-87*. Tananarive, Madagascar: Ministère de la Recherche Scientifique et Technologique pour le Développement, April 1985.
- 1141 Ramalanjaona, G. "Memorandum sur le Fonctionnement de la Recherche Scientifique et Technique en République Malgache." Paper presented at the UNESCO Colloquium "Sur la Politique Scientifique et l'Administration de la Recherche en Afrique," Yaounde, Cameroon, 10-12 July 1967.
- 1142 Office de la Recherche Scientifique et Technique Outre-Mer (ORSTROM). *Rapport 1975 Annuel Madagascar*. ORSTROM.
- 1144 Centre National de la Recherche Appliquée au Développement Rural (CENRADERU). *Rapport Annuel 1976. Tome I*. Tananarive, Madagascar: CENRADERU, n.d.
- 1146 Office de la Recherche Scientifique et Technique Outre-Mer (ORSTOM). *Mission a Tananarive. Rapport Annuel Année 1973*. Madagascar: ORSTOM, 1974.
- 1147 Office de la Recherche Scientifique et Technique Outre-Mer (ORSTOM). *Mission a Nosy-Bé. Rapport Annuel Année 1973*. Madagascar: ORSTOM, 1974.
- Other Sources (listed by source code)*
- 0010 Boyce, J.K., and R.E. Evenson. *National and International Agricultural Research and Extension Programs*. New York: Agricultural Development Council, Inc., 1975.
- 0014 Judd, M.A., J.K. Boyce, and R.E. Evenson. "Investing in Agricultural Supply." Economic Growth Center, Yale University, New Haven, Connecticut, 1983. Mimeo.
- 0016 Oram, P.A., and V. Bindlish. *Resource Allocations to National Agricultural Research: Trends in the 1970s*. The Hague and Washington, D.C.: ISNAR and IFPRI, November 1981.
- 0023 Bennell, P. *Agricultural Researchers in Sub-Saharan Africa: An Overview*. Working Paper No. 4. The Hague: ISNAR, October 1985.
- 0026 Oram, P.A., and M. Gieben. "Document Summaries." ISNAR, The Hague, 1984. Mimeo.
- 0027 Harvey, N., ed. *Agricultural Research Centers: A World Directory of Organizations and Programmes*. Seventh Edition, Two Volumes. Harlow, U.K.: Longman, 1983.
- 0073 Oram, P.A., and V. Bindlish. "Investment in Agricultural Research in Developing Countries: Progress, Problems, and the Determination of Priorities." IFPRI, Washington, D.C., January 1984. Mimeo.
- 0095 FAO-CARIS. *Agricultural Research in Developing Countries. Volume I: Research Institutions*. Rome: FAO-CARIS, 1978.
- 0165 Evenson, R.E., and Y. Kislev. *Agricultural Research and Productivity*. New Haven: Yale University Press, 1975.
- 0360 Cooper, St.G.C. "Towards Trained Manpower for Agricultural Research in Africa." Paper presented at the Conference on Agricultural Research and Production in Africa, organized by the Association for the Advancement of Agricultural Sciences in Africa (AAASA), Addis Ababa, 29 August-4 September 1971.
- 0373 Groupement d'Etudes et de Recherches pour le Développement de l'Agronomie Tropicale (GERDAT). *Rapport General d'Activité pour 1982*. Paris: GERDAT, 1983.
- 0400 UNESCO. *The Promotion of Scientific Activity in Tropical Africa*. Science Policy Studies and Documents No. 11. Paris: UNESCO, 1969.
- 0445 Swanson, B.E., and W.H. Reeves. "Agricultural Research Eastern and Southern Africa: Manpower and Training." World Bank, Washington, D.C., August 1986. Mimeo.
- 0653 Webster, B.N. *Index of Agricultural Research Institutions and Stations in Africa*. Rome: FAO, n.d.
- 0816 Saint-Clair, P.M. "Réflexions sur l'Organisation et le Fonctionnement Actuels de la Recherche au FOFIFA." ISNAR, Madagascar, April 1987. Mimeo.
- 0852 Evenson, R.E., and Y. Kislev. *Investment in Agricultural Research and Extension: A Survey of International Data*. Center Discussion Paper No. 124. New Haven, Connecticut: Economic Growth Center, Yale University, August 1971.
- 0886 Evenson, R.E., and Y. Kislev. "Investment in Agricultural Research and Extension: A Survey of International Data." *Economic Development and Cultural Change* Vol. 23 (April 1975): 507-521.
- 1134 Ministère de la Recherche Scientifique et Technologique pour le Développement. *Programme National de Recherche Agricole. Rapport de Préparation. Tome I Rapport Principal*. Antananarivo, Madagascar: Ministère de la Recherche Scientifique et Technologique pour le Développement, Septembre 1988.
- 1136 Ravohitrarivo, C.P. *Planification de la Recherche Agricole: Le Cas de Madagascar*. The Hague: ISNAR, July 1991.
- 1137 World Bank. *Staff Appraisal Report Madagascar. National Agricultural Research Project*. Washington, D.C.: World Bank, 19 May 1989.
- 1138 World Bank. *Madagascar Second Agricultural Institutions Development Project. Staff*

