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Statistical Brief on the National Agricultural Research System

of

RWANDA

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ISNAR INDICATOR SERIES PROJECT: PHASE II
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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 formally 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

CEAER	Centre d'Etudes et d'Applications de l'Energie au Rwanda	INRS	Institut National de Recherche Scientifique
CRAFOP	Centre de Recherche Appliquée, Fondamentale et de Formation Permanente	IRST	Institut de Recherche Scientifique et Technologique
CURPHA-METRA	Centre Universitaire de Recherche sur la Pharmacopée et la Médecine Traditionelle	ISAR	Institut des Sciences Agronomiques du Rwanda
CGIAR	Consultative Group on International Agricultural Research	ISNAR	International Service for National Agricultural Research
CIP	Centro Internacional de la Papa (International Potato Center)	NARS	National Agricultural Research System
FA/UNR	Faculté d'Agronomie - Université Nationale du Rwanda	OECD	Organisation for Economic Co-operation and Development
FTE	Full-time Equivalents	UNESCO	United Nations Educational, Scientific and Cultural Organization
IDA	International Development Agency		
INEAC	Institut National pour l'Etude Agronomique au Congo		

1. Introduction

The primary purpose of this brief is to provide various statistical and institutional details on the development and current status of the public agricultural research system in Rwanda. 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 Rwandan 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 Rwanda we refer to appendix 1.

2. Agricultural Research Institutions

2.1 Historical Evolution¹

Agricultural research in Rwanda had its institutional origin in a seed multiplication station established at Rubona in 1930. Initially this station produced seed for farmers whose stocks were depleted during the 1929 famine. As the effects of the famine receded, the Rubona station gradually shifted its focus from seed multiplication towards crop research. In 1935 the station was brought under the scientific supervision of the Institut National pour l'Etude Agronomique du Congo Belge (INEAC), which was established by royal decree in 1933. For the first twenty years or so, research at Rubona was limited to crops such as peanuts, corn, sorghum, cassava, sweet potatoes, carrots, fruit trees, and coffee. In 1950 the Rubona station was administratively and technically integrated into INEAC, together with an appendix for cattle breeding at Songa, a former state farm established in 1935. In 1955 an experiment station was established at Rwerere to research high-altitude crops such as potatoes, peas, barley, corn, wheat, pyrethrum, and tea. A second livestock station was established at Karama in the Bugesera region in 1959 to study the possibilities of developing the savannah regions in the south-eastern part of the country that at the time were heavily infested by tsetse flies. The station gave increasingly more attention to crop-related problems when settlement in the region became possible as the tsetse fly problem was got under control.

With Rwandan independence in 1962, the local research facilities of INEAC were transformed into the Institut des Sciences Agronomiques du Rwanda (ISAR). At that time the research staff of ISAR consisted only of expatriates, mainly Belgians. An agreement signed by Rwanda and Belgium in 1965 charged Belgium with the scientific, technical, and administrative management of ISAR. This agreement was revised in 1969 giving supervision of ISAR's scientific and technical activities to the Faculty of Agricultural Sciences of the University of Gembloux (Belgium). A new ISAR station was established at Tamira in 1972 to study pyrethrum.

In 1975, administrative authority over ISAR was transferred to the government of Rwanda and for the first time a Rwandan national was appointed as the director general of the institute. As of this date the number of Rwandan researchers increased rapidly. Concomitant with this change of administrative control, the Belgian government began to decrease its financial and scientific support to ISAR in 1977. The country's relationship with Belgium deteriorated during the late 1970s and early 1980s, and by June 1982 all Belgian researchers had departed.

Until 1976 the Belgians constituted the only source of external support for ISAR. Since then, ISAR has succeeded in obtaining assistance from a wide range of international research agencies and donors. During the past 15 years, a major part of this assistance has been used for the expansion and upgrading of ISAR's experiment station network from six permanently staffed stations in 1978 to 10 in 1992.

In addition to ISAR, the principal agricultural research institute in the country, some agriculturally related research is done by the Institut de Recherche Scientifique et Technologique (IRST), such as research on medicinal and oil plants, forestry, and irrigation. IRST was constituted in its present form and under its present name in 1989 by the Ministère de l'Enseignement Supérieur et de la Recherche Scientifique. It resulted from the merger of the Institut National de Recherche

1. The material presented in this section draws largely from ISNAR (1983), Eicher and Eicher (1984), Demol (n.d.), Université Nationale du Rwanda (n.d.), and Neel (1978).

