Statistical Brief

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Statistical Brief on the National Agricultural Research System

of

SENEGAL

Valentina Mazzucato
Mohamadou El-Habib Ly

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.

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Contents

Acronyms

AgGDP	Agricultural Gross Domestic Product
AOF	Afrique Occidentale Française
BAST	Bureau des Affaires Scientifiques et Techniques
CDH	Centre de Développement Horticole
CFA	Communauté Financière Africaine (franc de la)
CFD	Caisse Française de Développement
CFDT	Compagnie Française pour le Développement des Fibres Textiles
CILSS	Comité Permanent Inter-états de Lutte Contre la Sécheresse dans le Sahel
CIRAD	Centre de Coopération Internationale en Recherche Agronomique pour le Développement
CNRA	Centre National de Recherches Agronomiques
CNRF	Centre National des Recherches Forestières
CRA	Centre de Recherches Agronomiques
CREA	Centre de Recherches en Economie Appliquée
CRODT	Centre de Recherches Océanographiques de Dakar-Thiaroye
CTFT	Centre Technique Forestier Tropical
DAST	Direction des Affaires Scientifiques et Techniques
DGRST	Délégation Générale à la Recherche Scientifique et Technique
DSA	Département des Systèmes Agraires
EEC	European Economic Community
EISMV	Ecole Inter-Etats des Sciences et Médecines Vétérinaires
ENSUT	Ecole Nationale Supérieure Universitaire de Technologie
FAO	Food and Agriculture Organization
FTE	Full-Time Equivalent
GDP	Gross Domestic Product
GERDAT	Groupement d'Etudes et de Recherches pour le Développement de l'Agronomie Tropicale
ICRAF	International Council for Research on Agroforestry
ICRISAT	International Crop Research Institute for the Semi-Arid Tropics
IDRC	International Development Research Center (Canada)
IEMVT	Institut d'Elevage et de Médecine Véterinaire Tropicale
IFAN	Institut Fondamental d'Afrique Noire
IITA	International Institute for Tropical Agriculture
ILCA	International Livestock Center for Africa
ILRAD	International Laboratory for Research on Animal Diseases
INDR	Institut National de Développement Rural
INSAH	Institut du Sahel
IRAT	Institut de Recherches Agronomiques Tropicales et des Cultures Vivrières
IRCT	Institut de Recherches du Coton et des Textiles
IRFA	Institut de Recherches sur les Fruits et Agrumes
IRHO	Institut de Recherches pour les Huiles et Oléagineux
ISE	Institut Supérieur de l'Environnement
ISNAR	International Service for National Agricultural Research
ISRA	Institut Sénégalais de Recherches Agricoles
ITA	Institut de Technologie Alimentaire
IUT	Institut Universitaire de Technologie
LNERV	Laboratoire National d'Elevage et de Recherches Vétérinaires
LFERV	Laboratoire Fédéral d'Elevage et de Recherches Vétérinaires
NARS	National Agricultural Research System
ORSTOM	Institut Français de Recherche Scientifique et Technique pour le Développement en Coopération (previously Office de la Recherche Scientifique et Technique Outre-Mer)
OUA	Organisation de l'Unité Africaine
SAFGRAD	Semi-Arid Food Grain Research and Development
SPAAR	Special Program for African Agricultural Research
USAID	United States Agency for International Development
WARDA	West-African Rice Development Association

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 Senegal. 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 Senegalese 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 Senegal we refer to appendix 1.

2. Agricultural Research Institutions

2.1 Historical Evolution[1]

Senegal was the first French colony in Africa. In 1890 it was effectively occupied, although relations with France date from 1659 when France established a fort and trading post in Saint Louis to reap the benefits of the Atlantic slave trade and to assert France's position as a major European naval power. Throughout the 18th and first half of the 19th centuries French and English armies battled over the coastal areas along West Africa and made small territorial gains towards the interior (Gellar 1982).

The French West Africa Federation (Afrique Occidentale Française (AOF)) was created in 1895. It was initially governed from Saint Louis and beginning in 1902 from Dakar. As the administrative capital of French West Africa, Dakar became an active center of African politics (Europa Publications 1992). During the 19th century, inhabitants of Saint Louis were granted a form of French citizenship and thereafter had representation in the French national assembly, thus making Senegal the French colony in Africa with the closest ties to Paris.