- 1139 *Appraisal Report*. Washington, D.C.: World Bank, 5 December 1985.
- 1139 Ministère de Recherche Scientifique et Technologique pour le Développement. *Bilan de la Recherche Agricole à Madagascar*. Centre d'Information et Documentation Scientifique et Technologique, n.d.
- 1140 Ministère de Recherche Scientifique et Technologique pour le Développement. *Rapport d'Activités 1987-1988-1989 du FOFIFA*. Antananarivo, Madagascar: Ministère de Recherche Scientifique et Technologique pour le Développement, Novembre 1989.
- 1143 World Bank. *Madagascar Second Agricultural Institutions Development Project: Agricultural Research Component*. Working Paper. Washington, D.C.: World Bank, August 1985.
- 1145 UNESCO. *Comperative Study on the National Science and Technology Policy-Making Bodies in the Countries of Eastern and Southern Africa*. Paris: UNESCO, 1987.
- 1250 IRAT. "Historique de l'IRAT." Document Provisoire. IRAT, Paris, Août 1990. Mimeo.
- 1254 Angladetie, M.A. "Trois Quarts de Siècle de Recherche Agronomique Française en Afrique Intertropicale." *Mondes et Cultures*, Vol. 48, No. 3 (May 1988): 371-398.
- 1377 FOFIFA / Ministère de la Recherche Scientifique. "Document de Travail sur la Revue/Actualisation du PNRA: Synthèse des Premières Réflexions Conduites au Niveau du FOFIFA." FOFIFA Direction Générale, June 1993.

Appendix 1: Country background information



Geography

Area: 58.7 million ha

Location: The fourth largest island in the world, it lies 390 km from the eastern shores of Mozambique in southeastern Africa.

Agroecological features: a basically tropical marine climate prevails on the island, but there are very important regional differences in temperature and rainfall (Eastern belt: 2000-3000 mm; Central highlands: 800-1700 mm; Western slopes: 500-1500 mm). Soils: productive land limited. Alluvial soils exist in a long narrow belt along the east coast, in the Lake Aloatra region, and in small areas in the central highlands.

Population

Total (1991): 12.0 million

Annual growth rate (1981-90)^a: 3.0%

Literacy (1990): 80.2%

Life expectancy (1991): 51 years

Economy (values reported in 1985 PPP dollars)

Gross Domestic Product (1991): 8,992 million dollars

Per capita GDP (1991): 747 dollars

Agricultural GDP (1991): 3,076 million dollars

Share of agriculture in GDP (1991): 34.2%

Annual growth rates (1981-90)^a

GDP: 1.8%

GDP per capita: -1.1%

AgGDP: 2.8%

Trade (values reported in current dollars)

Net surplus total trade (1991): -130 million dollars

Net surplus agricultural trade (1991): 114 million dollars

Percentage of agricultural imports in total imports: 15.7%

Percentage of agricultural exports in total exports: 59.6%

Major agricultural import commodities (1991)^b: wheat (20%), rice (20%), forestry products (14%), and cotton seed oil (7%)

Major agricultural export commodities (1991)^b: vanilla (30%), fishery products (25%), coffee (19%), and raw sugar (7%)

Agriculture

Agricultural land (1990): 37.1 million ha

Annual growth rate (1981-90)^a: 0.04%

Percentage arable: 7.0%

Percentage permanent crop: 1.4%

Percentage permanent pastures: 91.6%

Percentage irrigated arable and permanent cropland: 29.7%

Economically active agricultural population (1991): 4.0 million

Annual growth rate (1981-90)^a: 1.7%

Percentage in total economically active population: 76.1%

Fertilizer use per ha arable land (1990): 2.6 kg

Annual growth rate (1981-90)^a: -1.9%

Major crops (in descending order of value of production): rice, cassava, coffee, vanilla, sugar cane, man-goes

Sources: Europa Publications (1992), FAO (1993), and World Bank (1992).

^a Least squares growth rate.

^b Bracketed percentages represent value share of the respective total.