Scientifique (INRS) with several research centers of the National University of Rwanda, namely the Centre d'Etudes et d'Applications de l'Energie au Rwanda (CEAER), the Centre de Recherche Appliquée, Fondamentale et de Formation Permanente (CRAFOP), and the Centre Universitaire de Recherche sur la Pharmacopée et la Médecine Traditionnelle (CURPHAMETRA). Establishment dates for CEAER, CRAFOP, and CURPHAMETRA are 1974, 1979, and 1980, respectively. INRS, established in 1963 as the Rwandan successor to the Institut de Recherche Scientifique en Afrique Centrale (IRSAC), was managed by the Belgian government between 1964 and 1976. INRS's research primarily focused on more fundamental research in disciplines like botany, zoology, ecology, nutrition, geology, seismology, anthropology, languages, and sociology.

Agricultural science was first taught in Rwanda in 1958, when the Faculty of Agriculture and Animal Husbandry was created at the Université Officielle du Rwanda-Urundi at Butare. In 1960 this Faculty was transferred to Bujumbura (Burundi), leaving Rwanda without facilities for higher training in agricultural sciences until 1974 when, with the major support of the Canadian government, a Department of Agriculture was established in the Faculty of Science of UNR. In 1979 this department was upgraded to faculty status. To date, the Faculty of Agriculture (FA/UNR) has limited research facilities and most of the research is carried out by students preparing their second-cycle theses under the direction of the faculty.

2.2 Present Structure

ISAR is the dominant agricultural research establishment in Rwanda, accounting for 49 (86%) of the country's 57 full-time equivalent agricultural researchers in 1991 (table 2). The two other research agencies, IRST and FA/UNR, make only modest contributions to the agricultural research activities within the country.

The internal institutional structure of ISAR has been fairly stable over the past 30 years. Until recently the institute was traditionally organized along commodity lines. As of 1982 it consisted of four scientific departments, namely: Département Productions Végétales, Département Productions Animales, Département de Foresterie, and Département Etudes du Milieu et Systèmes de Production. In 1992 ISAR began moving towards a new organizational structure in which an agricultural systems approach is the leading organizational principle.

A network of eight regional research centers has been set up and each center is to be given responsibility for conducting agricultural research on all aspects relevant for the type of agricultural systems in that region. The new management structure of ISAR reflects this decentralization and consists of a Direction Générale assisted by a Direction Scientifique and a Direction Administrative et Financière. In addition, each of the regional centers has its own Direction who reports directly to the Direction Générale.

Since 1989 IRST consists of three centers (Centre Pharmacopée, Centre Etudes Rwandaises, and Centre Energie) as well as the National Herbarium of Rwanda. Although constituted as a parastatal under the Ministère de l'Enseignement Supérieur et de la Recherche Scientifique, IRST maintains close professional links with the University of Rwanda as well as several universities abroad (ISNAR 1992). Its research activities are quite diverse, ranging from medicinal plants to forestry and water resources.

Table 2: Overview of Present NARS Structure

Institutional category	Supervising agency			Executing agency			Staffed research sites ^a	Number of researchers		
	Name	Name	Acronym	Research focus	National	Expats		Total	FTEs	
Government	Ministère de l'Agriculture, de l'Élevage et de l'Environnement	Institut des Sciences Agronomiques du Rwanda	ISAR	crops, livestock, forestry, soils, socio-economics	37	12	13 (10)	49	49	
	Ministère de l'Enseignement Supérieur et de la Recherche Scientifique	Institut de Recherche Scientifique et Technologique	IRST	medicinal and aromatic oil plants, forestry, water resources	2	1	1 (1)	3 ^b	3	
Academic	Université Nationale du Rwanda	Faculté d'Agronomie	FA/UNR	crops, livestock, fisheries	10	7	1 (1)	17	5	
<i>Total</i>					<i>49</i>	<i>20</i>	<i>15 (12)</i>	<i>69</i>	<i>57</i>	

Source: 0999.

Note: The information in this table refers to 1991/92.

^a Staffed with researchers and/or technicians. Bracketed sites are staffed with researchers.

^b IRST has a total research staff of about 19, most of whom work on non-agricultural issues.

FA/UNR consists of four departments, namely: Departement des Productions Végétales, Departement des Productions Animales, Departement des Sols et Génie Rural, and Departement Piscicole. What little research the faculty does parallels that of ISAR, except for fisheries research.

The present organizational structure of ISAR, IRST, and FA/UNR are provided in diagrammatic form in appendix 3.

3. NARS Statistics

Questionnaire responses were received from ISAR, IRST, and FA/UNR and combined with data from the other sources cited at the conclusion of this report. Incomplete historical data meant that the predecessor(s) of IRST (i.e., INRS, CEAER, CRAFOP, and CURPHA-METRA) are excluded from these data. Although some of these institutes have engaged in agricultural research in the past, it has always been in a rather minor way compared with ISAR. Agricultural research by academic institutions is included beginning with the period 1976-80, as the predecessor of FA/UNR (the Department of Agriculture of the Faculty of Science) was only established in 1974.

The expenditure data presented in this brief include an estimate of donor expenditures on salaries and supplements of expatriate researchers that were presumed not to be included in

the expenditure data reported by the national institutes (see appendix 2 and table 3 for more details).