1903-60

Agricultural research in Senegal began in earnest with the creation of a Jardin d'Essais at Hann, near Dakar in 1903. The garden had a federation-wide mandate and comprised a botanic division, an experiment division for the introduction of new crops and fruits, a nursery, and laboratories. During the 1920s and 1930s, the country's research capacity was further expanded. The ferme école de Bambey, created in 1913, was transformed into the Station Expérimentale de l'Arachide in 1921 and underwent substantial expansion between 1921-24. This station, which was supported by the French vegetable oil industry, conducted research on groundnuts as well as on millet, sorghum, and cowpea (crops that are rotated with groundnuts) and on animal traction used for groundnut cultivation. In 1933, the station became the principal groundnut research station in AOF with several substations throughout the federation. In 1936 a chemical laboratory was established to conduct soil research. Livestock research began in 1930 with the creation of a livestock research center in Dahra. Additionally, in 1935, the Laboratoire Central de l'Elevage was established in Hann (Dakar).

Regional cooperation in agricultural research within the AOF was substantially intensified after World War II. In 1949 the Comité de Coordination et de Contrôle des Recherches Agronomiques et de la Production Agricole was created to define research policy, to coordinate and evaluate research and extension, and to supervise the budgets for these activities. A year later, the AOF's main stations were upgraded to research centers. Thus the station at Bambey became the Centre de Recherches Agronomiques (CRA) conducting research on food and cash crops for the whole Sudanian zone of the AOF, while the CRA Bingerville in Côte d'Ivoire became the Centre de Recherches Agronomiques for the subtropical and subequatorial zones. The centers in Bambey and Bingerville both received scientific backstopping from the Section Technique d'Agronomie Tropicale (the predecessor of IRAT) in Nogent-sur-Marne, France. Some principal stations were created to specialize in certain crops: Station Principale de Seredou in Guinea conducted research on cinchona (quinine) and mountain crops, while the Station Principale de Kankan, also in Guinea, was responsible for rice research for the maritime

1 The majority of the information in this section is taken from Angladetie (1988) and Faye and Bingen (1989).

regions. Each of these centers and principal stations had satellite research and support stations located throughout the AOF. The centers and principal stations received budgetary support from AOF whereas the support stations were financed by the territories in which they were located. French research organizations (IRCT, IRHO, and IRFA) were also considered an integral part of the federal scientific policy framework. Their research was monitored by the Comité de Coordination and they received financial contributions from the federation. In 1950 IRHO established itself in Senegal with stations in Darou and Louga. It conducted research on groundnuts for both crop and oil production.

Livestock research was reorganized after 1950 into two main areas of research. The Laboratoire Central de l'Elevage was transformed into the Laboratoire Fédéral d'Elevage et de Recherches Vétérinaires (LFERV) in 1953 and became the principal center for animal health and nutrition research within the AOF. It had a farm in Sangalkam. Research was conducted on animal pathology, disease prevention, vaccine production, and animal nutrition. LFERV was linked with various laboratories throughout the AOF territory. Its laboratory in Saint Louis conducted research for Senegal and Mauritania. These laboratories prepared biological products, provided diagnostic services, and conducted location-specific research. The other branch of livestock research was the Centre Fédéral de Recherches Zootechniques de Sotuba near Bamako (Mali), which was mandated with the genetic improvement of indigenous breeds, as well as animal nutrition and fodder crop research. It had a station in Minankro (Côte d'Ivoire) to adapt its results to the Guinean zone.

In 1936 the Institut Français d'Afrique Noire (IFAN) was established at Dakar to provide training and to conduct research in biology, ecology, and the social sciences. With the creation of the Université de Dakar in 1957, IFAN was integrated into the university. Although the university did not establish a faculty of agriculture, some agricultural research was conducted by the university through the faculty of science. Overall, however, the academic sector constituted a very minor component of Senegal's NARS.

1960-75

This basic structure of research in the region did not change until political independence of the African states. At independence each state inherited the research structures that were operating in its territory. However, the absence of trained African personnel meant that the majority of the newly independent states were forced to rely heavily on French research institutes, such as IRHO, IRAT, and IEMVT, which in 1963 were reorganized under one central committee, GERDAT, based in Paris, France.