Appendix 2: Definitions and concepts

NARS

The construction of quantitative and internationally comparable expenditure, personnel, and related measures of a national agricultural research system (NARS) requires a precise idea of what, in fact, is being measured. Since the term NARS is subject to a variety of interpretations, it is necessary to define rather precisely the NARS concept used here. Our approach adheres, wherever possible and appropriate, to the internationally accepted statistical procedures and definitions developed by the OECD and UNESCO for compiling R&D statistics (OECD 1981 and UNESCO 1984). For statistical purposes a NARS is defined in terms of the following characteristics:

(a) National. The concept of a “national” system used in this report refers to domestically targeted research activities funded and/or executed by the public sector of a particular country. A relatively broad concept of the public sector is taken to include government, semi-public and academic research institutes. However, private, for-profit research as well as the research activities of supranational research agencies that are not executed through national institutes are excluded. Also excluded is research undertaken by short-term development projects.

(b) Agricultural. Agricultural research, as defined here, includes crop, livestock, forestry, and fisheries research, as well as research on agricultural inputs, the natural resource base, and socio-economic aspects of primary agricultural production. It excludes, where possible, research concerning the off-farm storage and processing of agricultural products, commonly referred to as post-harvest research and food-processing research. This delineation corresponds with the national accounts definition of the agricultural sector.

(c) Research. Research is often performed in conjunction with other activities such as extension, education, and production. To the extent possible, research activities (in terms of expenditures and staff) are differentiated from these other activities. However, if an institute’s non-research activities were an integral part of its research, and accounted for less than 20% of the resources of the institute, it was expedient to classify all the activities of the institute as being research related.

Full-Time Equivalent (FTE)

A full-time equivalent researcher year is taken to be a person who holds a full-time position as a researcher during the whole year. Adjustments to full-time equivalents have only been made when: (a) a research position was part-time; (b) a research position was not filled for the whole year; or (c) if the position explicitly involved tasks other than agricultural research. In the latter case

an estimate was made of the time spent on agricultural research. No adjustments were made, however, for vacation or sick leave nor for time spent on administration, meetings, travel or other activities that form part of the normal duties required to support a research endeavor. Following this line of reasoning, professional staff in management positions were classified as researchers.

The degree status of researchers is determined on the following basis: 3-4 years full-time university education (BSc), 5-6 years (MSc), and more than 6 years plus doctorate thesis (PhD).

Expatriate Researcher Costs

Many expatriate researchers working on donor-supported projects in NARSs are paid their salaries and living expenses directly by the donor agency. All (or some substantial fraction) of these costs do not get included in the financial reports of the agricultural research organizations. To calculate these implicit costs we took the average cost per researcher in 1985 to be 120,000 “1985 PPP dollars” and backcast this figure using the rate of change in real personnel costs per FTE researcher in the US state agricultural experiment station system. This extrapolation procedure makes the assumption that the personnel-cost trend for US researchers is a reasonable proxy of the trend in real costs of internationally recruited staff working in NARSs. Unless otherwise stated, FTE expatriate researchers were costed at \$80,000 “1985 PPP dollars” per researcher for the 1961-65 period, \$85,000 per researcher for 1966-70, \$90,000 per researcher for 1971-75, \$110,000 per researcher for 1976-80, and \$120,000 per researcher for 1981-91.

Deflators and Exchange Rates

All expenditure figures were first compiled in current local currency units (appendix 5). In order to facilitate comparisons over time and across countries these figures are deflated with a local GDP deflator to base year 1985, and then converted to a common currency (US dollars) using the 1985 purchasing power parity (PPP) over GDP. PPPs are synthetic exchange rates that attempt to reflect the purchasing power of a country’s currency. The PPPs used here are derived from the Penn World Table (Mark 5) which is based on the benchmark studies of the International Comparison Project (Summers and Heston 1991). For additional information on currency conversion methods in this context see Pardey, Roseboom, and Craig (1992).