3.1 Long-term development

There has been a rapid and fairly steady growth in researchers over the longer term. Expenditures grew at a slower rate than personnel and have fluctuated quite dramatically (table 3). After 25 years of relative stagnation, real expenditures increased by 2.4-fold between 1981-85 and 1986-90 but declined considerably in the early 1990s. The rapid growth in agricultural research expenditures during the 1980s was due largely to World Bank support for the Rwandan Agricultural Research Project. This project sought to upgrade and expand the research facilities of ISAR as well as improve its organization and management. Planned expenditures for this project were estimated to be 18 million dollars over the five years beginning in 1985, of which 11.5 million dollars was provided by IDA (World Bank 1985).

Agricultural research expenditures grew at an annual average rate of 5.7% during the past three decades. This figure is higher than the sub-Saharan African growth rate (4.7%) calculated for the period 1961-85 (Pardey, Roseboom, and Anderson 1991). The annual rate of growth of 8.8% for research staff is substantial higher than the continental average (6.8%). Rwanda began in the early 1960s with a relatively low level of research inputs. In 1961-65 there were, on average, 15 researchers per million farmers in sub-Saharan Africa, compared with just 4.5 researchers per million farmers in Rwanda. Rwanda's higher than average growth has narrowed this gap somewhat over the past three decades, but in 1986-90 the country still had less than half the 42 researchers per million farmers reported for the sub-Saharan African region in 1981-85.

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)	7.0	10.0	15.1	21.7	37.4	60.4	57.1	8.8
Expenditures (millions 1985 Rwandan francs)	108.705	150.359	125.701	182.183	236.172	573.819	369.291	5.7
Expenditures (millions 1985 PPP dollars)	2.757	3.813	3.188	4.620	5.990	14.553	9.366	5.7
Expenditures per researcher (1985 PPP dollars)	394,000	381,000	211,000	213,000	170,000	243,000	164,000	-2.9
Number of farmers (millions)	1.6	1.8	2.0	2.3	2.7	3.0	3.3	2.7
Researchers per million farmers	4.5	5.7	7.5	9.4	14.1	19.8	17.3	5.9
AgGDP (million 1985 PPP dollars)	999	934	1130	1705	1953	1778	1698	3.0
Expenditures as a % of AgGDP	0.20	0.29	0.22	0.31	0.34	0.86	0.58	4.7

Source: See appendices 5 and 6.

Note: Includes ISAR, IRST, and FA/UNR. Since IRST and FA/UNR reported only research staff data, with no corresponding expenditure data, it was assumed that the expenditures per researcher (excluding expatriate salaries) for these two institutes equaled those of ISAR. The expenditure data for ISAR for the years 1961-65 have been constructed by multiplying the number of researchers in each year with the 1966 expenditure-per-researcher figure. We assumed that ISAR's financial data included the costs of expatriate researchers until 1975. (Until that year ISAR was managed and financed completely by the Belgian government.) From 1976 onwards we have included expatriate costs at 110,000 "1985 PPP dollars" for the period 1976-80 and 120,000 "1985 PPP dollars" for the period 1981-91 in addition to the expenditures reported by ISAR.

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

3.2 Human Resources

Degree and Nationality Status of Researchers

Table 4 presents a fairly detailed, long-run view of developments concerning the country's agricultural research staff. At the time of independence in 1962 all research positions were filled by expatriates, mainly Belgians. The first Rwandan researcher was not appointed until 1971. After 1975 the number of Rwandan researchers increased rapidly as management of ISAR was placed under the control of a Rwandan national for the first time. While the Belgians were gradually scaling down and eventually curtailed their financial and scientific support in 1982, other donors and international agencies moved in with research staff and financial support. At present some 26% of the system's research staff are expatriates. The shift from a predominantly expatriate research staff to a national research staff took place quite rapidly. In 1975 more than 90% of the research staff were still expatriates, but in just six years this had dropped to below 50%. Throughout the 1980s about a third of the research staff of ISAR and FA/UNR were expatriates.