Although the ownership of research facilities located within Senegal was transferred from France to the Senegalese government upon independence in 1960, the main organizational structure of the research system remained virtually unchanged until 1975. France and Senegal agreed to jointly finance research, with France providing the researchers and Senegal the agricultural laborers. Most of the "nationalized" research structures were managed by the various French institutes for tropical agricultural research. So the CRA in Bambey, which became the Centre National de Recherches Agronomiques at independence (CNRA), and the Laboratoire National d'Elevage et de Recherches Vétérinaires (LNREV), formerly LFERV, were managed by the French agencies IRAT and IEMVT, respectively. The stations Nioro du Rip, Sinthiou Malème, Richard-Toll, Guédé, and Séfa administered by IRAT. IRHO kept its stations in Darou and Louga. Research on cotton began in 1963 under the direction of IRCT which had a base in Kaolack but used IRAT's stations and collaborated with CFDT. Forestry

research began in 1965 with the creation of the Centre National des Recherches Forestières (CNRF) under the department of water and forestry and was assigned to CTFT. The center worked primarily on conservation and regeneration of natural forests and on the introduction of rapidly growing trees for reforestation purposes.

Other research agencies not directly linked with the French tropical institutes undertook fisheries and horticultural research. Fisheries research began in 1961 with the establishment of the Centre de Recherches Océanographiques de Dakar-Thiaroye (CRODT). This was created with the assistance of another French research organization, ORSTOM, and placed under its supervision. In 1963 the Institut de Technologies Alimentaires (ITA) began research on food processing. It was created as an établissement public à caractère industriel et commercial which made it a profit-seeking, public-sector institute. However, in 1967, in order to qualify for FAO assistance, it was converted to an établissement public à caractère administratif, making it a nonprofit entity. In 1972 horticultural research began at the Centre de Développement Horticole (CDH) under the Ministère de l'Economie Rurale.

During the 1960s and early 1970s livestock research developed at a slower pace than crop research and much of the work was done in conjunction with the livestock center at Sotuba, Mali. The livestock research centers in Dahra and Kolda, the latter having been established in 1972, were administered by the livestock department of the ministry in charge of agriculture rather than the French research institutes. Animal breeding continued to be the main focus of the program with little or no emphasis given to socioeconomic aspects of livestock production.

All agricultural and livestock research activities were placed under the Ministère de l'Economie Rurale. The ministry formed a Comité des Recherches Scientifiques et Techniques to advise the research programs. Additionally, a commission composed of representatives of France and Senegal met periodically to set the broad lines of the research programs and allocate the available financial resources.

The nationalization of the research system coincided with preparations for the second economic and social development plan. In 1966 the government created a Conseil Interministériel sur la Recherche Scientifique et Technique and the Bureau des Affaires Scientifiques et Techniques (BAST), both attached to the Secrétariat d'Etat à la Présidence. These units were responsible for setting national scientific policy. In 1970 the BAST became the Direction des Affaires Scientifiques et Techniques (DAST) under the Secrétariat d'Etat au Plan. In 1973 the DAST became the Délégation Générale à la Recherche Scientifique et Technique (DGRST). It was the first organization to oversee all agricultural research institutes, including the French research institutes, which until then had been under the Ministère du Développement Rural (the former Ministère de l'Economie Rurale). In November, 1974, the DGRST established the Institut Sénégalais de Recherches Agricoles (ISRA).

The academic component of the NARS expanded during this period with the establishment of the Institut Universitaire de Technologie (IUT) at the Université de Dakar in 1967. IUT, recently renamed Ecole Nationale Supérieure Universitaire de Technologie (ENSUT), provides training in chemistry and food technology.

1975 - present

Through its seven research departments, ISRA took control of all research activities that were previously conducted by the French institutes for tropical agricultural research and some Senegalese organizations. Thus, research work conducted by IRAT, IRCT, and IRHO, was

incorporated into ISRA's new Département d'Agronomie et Bioclimatologie, the Département de Machinisme Agricole et Equipements Ruraux, the Département de Pédologie et Hydraulique Agricole, and the Département d'Economie et Sociologie. IEMVT's work was incorporated into the Département de Médecine Véterinaire et Sciences Animales. Research conducted by CTFT was taken over by the Département de Recherche Forestière et Hydrobiologie, while CRODT became ISRA's Département d'Océanographie. In 1981 the Senegalese institute CDH was also merged with ISRA, adding horticultural research to ISRA's mandate. ITA was the only agricultural research organization to remain administratively separate from ISRA. Additionally, ISRA inherited ten research centers. Each of these centers had its own internal administrative structure. A dual organizational structure involving research departments and research centers emerged with responsibility for defining research programs and budgets given to department directors, while center directors were responsible for implementing research programs and managing their assigned budgets. No hierarchy was formally established between these two sets of directors. Both centers and departments were under a director general and a deputy-director general.