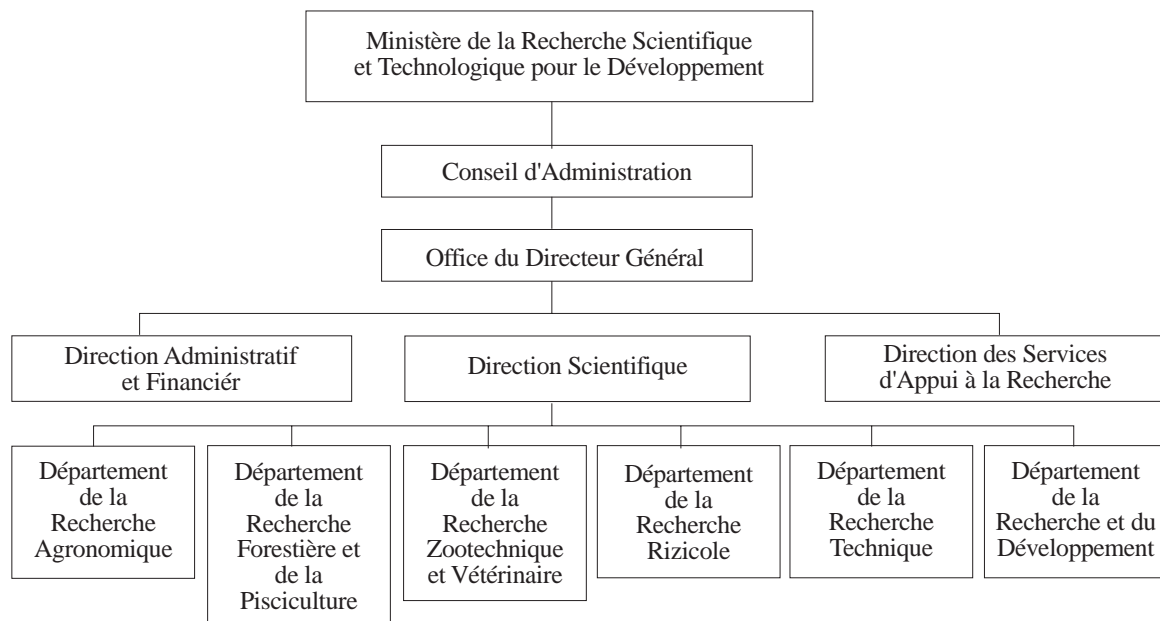
Nomenclature for tables in text

A zero indicates an actual observation of zero, a dash indicates that an observation is not relevant (due to institutional mergers, closures and so on), while “na” indicates an observation that is not available.

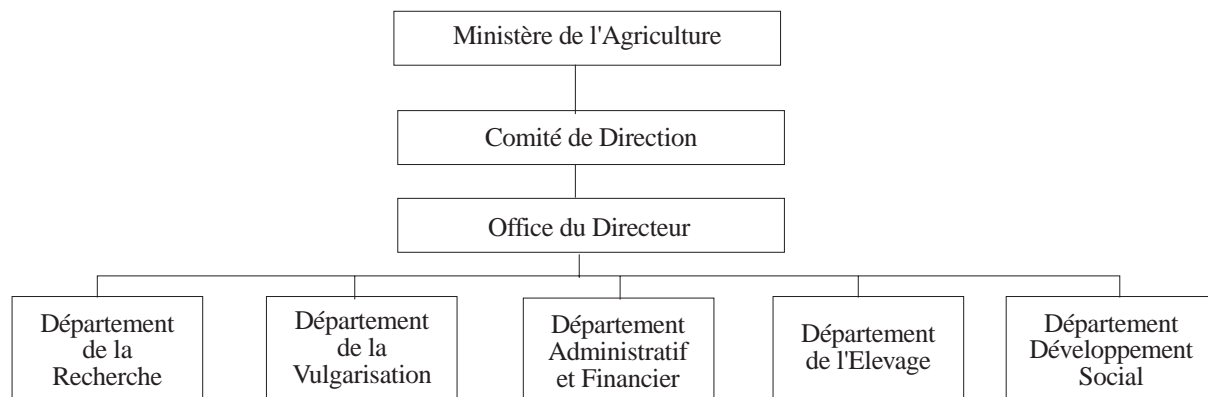
In the text we note any marked deviations from these data compilation norms and include points of clarification if warranted.

Appendix 3: Organizational charts of the agricultural research institutes

FOFIFA (1992)