Table 4: *Educational and Nationality Status of Researchers*

Institutional category	Researcher status	1961-65	1966-70	1971-75	1976-80	1981-85	1986-90	1991
<i>(full-time equivalents)</i>								
Government ^a	Nationals							
	PhD	0	0	na	na	2.6	5.0	4.0
	MSc	0	0	na	na	18.6	29.6	34.0
	BSc	0	0	na	na	2.0	3.4	1.0
	Subtotal	0	0	1.0	na	23.2	38.0	39.0
	Expatriates	7.0	10.0	14.1	na	10.2	17.2	13.0
	<i>Total</i>	<i>7.0</i>	<i>10.0</i>	<i>15.1</i>	<i>19.0</i>	<i>33.4</i>	<i>55.2</i>	<i>52.0</i>
Academic ^b	Nationals							
	PhD	0	0	0	na	0.5	1.2	1.8
	MSc	0	0	0	na	2.4	2.0	1.2
	BSc	0	0	0	na	0	0	1.0
	Subtotal	0	0	0	na	2.9	3.2	3.0
	Expatriates	0	0	0	na	1.5	2.0	2.1
	<i>Total</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>2.7</i>	<i>4.4</i>	<i>5.2</i>	<i>5.1</i>
Total	Nationals							
	PhD	0	0	0	na	3.1	6.2	5.8
	MSc	0	0	0	na	21.0	31.6	35.2
	BSc	0	0	0	na	2.0	3.4	1.0
	Subtotal	0	0	1.0	na	26.1	41.2	42.0
	Expatriates	7.0	10.0	14.1	na	11.7	19.2	15.1
	<i>Total</i>	<i>7.0</i>	<i>10.0</i>	<i>15.1</i>	<i>21.7</i>	<i>37.8</i>	<i>60.4</i>	<i>57.1</i>

Source: See appendix 6.

^a Includes ISAR and IRST (as of 1989).

^b Includes FA/UNR.

The period averages presented in table 4 suggest the degree composition of the nation's research staff changed little during the 1980s. By contrast, the annual, institutional-level figures reported in appendix 6 indicate a rapid increase in the number of doctorates working for ISAR from zero in 1981 to five in 1984, but little change in that number for the rest of the decade. Although the number of PhDs within FA/UNR increased steadily from one in 1982 to six in 1991 this constitutes only 1.8 FTE years at the PhD level directed to research within the university's faculty of agriculture.

During the first half of the 1980s, more than 50% of African researchers held only a Bachelor's degree. Based on the classification scheme used to compile the data in table 4 the average education level of Rwandan researchers appears to be considerably higher. But, the ingenieur d'agronomie degrees are classified as Master's degrees in this table on the basis of the length of the curriculum (six years of post-secondary training which was reduced to five years in 1988/89). It appears that the local ingenieur d'agronomie programs lack the research focus that elsewhere is considered part of a Master's degree training and for comparative purposes it may be more appropriate to classify them at the BSc level. In that case more than 70% of Rwandan researchers would be classified as holding the equivalent of a Bachelor's degree.

stepped in and supported part of ISAR's local salaries and operating costs in order to keep the institution operational.

Table 6: *Agricultural Research Expenditures, ISAR*

Expenditures	1985	1986	1987	1988	1989	1990	1991
	<i>(millions 1985 PPP dollars)</i>						
Total expenditures	6.313	9.987	13.670	15.165	17.320	8.654	7.922
Recurrent expenditures	5.951	7.540	7.989	9.238	9.287	7.818	7.339

Source: 0999.

Factor Mix

Table 7 provides a breakdown of the total expenditures by cost category and shows the marked increase in the share of expenditures going to capital items during the latter half of the 1980s.

Table 7: *Expenditure Cost Categories, ISAR*

Cost Category	1983	1985	1986	1987	1988	1989	1990	1991
	<i>(percentages)</i>							
Personnel	63.1	78.1	62.2	47.8	46.6	40.2	73.1	64.9
Operating	18.7	15.8	12.8	9.5	12.8	12.3	15.2	24.5
Maintenance	-	0.4	0.5	1.3	1.0	0.9	0.7	1.3
Training	-	0	0	0	0.5	0.2	1.3	1.9
Capital	18.2	5.7	24.5	41.5	39.1	46.4	9.7	7.4

Source: 1983, 0017; and 1985-91, 0999.

The large fluctuation in capital expenditures markedly affects the shares going to other cost categories. When capital expenditures are excluded, personnel costs represent a rather stable share of the remaining recurrent costs, accounting for 75% to 83% of these costs between 1983 and 1990, and 70% of these costs in 1991.

Source of Funds

Throughout its existence, ISAR has been heavily reliant on donor support. Between 1962 and 1976, the period when the institute was managed by Belgium, all expenditures were paid by the Belgian government. When the management of the institute passed to the Rwandan government in 1975, the Belgium government reduced its level of support considerably. Between 1976 and 1983, the Rwandan government's contribution to the funding of ISAR increased from zero to 33%, the Belgium government's share decreased from 83% to zero, while other donors increased their share from zero to 40% (table 8). After 1983, donor support to ISAR increased steadily, largely as a result of World Bank support. On completion of the World Bank project total expenditures dropped precipitously (table 6), although donor funding continued to account for more than two-thirds of the institute's total expenditures. This was due to the concomitant decline in locally sourced funding for agricultural research that occurred in 1990 and 1991.