Until 1982 ISRA's research orientation was largely a continuation of the programs of the French research institutes it inherited. Crop breeding and on-station research dominated the program. The focus was on millet, sorghum, maize, peanut, cowpea, and soybean research at the Bambey research center, cotton at Kaolack, mangrove rice at Djibélor, and irrigated rice at Richard-Toll. Some production systems research was conducted at Kaolack and Richard-Toll and horticultural research was carried out at the Centre de Développement Horticole de Cambéréne. LNERV, which conducted livestock research, focussed on animal health, agrostology, animal nutrition, forage cultivation, and milk production of exotic breeds. The main focus of forestry research was on the regeneration of natural forests and on the introduction of fast-growing varieties.

A large World Bank funded project lasting five years began in 1981 called the Agricultural Research Project. As part of the project, ISRA was reorganized in 1982 and again in 1983. As a consequence of this restructuring, it reduced its number of departments from seven to five, multidisciplinary, commodity-based departments and created three new bureaus to deal with human resources, macroeconomic analyses, and research planning and evaluation.

In 1985 ISRA ceased to be part of the DGRST and was transferred to the Ministère du Développement Rural as an établissement public à caractère industriel et commercial. In 1987 ISRA was again reorganized to simplify its structure by combining scientific and management responsibilities. Each of the ten research centers was placed under one of the five departments, now called *directions*: the Direction des Systèmes Agraires et Economie Agricole, Direction de Productions Végétales, Direction de la Santé et Productions Animales, Direction des Productions Forestières, and the Direction des Productions Halieutiques et Hydrologie. This structure has changed little since 1987 (appendix 3). ISRA has remained part of the ministry in charge of agriculture, which in 1990 was renamed the Ministère du Développement Rural et de l'Hydraulique and in 1992 became the Ministère de l'Agriculture.

Until the late 1970s, the role of the academic sector in agricultural research has been quite limited. Degree-level courses in the agricultural sciences only began in 1980 with the establishment of the Institut National de Développement Rural (INDR), which more recently was renamed Ecole Nationale Supérieure d'Agriculture (ENSA). ENSA's degree program normally takes five years to complete and leads to an ingénieur agronome degree. To further

develop its research activities, ENSA recently created three multidisciplinary centers that focus on crop production, livestock production, and agribusiness management.

In addition, with support from Belgium, the Université de Dakar established the Institut des Sciences de l'Environnement (ISE) within the faculty of science in 1978/79. ISE provides postgraduate training in the environmental sciences and conducts research on natural resources. In 1987 the Université de Dakar was renamed Université Cheikh Anta Diop.

2.2 Present Structure

The present structure of the national agricultural research system in Senegal is given in table 2. ISRA is by far the most important agricultural research organization in the country with more than 90% of the country's total number of FTE researchers.

ISRA's mandate is to conduct research on agriculture, livestock, forestry, and fisheries, collect and store scientific knowledge generated by the different research organizations working in the country, manage agricultural research centers and stations, encourage and participate in the training of national researchers, and foster cooperation with other research organizations both in the region and internationally.

The only government institute other than ISRA that conducts agricultural research is ITA. ITA's mandate is to conduct research on the storage, conservation, and processing of agricultural products, develop new local food products derived primarily from groundnuts, fish, meat, milk, fruits and vegetables, develop and distribute large-scale processed foods, and to assist in the quality control of food products during production, marketing, and international trade. ITA also conducts studies in food technology for state agencies and has a training section to instruct professionals in the nutritional and agribusiness industries.

The academic component of the NARS consists of ENSA and several units within the Université Cheikh Anta Diop (formerly the Université de Dakar). These entities are: (a) the Institut Supérieur de l'Environnement (ISE), which conducts research on natural resources, in particular water and forestry; (b) the Centre de Recherches en Economie Appliquée (CREA), which conducts socio-economic research, some of which focusses on agriculture; and (c) the Ecole Nationale Supérieure Universitaire de Technologie (ENSUT), which trains annually about 30 research technicians in the areas of food technology, plant protection, hydrology and rural engineering, and meteorology. ENSUT probably also conducts some research in these areas.

At the regional level, the Ecole Inter-Etats des Sciences et Médecine Vétérinaires de Dakar (EISMV) gives instruction in the animal and veterinary sciences to the MSc level. It was founded by the Etats de l'Organisation Commune Africaine et Mauricienne and is operated by a Board of Directors comprised of all African member states. Since it is not a national organization it has not been included in the overview presented in table 2.