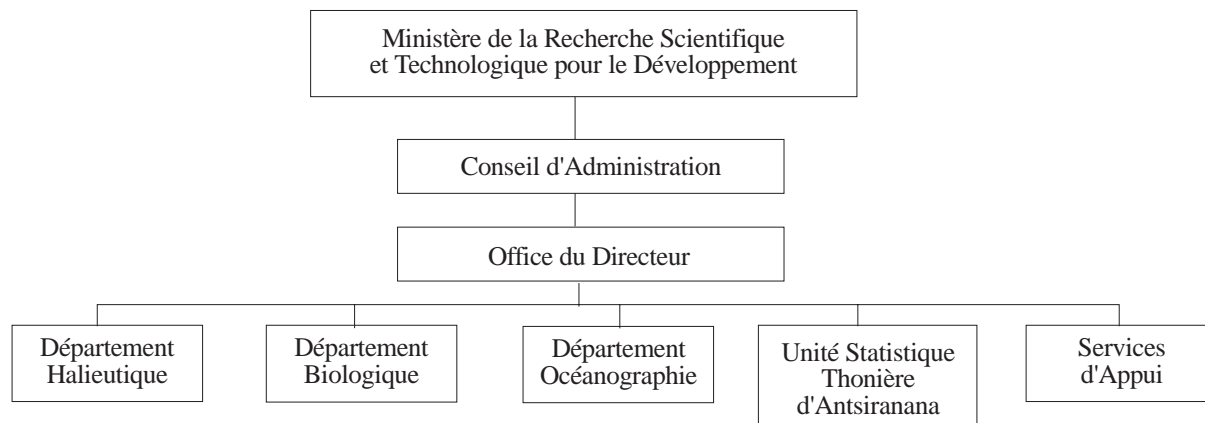


FIFAMANOR (1992)



Appendix 3: Organizational charts of the agricultural research institutes (contd.)

CNRO (1992)

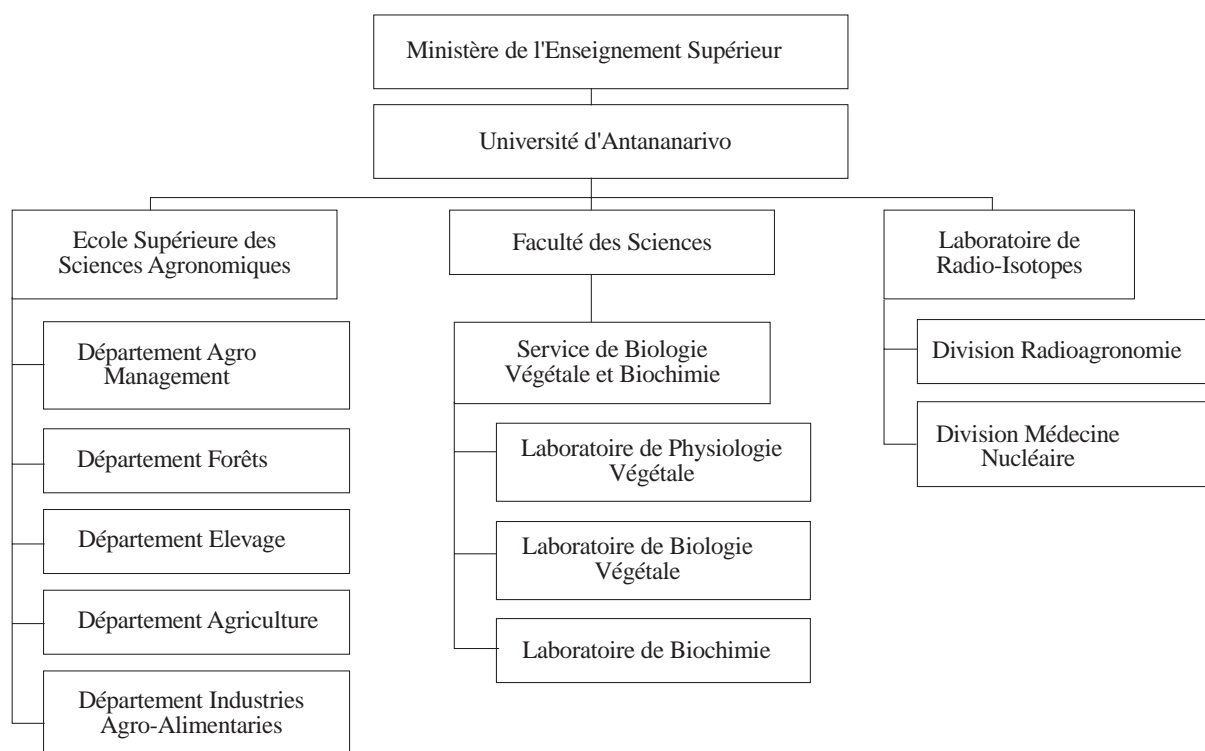


CNRE (1992)

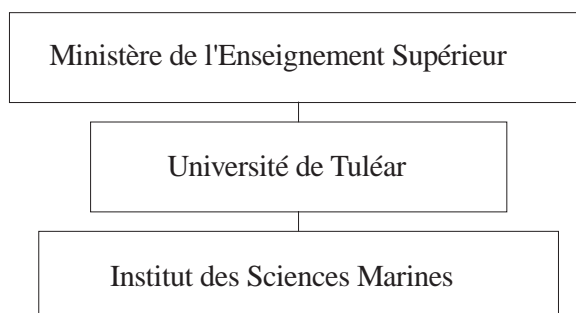


Appendix 3: Organizational charts of the agricultural research institutes (contd.)