Table 8: *Source of Funding, ISAR*

Source of funding	1966	1971	1976	1983	1985	1986	1987	1988	1989	1990	1991
	<i>(percentages)</i>										
Government	0.0	0.0	0.0	33.5	26.0	22.6	19.9	17.2	18.7	14.8	14.2
Sale of products or services	10.9	25.8	17.3	26.7	15.7	14.9	10.4	7.4	12.3	12.8	15.5
Donors	89.1	74.2	82.7	39.8	58.3	62.5	69.7	75.4	69.0	72.3	70.3

Source: 1966&71, 0589; 1976, 0095; 1983, 0017; and 1985-91, 0999.

3.4 Research Focus

In 1991, ISAR's research staff spent 45% of their time on crops research, 17% on livestock, 8% on forestry, 16% on natural resources, and 14% on non- or cross-commodity research (table 9). In the latter category 62% was spent on socio-economics, 21% on biotechnology, and 17% on meteorology.

The crops receiving most research attention are beans (21%), (sweet) potatoes (18%) and bananas (15%). Other crops being research include corn, coffee, tea, cassava, sorghum, wheat, rice, and sugarcane. ISAR's livestock research concentrates mainly on cattle (50%), pastures and forage (35%), and sheep and goats (15%). Around 75% of the forestry research is on forest plantations and 25% on natural forests.

With limited human resources, IRST is attempting to address a particularly broad research mandate, ranging from medicinal and aromatic oil plants, natural forests, water conservation and irrigation, through to biotechnology. FA/UNR has also spread its scarce human capital thinly. Based on the numbers of faculty located in the various departments, around 11% of the university's agricultural research is on crops, 39% on livestock, 28% on natural resources, and 22% on fisheries. FA/UNR is the only institute in the country that conducts fisheries research.

An overview of the research orientation of the Rwandan system is provided in table 9.

Table 9: *Research Focus, 1991*

Research area	ISAR		IRST		FA/UNR		Total	
	FTE	Share	FTE	Share	FTE	Share	FTE	Share
		%		%		%		%
Crops	22.1	45	1.0	33	0.6	11	23.7	41
Livestock	8.3	17	0	0	2.0	39	10.3	18
Forestry	3.9	8	1.0	33	0	0	4.9	9
Fisheries	0	0	0	0	1.1	22	1.1	2
Natural resources	7.7	16	0.5	16	1.4	28	9.6	17
Other	7.0	14	0.5	16	0	0	7.5	13
<i>Total</i>	<i>49.0</i>	<i>100</i>	<i>3.0</i>	<i>100</i>	<i>5.1</i>	<i>100</i>	<i>57.1</i>	<i>100</i>

Source: 0999.

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

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Appendix 1: Country background information



Geography

Area: 2.6 million ha

Location: Land-locked country in Central Africa just south of the Equator bordered by Zaire to the west, Uganda to the north, Tanzania to the east and Burundi to the south.

Agroecological features: 12 agroecological regions, grouped into 3 main zones by altitude. These include: (1) Savanna zone in the east comprising 50% of the country, 1000-1500 m altitude, rainfall 700-1000 mm, long and pronounced dry season, average temperature 20-21°C, gentle relief, small risk of erosion, soils deep and often fertile; main constraint is the excessive irregularity of rainfall. (2) Central plateau and western slopes of the Nile-Zaire Divide, comprising 20% of the country, 1500-2000 m altitude, rainfall 1000-1250 mm in two seasons, average temperature 17-20°C, 22°C along Lake Kivu. Most densely populated area with highest agricultural potential, but much erosion and declining chemical soil fertility. (3) Mountainous Zaire-Nile Divide, 30% of the country, altitude 2000-2500 m, rainfall 1250-2000 mm or more, average temperature 15-17°C or less; no pronounced dry season; temperate climate; steep slopes with major erosion hazards where intensively cultivated. Two subzones, with vastly different soils: - very fertile, volcanic soils in the north (10% of country); - highly acidic, badly leached soils derived from granites and schists in the centre and south, causing major problems for development (20% of country).

Population

Total (1991): 7.1 million
 Annual growth rate (1981-90)^a: 3.0%
 Literacy (1990): 50.2%
 Life expectancy (1991): 48 years

Economy (values reported in 1985 PPP dollars)

Gross Domestic Product (1990): 4,272 million dollars
 Per capita GDP (1990): 617 dollars

Agricultural GDP (1990): 1,698 million dollars
 Share of agriculture in GDP (1990): 39.7%

Annual growth rates (1981-90)^a:

GDP: 0.5%
 GDP per capita: -2.4%
 AgGDP: -1.8%

Trade (values reported in current dollars)

Net surplus total trade (1991): -215 million dollars
 Net surplus agricultural trade (1991): 33 million dollars

Percentage of agricultural imports in total imports: 17.4%

Percentage of agricultural exports in total exports: 93.1%

Major agricultural import commodities (1991)^b: palm oil (20%), malt (16%), dry milk (14%), refined sugar (12%) and wheat (11%)

Major agricultural export commodities (1991)^b: coffee (72%) and tea (28%)

Agriculture

Agricultural land (1990): 1.6 million ha
 Annual growth rate (1981-90)^a: 0.1%
 Percentage arable: 52.6
 Percentage permanent crop: 18.9%
 Percentage permanent pastures: 28.6%

Percentage of arable and permanent cropland irrigated: 0.3%

Economically active agricultural population (1991): 3.3 million

Annual growth rate (1981-90)^a: 2.8%
 Percentage in total economically active population: 91.1%

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

^a Least squares growth rate.