Also excluded from table 2 are the many foreign research agencies that collaborate with Senegalese institutes. These include the French tropical research institutes that collaborate with ISRA, such as CTFT, IRAT, IEMVT, IRHO, IRCT, IEMVT, and DSA, as well as ORSTOM which conducts more basic research on soil science, hydrology, microbiology, and the humanities with limited direct interaction with any Senegalese research agencies. In addition, ISRA collaborates with various regional and international (research) organizations, such as WARDA, IITA, ILCA, ILRAD, ICRAF, ICRISAT, INSAH, CILSS, SPAAR, OUA,

Table 2: *Overview of Present Structure of NARS (1992)*

Institutional category	Supervising agency	Executing agency		Research focus	Staffed research sites[a]	Number of researchers			
		Name	Acronym			National	Expats	Total	FTEs
Public	Ministère de l'Agriculture	Institut Sénégalais de Recherches Agricoles	ISRA	crops, livestock, forestry, fisheries, soils, socio-economics	12 (12)	109	46	155	155.0
	Ministère de l'Industrie, du Commerce et de l'Artisanat	Institut de Technologie Alimentaire	ITA	food technology	1 (1)	19	1	20	10.0
Academic	Ministère d'Education Nationale	Ecole Nationale Supérieure d'Agriculture	ENSA	agriculture, animal husbandry, hydrology, forestry	1 (1)	7	7	14	3.5
	Université Cheikh Anta Diop	Institut de Sciences de l'Environment, Faculté des Sciences et Techniques	ISE	natural resources, environment	1 (1)	na	na	na	na
		Centre de Recherches en Economie Appliquée, Faculté des Sciences Economiques	CREA	economics	1 (1)	na	na	na	na
		Ecole Nationale Supérieure Universitaire de Technologie	ENSUT	agro-food industry, plant protection, hydraulics, rural engineering	1 (1)	na	na	na	na
Total					*17 (17)*	*135*	*54*	*189*	*168.5*

Source: 0999.
[a] Staffed with researchers and/or technicians. Bracketed figures represent those sites staffed with researchers.

SAFGRAD, and FAO. Collaboration with these organizations has generally been sporadic and not of a long-term nature. It has often been limited to short-term training, participation in seminars and workshops, and the provision of germplasm accessions. ISRA also has linkages with various European and North American universities involving both long- and short-term training for researchers.

3. NARS Statistics

Data presented in the following sections come from survey questionnaires completed by ISRA, ITA, and ENSA for the years 1986-92. For the years prior to 1986, secondary sources were used and are referenced at the end of this report. The academic sector institutes ISE, CREA, and ENSUT did not respond to our questionnaire. We assume these three institutes conduct relatively little research of direct relevance to agriculture and jointly account for less than 5% of the Senegalese NARS.

As international organizations are excluded from our definition of a NARS (appendix 2), the following data do not include independent research activities conducted by WARDA, IITA, ILCA, ILRAD, ICRAF, ICRISAT, and SAFGRAD. Their contributions to research have only been included when they were in the form of activities conducted through ISRA, and in these cases the corresponding funding has been included as part of the donor funds received by ISRA. Personnel and expenditures of the French tropical agricultural research institutes were included for the period 1961-74 when a national research structure did not yet exist and the French institutes managed and conducted all agricultural research in the country. After 1974, all French agricultural research activities conducted through ISRA are reported, where appropriate, under ISRA as donor funds and/or expatriate researchers. ORSTOM's research has been excluded from the data reported below, as it is classified as a foreign and not a national institute. However, the research center CRODT did become part of the national research system after 1975 and was therefore included in the pre-1975 data when it was managed by ORSTOM.

The expenditure data presented in this brief are based on the actual expenditures as reported by the various institutes. However, institutes systematically underestimate the degree of donor support to the degree they only have information about the donor support that is 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 an implicit cost series was constructed for expatriate researchers (see appendix 2) and, where necessary, this was added to the expenditures reported by the various institutes.

3.1 Long-term development

The number of agricultural researchers in Senegal grew at an annual rate of 5.1% on average over the period 1961-92. The number of researchers expanded rapidly between the early 1970s and 1980s. Thereafter the number of researchers declined as ISRA, representing the largest component of the NARS, reduced its research personnel in 1985, 1987, and 1990 (table 3).