Université d'Antananarivo (1992)



Université de Tuléar (1992)



Appendix 4: Addresses of the agricultural research institutes

Directeur Général
FOFIFA
B.P. 1690
101 Antananarivo
MADAGASCAR

Directeur
Centre National de Recherche de Océanographie
B.P. 68
267 Nosy-Be
MADAGASCAR

Directeur
Centre National de Recherches sur l'Environnement
B.P. 1739
101 Antananarivo
MADAGASCAR

Directeur
FIFAMANOR
Ministère de l'Agriculture
B.P. 198-110
101 Antsirabe
MADAGASCAR

Directeur
Ecole Supérieure des Sciences Agronomiques
Université d'Antananarivo
B.P. 175
101 Antananarivo
MADAGASCAR

Directeur
Laboratoire de Radio-Isotopes
Université d'Antananarivo
B.P. 3383
Antananarivo
MADAGASCAR

Directeur
Station Marine de Tuléar
Faculté des Sciences
Université de Tuléar
B.P. 141
Tuléar
MADAGASCAR

Président
Faculté des Sciences
Université d'Antananarivo
B.P. 906
101 Antananarivo
MADAGASCAR

Appendix 5a: Total number of FTE Researchers

Category	Name institute	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	
Government	FOFIFA	60.0	60.0	60.0	60.0	60.0	60.0	60.0	62.3	64.7	67.0	70.0	71.0	72.0	55.0	34.0	35.0	
	CNRO	6.0	7.0	8.0	9.0	10.0	13.0	13.0	13.5	14.0	8.0	10.0	10.0	6.0	4.2	2.5	2.0	
	CNRE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	FIFAMANOR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	2.0	2.0	2.0
Subtotal government		66.0	67.0	68.0	69.0	70.0	73.0	73.0	75.8	78.7	75.0	80.0	82.0	79.0	60.2	38.5	39.0	
Academic	ESSA	0.0	0.0	3.9	4.2	4.4	4.6	4.9	5.2	5.4	5.1	5.0	4.9	4.7	4.6	4.5	4.7	4.7
	ORSTOM	3.6	4.8	6.0	9.0	13.8	19.2	22.2	24.0	24.0	24.0	28.8	30.0	24.0	15.8	7.5	7.5	7.5
TOTAL		69.6	71.8	77.9	82.2	88.2	96.9	100.1	105.0	108.1	104.1	113.8	116.9	107.7	80.6	50.5	51.2	
Source				888	1146	1146	1146	175	1146	888	532	448	1146	271	589	888	1144	
				1146				654		1146	1146	1146	1147	1146		1142		
								1146		1147	1147	1147	1147					
Government	Name institute	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	
	FOFIFA	44.8	54.5	65.2	76.0	75.5	75.0	68.0	83.5	101.0	117.0	110.0	116.0	144.0	155.0	157.0	153	
	CNRO	3.0	4.0	5.0	6.0	7.0	8.0	9.0	12.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0		
	CNRE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	4.0	4.0		
	FIFAMANOR	2.0	2.0	2.0	3.0	3.0	3.0	3.0	3.0	4.0	4.0	5.0	5.0	7.0	9.0	9.0		
Subtotal government		49.8	60.5	72.2	85.0	85.5	86.0	80.0	98.5	118.0	134.0	128.0	134.0	167.4	181.0	183.0		
Academic	ESSA	5.3	5.7	7.0	8.2	9.5	10.8	11.1	11.5	11.8	12.2	12.5	12.9	13.2	12.6	11.7		
	ORSTOM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
TOTAL		55.0	66.2	79.2	93.2	95.0	96.8	91.1	110.0	129.8	146.2	140.5	146.9	180.6	193.6	194.7		
Source			889		237		271	17	1135	271	271	999	999	999	999	999	999	
					1135		979			999	999	1135						

Note: Italicized figures represent data that are either constructed or interpolated. The pre-1974 data for FOFIFA and CNRO relate to the predecessors of these organizations.