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

Fertilizer use per ha arable land (1990): 2.6 kg
Annual growth rate (1981-90)^a: 14.1%

Major crops in order of production value (1991):
plantains, dry beans, sweet potatoes, coffee, cassava.

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, 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 non-research activities were an integral part of an institute’s research activities 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).

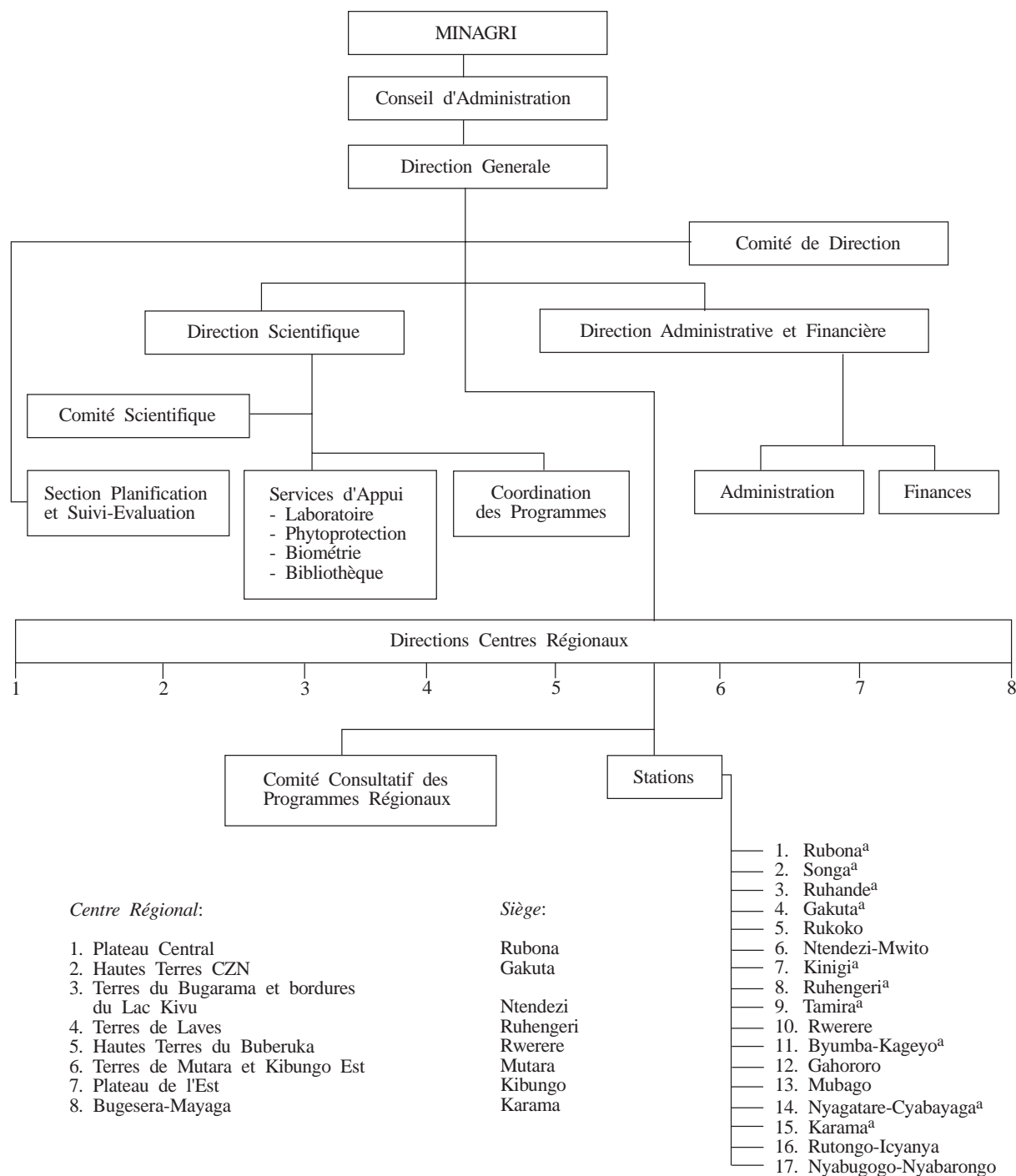
Nomenclature for tables in text

A zero indicates an actual observation of zero, a dash indicates 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