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

	1961-65	1966-70	1971-75	1976-80	1981-85	1986-90	1991	1992	annual growth[a]
									%
Researchers (FTEs)	62.2	70.2	76.6	136.6	210.6	195.5	174.5	168.5	5.1
Expenditures (millions 1985 francs CFA)	2,778	3,100	3,812	5,030	6,443	5,083	3,533	3,780	2.4
Expenditures (millions 1985 PPP dollars)	18.313	20.433	25.127	33.156	42.469	33.503	23.292	24.918	2.4
Expenditures per researcher (1985 PPP dollars)	295,000	291,000	331,000	250,000	200,000	170,000	133,000	148,000	-2.6
Number of farmers (millions)	1.4	1.5	1.7	2.0	2.2	2.4	2.5	na	2.2
Researchers per million farmers	45.7	45.7	44.0	69.7	97.3	82.6	69.6	66.1	2.8
AgGDP (million 1985 PPP dollars)	1,149	1,284	1,359	1,512	1,425	1,663	1,707	na	1.3
Expenditures as a % of AgGDP	1.60	1.60	1.81	2.14	3.06	1.85	1.30	na	1.1

Source: See appendices 5 and 6.
Note: Includes ISRA, ITA, and ENSA. For the period prior to ISRA's creation in 1975 the data include the French tropical research institutes, which until 1975 managed most of the agricultural research in the country.
[a] Least squares growth rate for the 1961-91 period.
[b] For information about "PPP dollars" see appendix 2.

Research expenditures grew over the 1961-91 period but at a slower rate than the 4.7% estimated for sub-Saharan Africa for the period 1961-85 (Pardey, Roseboom and Anderson 1991). Agricultural research expenditures grew rapidly during the latter half of the 1970s and early 1980s when numerous international donors in addition to France, began funding agricultural research as the country sought to "nationalize" its research endeavors. In particular, the International Development Association of the World Bank, along with other aid agencies and the government of Senegal, initiated an Agricultural Research Project for ISRA in 1983, totalling US$106.1 million over the subsequent 6 years.

Over the longer run, expenditures grew more slowly than researchers, so that expenditures per researcher declined by 2.6% per annum between 1961-92. Expenditures per researcher were high by regional and international standards between 1961-75 when the French tropical research institutes accounted for much of the research in the country. Following ISRA's creation in 1975 there was a marked increase in the number of researchers but no corresponding increase in research expenditures. However, the large number of (costly) expatriates still present in the system meant that expenditures per researcher in the early 1980s were still high relative to regional standards (Pardey, Roseboom, and Anderson 1991). Expenditures per researcher have since declined given the decrease in support for agricultural research.

Compared with other African countries, Senegal's agricultural research expenditures as a percentage of agricultural GDP have historically been rather high. In the early 1960s Senegal's intensity ratio was more than three times the regional average (Pardey, Roseboom and Anderson 1991). A reason for this relatively high research intensity can be found in Senegal's prominent role in the AOF with regard to agricultural research. At independence the country inherited a considerably better agricultural research infrastructure than most other French West African countries. However, more recently, agricultural spending expressed as a percentage of AgGDP declined dramatically from a high 3.1% in the early 1980s to 1.3% in 1991 so that

Senegal's research intensity is now about 20% below the level that prevailed three decades earlier and more than 50% lower than that in the early 1980s. This decline reflects a significant reduction in donor support in the past few years.

3.2 Human Resources

Prior to the creation of ISRA, agricultural research in the government sector was managed and largely conducted by the French tropical research institutes resulting in a preponderance of French researchers in the system. The majority of Senegalese staff were employed at the technician level. When research came under the management of ISRA, emphasis was given to training Senegalese staff. Senegalese researchers grew steadily in numbers until 1985, when ISRA, representing the majority of the Senegalese NARS, reclassified its national staff and as a consequence many former researchers were no longer classified as such (table 4). Expatriate researchers accounted for over one half of the total research staff at ISRA until the early 1980s. Correspondingly three large donor-financed projects were initiated during the period 1981-85. These include a FAO-Belgian financed project on horticultural crops that at the time were being integrated into ISRA's research portfolio, a CILSS-FAO financed project "lutte intégrée", and the World Bank-USAID funded Agricultural Research Project. During the late 1980s, the amount of donor funds decreased as did the number of expatriate researchers, so that by 1992 expatriates comprised less than one-third of the total number of researchers at ISRA.