Appendix 5b: Expenditure totals, 1961-91

Total Research Expenditures		Currency: million Malagasy francs															
Category	Name institute	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Government	FOFIFA	419.38	463.79	511.90	527.10	621.60	590.38	625.48	669.04	705.00	763.00	803.64	842.08	976.72	692.52	675.66	851.24
	CNRO	31.87	38.52	44.21	53.06	58.91	83.08	86.48	91.79	96.00	59.52	76.54	79.07	54.44	62.14	47.38	25.11
	CNRE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	FIFAMANOR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.37	13.22	12.74	39.62	47.37
Government subtotal		451.24	502.31	556.11	580.16	680.51	673.46	711.95	760.83	801.00	822.52	880.18	932.52	1044.38	767.40	762.66	923.72
Academic	ESSA	0.00	0.00	31.89	34.89	42.77	42.90	47.79	51.67	54.98	55.93	54.79	55.27	62.66	58.84	89.14	111.32
Bilateral	ORSTOM	23.90	33.02	43.29	54.98	73.91	104.76	132.42	144.91	143.22	152.65	185.76	205.28	176.06	136.54	67.33	74.03
Total (current M. francs)		475.14	535.33	631.30	670.03	797.19	821.11	892.16	957.40	999.20	1031.11	1120.73	1193.07	1283.11	962.79	919.13	1109.07
GDP Deflator		11.8	12.2	12.3	13.1	13.1	14.2	14.8	15.1	15.2	16.5	17.0	17.6	19.8	24.3	25.4	27.9
Total (constant 1985 M. francs)		4023.20	4374.63	5136.65	5110.83	6085.84	5777.85	6031.15	6331.93	6553.07	6232.16	6584.82	6785.42	6496.20	3969.31	3619.54	3972.42
Total (constant 1985 PPP dollars)		17.893	19.456	22.845	22.730	27.067	25.697	26.824	28.161	29.145	27.718	29.286	30.178	28.892	17.653	16.098	17.667
Expat costs included in the total (constant 1985 PPP dollars)		8.185	8.812	9.742	9.661	11.657	10.870	11.290	11.880	12.322	12.000	13.092	13.350	13.534	5.131	1.980	1.555
Source		1141	1141	1141	1141	1141	1141	1141	1146	1146	1146	1146	1146	589	37	37	37
				1146	1146	1146	1146	1146	1146	1146	1146	1146	1146	1146	1147	1142	1142
Category	Name institute	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Government	FOFIFA	932.99	1140.01	1222.72	1191.49	1024.19	1237.61	1995.42	2949.18	1868.78	2497.27	3466.96	3598.51	5582.13	6066.40	6984.00	8644.00
	CNRO	40.90	58.21	80.98	120.00	150.32	151.41	189.14	226.53	562.60	342.03	387.16	498.10	759.00	348.87	358.78	
	CNRE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	140.53	157.92	175.22	
	FIFAMANOR	40.79	40.96	37.12	47.98	42.71	50.21	85.11	99.76	132.97	208.49	243.36	295.67	437.23	572.68	498.44	
Government subtotal		1014.69	1239.19	1340.82	1359.47	1217.23	1439.22	2269.67	3275.47	2564.35	3047.79	4097.47	4392.28	6918.89	7145.87	8016.45	
Academic	ESSA	108.10	116.75	129.44	131.95	135.60	180.74	316.13	381.94	257.06	276.84	400.60	421.43	545.58	497.45	512.53	
Bilateral	ORSTOM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Total (current M. francs)		1122.78	1355.94	1470.26	1491.42	1352.83	1619.96	2585.81	3657.41	2821.40	3324.63	4498.07	4813.71	7464.47	7643.32	8528.98	
GDP Deflator		30.3	32.4	36.0	41.4	52.5	67.6	82.1	90.5	100.0	114.2	140.4	170.1	190.5	212.2	242.7	
Total (constant 1985 M. francs)		3703.30	4190.24	4082.31	3600.30	2575.37	2396.32	3148.74	4039.49	2821.40	2912.11	3203.38	2829.40	3917.94	3601.91	3514.59	
Total (constant 1985 PPP dollars)		16.470	18.636	18.156	16.012	11.454	10.658	14.004	17.966	12.548	12.952	14.247	12.584	17.425	16.019	15.631	
Expat costs included in the total (constant 1985 PPP dollars)		0.660	0.440	0.330	0.220	0.480	0.720	0.840	1.380	1.800	2.640	2.520	3.480	3.480	3.960	3.600	
Source		37	37	37	37	37	17	17	17	999	999	999	999	999	999	999	
				1135	1135	1135	1135	1135	1135	1135	1135	1135	1135	1135	1135	1135	

Note: Italicized figures represent data that are either constructed or interpolated. The pre-1974 data for FOFIFA and CNRO relate to the predecessors of these organizations.