Institut des Sciences Agronomiques du Rwanda (1992)

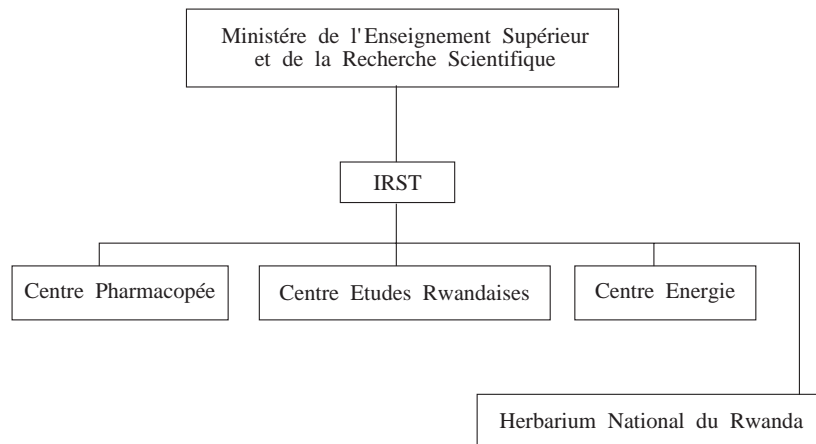


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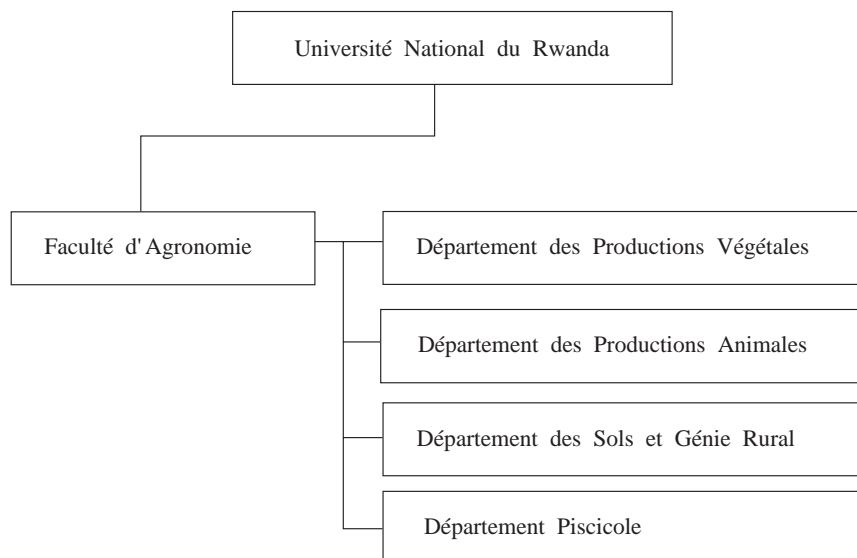
^aRepresents those stations staffed with researchers and/or technicians in 1992. The remaining stations are either not permanently staffed or are yet to be established.

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

Institut de Recherche Scientifique et Technologique (1992)



Faculté d'Agronomie (1992)



Appendix 4: Addresses of the agricultural research institutes

Directeur
ISAR
B.P. 138
Butare
RWANDA

Directeur Général
IRST
B.P. 227
Butare
RWANDA

Doyen
Faculté d'Agronomie
Université Nationale du Rwanda
B.P. 117
Butare
RWANDA

Appendix 5: Research and research expenditure totals, 1961-91

Total Number of Researchers		Units: full-time equivalents																
Category	Name institute	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	
Government	ISAR	5	6	7	8	9	10	10	10	10	10	16	16	16	14.5	13	15	
	IRST																	
	FAUNR	5	6	7	8	9	10	10	10	10	10	16	16	16	14.5	13	16	
Total		5	6	7	8	9	10	10	10	10	532	589	742	742		13	95	
Source:				742			175											
Government	Name institute	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	
	ISAR	17	19	21	23	25	21	31	40	49	51	51	50	58	60	49	56	
	IRST													3	3	3		
Academic	FAUNR	2	3	3.9	3.6	3.3	3	4.5	4.8	5.4	5.4	6.6	4.8	4.8	4.5	5.1		
	Total	19	22	24.9	26.6	28.3	24	35.5	44.8	54.4	56.4	57.6	54.8	65.8	67.5	57.1		
	Source:			888		13	13	17	230	984	999	999	999	999	999	999	999	