Table 4: *Educational and Nationality Status of Researchers*

Institutional category	Researcher status[a]	1961-65	1966-70	1971-75	1976-80	1981-85	1986-90	1991	1992
					(full-time equivalents)				
ISRA	Nationals								
	PhD	na	na	na	na	na	na	na	na
	MSc	na	na	na	na	na	na	na	na
	BSc	na	na	na	na	na	na	na	na
	Subtotal	na	na	13.3	47.4	101.7	118.3	112.7	109.0
	Expatriates	na	na	56.5	77.4	89.5	58.1	48.3	46.0
	Total	*60.7*	*66.3*	*69.8*	*124.8*	*191.2*	*176.4*	*161.0*	*155.0*
ITA	Nationals								
	PhD	na	na	na	na	na	4	3	3
	MSc	na	na	na	na	na	7	5	5
	BSc	na	na	na	na	na	5	2	3
	Subtotal	na	na	na	na	na	15	10	10
	Expatriates	na	na	na	na	na	0	1	1
	Total	*2.4*	*3.9*	*6.8*	*11.6*	*17.2*	*15.3*	*10.0*	*10.0*
ENSA	Nationals								
	PhD	0	0	0	0	na	na	na	na
	MSc	0	0	0	0	na	na	na	na
	BSc	0	0	0	0	na	na	na	na
	Subtotal	0	0	0	0	na	1.4	1.5	1.8
	Expatriates	0	0	0	0	na	2.4	2.0	1.8
	Total	*0*	*0*	*0*	*0*	*2.2*	*3.8*	*3.5*	*3.5*

Source: See appendix 6.
[a] For a list of PhD, MSc, and BSc equivalent degrees see appendix 2.

ITA witnessed a steady increase in FTE researchers until 1983, and then remained at that level until 1988 whereafter the number of researchers working for the institute began to decline. The decline experienced since the late 1980s is due to an increase in ITA's non-research activities such as extension, training, and meat quality control. ENSA, being a relatively new institution, has a small number of staff and still significantly relies on expatriate researchers.

Gender

In 1992 female researchers accounted for 10% of the total number of ISRA's national researchers. At ITA female researchers accounted for just over 30% of the total number of national researchers between 1986-92.

Staff Composition

The technician to researcher ratio for ISRA was 1.1 in 1983 (table 5) and 1.3 in 1990 but declined dramatically to 0.8 by 1992 given the greater decline in technical support staff compared with staff classified as researchers. The corresponding ratio for ITA was slightly higher (i.e., 1.5) during the late 1980s, increasing to 1.8 by 1992. Both institutions have a relatively large number of staff in the "other support" category, which includes agricultural laborers, watchmen, drivers, and so on.

Table 5: *Staffing Structure*

Institute	Staffing structure	1970[a]	1983	1986	1987	1988	1989	1990	1991	1992
					(full-time equivalents)					
ISRA	Research	69	197	193	172	176	174	167	161	155
	Support									
	Technical	61	215	na	na	na	na	221	211	119
	Administrative [b]	-	-	-	-	-	-	52	62	84
	Other	194	1043	na	na	na	na	190	185	220
	Subtotal	255	1258	1300	820	na	na	463	458	423
	Total	*324*	*1455*	*1493*	*992*	*na*	*na*	*630*	*619*	*578*
ITA	Research	5	17	17	17	16	14	13	10	10
	Support									
	Technical	3	na	26	26	23	18	19	18	18
	Administrative [b]	-	na	12	12	13	7	7	9	9
	Other	20	na	18	18	14	8	8	9	9
	Subtotal	23	53	56	56	50	33	34	35	35
	Total	*28*	*70*	*73*	*73*	*67*	*47*	*47*	*45*	*45*

Source: 0015, 0068, 0532, and 0999.
[a] ISRA data for the year 1970 pertains to the French institutes that preceded ISRA.
[b] The administrative category is included in the "other" category until 1989 for ISRA and 1986 for ITA.

3.3 Financial Resources

Expenditures

While research expenditures by government sector institutes trended upward between 1961 and 1985 they were also highly variable (table 6). During the late 1970s and early 1980s the funding base broadened to include many new international donors. This brought about an abnormally

large increase in research expenditures that lasted until 1985. Since then research expenditures have dropped precipitously as donor-funded projects ended and ITA shifted its focus toward non-research activities.

Table 6: *Agricultural Research Expenditures*

Institution	1961-65	1971-75	1981-85	1986	1987	1988	1989	1990	1991	1992
					(millions 1985 PPP dollars per year)					
Government	18.313	25.127	42.231	42.644	35.270	33.923	28.072	25.479	22.933	24.597
Academic [b]	0.000	0.000	0.238	0.602	0.435	0.402	0.323	0.363	0.359	0.321
Total	*18.313*	*25.127*	*42.469*	*43.246*	*35.705*	*34.325*	*28.394*	*25.394*	*23.292*	*24.918*

Source: See appendix 5.
[a] Least squares growth rate for the period 1961-92.
[b] Includes ENSA only.