Appendix 6: Research staff development by institute

FOFIFA	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Nationals																
PhD													0			
MSc													0			
BSc													12			22
Subtotal													12	17	22	27
Expatriates													60	38	12	8
Total	60.0	60.0	60.0	60.0	60.0	60.0	60	62.3	64.7	67	70	71	72	55	34	35
Source							175			532	448		271	589		1144
	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Nationals																
PhD							3						11	12	12	15
MSc							19						66	77	81	77
BSc							39	42	48	47	42		42	37	38	35
Subtotal	39	50	62	74	71.5	69	61	74.0	89	98	92	90	119	126	131	127
Expatriates	6	4	3	2	4.0	6	7	9.5	12	19	18	26	25	29	26	26
Total	45	54	65	76	75.5	75	68	83.5	101	117	110	116	144	155	157	153
Source				237		271	17	1135	271	271	1135	999	999	999	999	999
				1135												

Appendix 6: Research staff development by institute (contd.)

FIFAM/NOR		1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Nationals																	
PhD																	
MSc																	
BSc																	
Subtotal																	
Expatriates																	
Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	2.0	2.0
Source																	
		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Nationals																	
PhD															0	0	
MSc															7	7	
BSc															0	0	
Subtotal										3	3	4	4	5	7	7	
Expatriates										1	1	1	1	2	2	2	
Total	2.0	2.0	2.0	3.0	3.0	3.0	3.0	3.0	3.0	4.0	4.0	5.0	5.0	7.0	9.0	9.0	
Source										999	999	999	999	999	999	999	

Appendix 6: Research staff development by institute (contd.)

Centre National de Recherches Oceanographiques (CNRO)																
	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Nationals																
PhD																
MSc																
BSc																
Subtotal	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0	0	0	0	0.0	0	0	2.0
Expatriates	6.0	7.0	8.0	9.0	10.0	13.0	13	13.5	14	8	10	10	6	4.2	2.5	0.0
Total	6.0	7.0	8.0	9.0	10.0	13.0	13	13.5	14	8	10	10	6	4.2	2.5	2.0
Source							654		1147	1147	1147	1147	1147		1142	
	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Nationals																
PhD									2	2	2	2	2	2	2	
MSc									7	7	7	7	7	7	7	
BSc									2	2	2	2	2	2	2	
Subtotal	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11	11	11	11	11	11	11	
Expatriates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2	2	2	2	2	2	2	
Total	3.0	4.0	5.0	6.0	7.0	8.0	9.0	12.0	13	13	13	13	13	13	13	
Source									999	999	999	999	999	999	999	

Centre National de la Recherche sur l'Environnement (CNRE)																
	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Nationals																
PhD																
MSc																
BSc																
Subtotal													29	35	35	
Expatriates													5	5	5	
Total													34	40	40	
FTE Researchers													3.4	4.0	4.0	
Source													999	999	999	

Note: Ten percent of CNRE's research activities are of direct relevance to agriculture.

Appendix 6: Research staff development by institute (contd.)

Institute: Centre ORSTOM de Tananarivo																
	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Nationals																
PhD																
MSc																
BSc																
Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	3	1.5	0	0.0
Expatriates	6	8	10	15	23	32	37	40	40	40	48	50	37	22.5	8	8.0
Total	6	8	10	15	23	32	37	40	40	40	48	50	40	24.0	8	8.0
FTE Researchers	3.6	4.8	6	9	13.8	19.2	22.2	24	24	24	28.8	30	24	15.8	7.5	7.5
Source			1146	1146	1146	1146	1146	1146	1146	1146	1146	1146	1146		1142	

Note: Based on an actual observation for 1973, we have assumed that 60% of ORSTOM's activities were agriculture-related during the years 1963-73.

Ecole Supérieure des Sciences Agronomiques (ESSA)																
	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Nationals																
PhD																
MSc																
BSc																
Subtotal																
Expatriates																
Total	0	0	13	13.8	14.7	15.5	16.3	17.2	18	17	16.6	16.2	15.8	15.4	15	15.7
FTE Researchers	0.0	0.0	3.9	4.2	4.4	4.6	4.9	5.2	5.4	5.1	5.0	4.9	4.7	4.6	4.5	4.7
Source			888						888	532					888	
	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Nationals																
PhD						11									26	
MSc						11									8	
BSc						4									0	
Subtotal		10	14.0	18.0	22.0	26	27.1	28.3	29.4	30.6	31.7	32.9	34	34	34	
Expatriates		9	9.2	9.5	9.8	10	10.0	10.0	10.0	10.0	10.0	10.0	10	8	5	
Total	17.7	19	23.2	27.5	31.8	36	37.1	38.3	39.4	40.6	41.7	42.9	44	42	39	
FTE Researchers	5.3	5.7	7.0	8.2	9.5	10.8	11.1	11.5	11.8	12.2	12.5	12.9	13.2	12.6	11.7	
Source		889				979							999	999	999	

Note: Faculty spend 30% of their time on research.

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