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

Total Research Expenditures		Units: millions of current Rwandan francs																
Category	Name institute	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	
Government	ISAR	6.223	7.995	8.579	11.042	16.243	24.700	33.265	33.007	33.246	34.321	33.700	32.250	31.361	34.056	56.497	66.000	
	IRST																	
	FAUNR	6.223	7.995	8.579	11.042	16.243	24.700	33.265	33.007	33.246	34.321	33.700	32.250	31.361	34.056	56.497	71.151	
Total (nominal Rwandan francs)		6.223	7.995	8.579	11.042	16.243	24.700	33.265	33.007	33.246	34.321	33.700	32.250	31.361	34.056	56.497	71.151	
GDP Deflator (1985=100)		8.0	8.6	7.9	8.9	11.6	15.9	21.8	22.0	22.5	23.6	23.6	24.0	24.9	29.1	52.1	57.1	
Total (constant 1985 Rwandan francs)		77.647	93.176	108.705	124.234	139.764	155.293	152.826	150.359	147.892	145.425	142.958	134.329	125.701	117.072	108.444	124.595	
Total (constant 1985 PPP dollars)		1.969	2.363	2.757	3.451	3.545	3.938	3.876	3.813	3.751	3.688	3.626	3.407	3.188	2.969	2.750	3.160	
Expat costs included in the total (1985 PPP dollars)		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.460	
Source:							589					589					95	

Total Research Expenditures		Units: millions of current Rwandan francs																
Category	Name institute	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	
Government	ISAR	97.528	107.784	123.521	133.158	150.192	134.889	163.060	204.688	248.927	367.138	509.169	584.357	694.605	356.838	377.712		
	IRST													37.006	18.337	24.643		
	FAUNR	11.026	16.734	23.008	21.270	20.059	22.726	25.510	26.437	24.623	37.083	62.764	61.481	61.617	31.959	44.182		
Total (nominal Rwandan francs)		108.554	124.518	146.529	154.429	170.251	157.615	188.570	231.125	273.550	404.221	571.932	645.838	793.228	407.133	446.537		
GDP Deflator (1985=100)		63.0	65.3	70.4	71.8	74.9	78.7	80.4	94.3	100.0	93.2	94.5	97.7	101.7	104.6	120.9		
Total (constant 1985 Rwandan francs)		172.3766	190.7347	207.9954	215.2114	227.3173	200.3582	234.6026	245.0329	273.5495	433.5522	605.4385	660.8836	779.9133	389.3077	369.2913		
Total (constant 1985 PPP dollars)		4.372	4.837	5.275	5.458	5.765	5.081	5.950	6.214	6.937	10.995	15.355	16.761	19.779	9.873	9.366		
Expat costs included in the total (1985 PPP dollars)		1.293	1.390	1.481	1.499	1.638	0.660	1.020	1.260	2.460	2.340	2.220	2.244	2.172	2.568	1.812		
Source:							13	17		999	999	999	999	999	999	999		

Note: Italicized figures represent data that are either constructed or interpolated. See appendix 2 for details about estimating salaries and supplements of expatriate researchers paid directly by donors.

Appendix 6: Research staff development by institute

Name institute: ISAR	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	1	1	1	2.0	3	4.7
Expatriates	5	6	7	8	9	10	10	10	10	10	15	15	15	12.5	10	10.3
Total	5	6	7	8	9	10	10	10	10	10	16	16	16	14.5	13	15
Source:			742			175				532	589		742		13	95
	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Nationals																
PhD					0	1	2	5	4	5	4	4	6	6	4	
MSc					13	13	22	22	23	25	28	27	33	33	33	
BSc					0	3	0	4	3	3	2	3	4	3	0	
Subtotal	6.3	8.0	9.7	11.3	13	17	24	31	30	33	34	34	43	42	37	
Expatriates	10.7	11.0	11.3	11.7	12	4	7	9	19	18	17	16	15	18	12	
Total	17.0	19.0	21.0	23.0	25	21	31	40	49	51	51	50	58	60	49	56
Source:					13	13	17	230	999	999	999	999	999	999	999	999

Name institute: IRST	1989	1990	1991
Nationals			
PhD	0	0	0
MSc	1	1	1
BSc	1	1	1
Subtotal	2	2	2
Expatriates	1	1	1
Total	3	3	3
Source:	999	999	999

Name institute: FA/UNR	1974	1975	1976
Nationals			
PhD			
MSc			
BSc			
Subtotal	0	0	1.7
Expatriates	0	0	1.7
Total	0	0	3.3

Name institute: FA/UNR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Nationals																
PhD						1		2	2	2	3	4	5	6	6	
MSc						4		9	11	11	14	3	4	1	4	
BSc						0		0	0	0	0	0	0	0	0	
Subtotal	3.3	5.0	6.5	6.0	5.5	5	10	11	13	13	17	7	9	7	10	
Expatriates	3.3	5.0	6.5	6.0	5.5	5	5	5	5	5	5	9	7	8	7	
Total	6.7	10.0	13	12.0	11.0	10	15	16	18	18	22	16	16	15	17	
Source:			888			13	979	984	999	999	999	999	999	999	999	

Note: Total faculty counts are reported here. To convert counts to full-time equivalent units we used a conversion factor of 0.3. Figures in italics are constructed by the authors.

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