In terms of agricultural research expenditures the academic sector represents a very small component of the NARS. However, our data underestimate the extent of the academic sector since it only includes ENSA. For the other academic entities, ISE, CREA, and ENSUT, no acceptable quantitative information was available. Together these entities constitute only a small component of the NARS (probably less than 5%), but even this relatively small percentage would be sufficient to double the share of overall expenditures attrituable to the academic sector.

Factor Mix

Personnel costs have historically accounted for the largest share of ISRA's expenditures, usually comprising as much as 75% of total expenditures. In years of large capital expenses, personnel costs dropped to 60% of total expenditures. Operating costs, including maintenance, comprised approximately 25% of ISRA's total expenditures throughout the 1980s while capital costs fluctuated in line with the amount of donor funding.

Table 7: *Expenditure Cost Categories, ISRA*

Cost category	1976	1984	1985	1986	1987	1988	1989	1990	1991	1992
					(percentages)					
Personnel [a]	74.8	61.9	60.3	64.2	68.5	64.8	72.5	75.1	75.4	71.4
Operating	24.4	26.8	23.5	11.3	12.7	14.0	13.7	13.7	14.5	13.6
Maintenance [b]	-	-	-	8.3	9.8	10.5	7.6	6.2	6.0	9.5
Capital	0.8	11.3	16.2	16.1	9.1	10.7	6.1	5.0	4.0	5.4
Total	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*

Source: 1175 and 0999.
[a] Training expenditures are included in the personnel expenditures.
[b] From 1976-85 maintenance expenditures are included as part of operating expenditures.

Source of Funds

Donors have played a major role in funding public agricultural research in Senegal. In the past, important donors were IDRC, USAID, France, EEC, Belgium, and the World Bank. Since 1985 donor-sourced funds accounted for up to 77% of ISRA's expenses and 42% of ITA's budget (table 8). However, the amount of donor funding is also highly variable. During this same period it fell to less than 60% and 5% of ISRA's and ITA's budgets, respectively. ISRA's government-sourced funds have also been highly variable and at times extremely low. ISRA also receives a sizeable amount of funds from the sale of products and services.

Table 8: *Source of Funding*

Institute	Source of funding	1986	1987	1988	1989	1990	1991	1992
					(percentages)			
ISRA	Government	23.0	31.4	18.9	19.5	33.0	31.8	32.5
	Own income	5.0	4.3	6.9	3.5	7.3	3.3	4.2
	Donor	72.1	64.2	74.2	77.0	59.7	65.0	63.3
	Total	*100*	*100*	*100*	*100*	*100*	*100*	*100*
ITA	Government	52.9	53.5	62.0	74.1	81.2	52.7	66.4
	Own income	4.4	6.2	6.1	11.9	14.3	18.5	22.0
	Donor	42.7	40.3	32.0	14.0	4.5	28.8	11.5
	Total	*100*	*100*	*100*	*100*	*100*	*100*	*100*

Source: 0999.

ITA relies heavily on government funding but has received an increasing portion of its funds from the sale of products and services, which in 1992 accounted for over one fifth of the total funds available.

3.4 Research Focus

Most of the agricultural research conducted in the government sector relates to crops, with 49% of ISRA's researchers working on crop-related issues, 70% of ITA's researchers, and 25% of ENSA's researchers. In fact, crop research at ISRA experienced the largest increase in numbers of Senegalese researchers and it is also the research focus that accounts for the largest number of expatriate scientists in the government sector (Faye and Bingen 1989). Fisheries and forestry research are only conducted by ISRA. The share of resources going to each commodity area remained fairly stable throughout the 1980s. The exception was forestry research which grew from two researchers in 1979 (Faye and Bingen 1989) to 16 full-time researchers in 1993. ENSA is mainly concerned with livestock research with 43% of its FTE researchers nominating this as their primary areas of investigation.

Table 9: *Research Focus, 1992*

	ISRA		ITA		ENSA		Total	
Research area	FTE	Share	FTE	Share	FTE	Share	FTE	Share
		%		%		%		%
Crops	75.4	48.7	7.0	70.0	1.0	28.6	83.4	49.5
Livestock	29.3	18.9	3.0	30.0	1.5	42.9	33.8	20.1
Forestry	17.0	11.0					17.0	10.1
Fisheries	33.3	21.5					33.3	19.7
Other					1.0	28.6	1.0	0.6
Total	*155.0*	*100*	*10.0*	*100*	*3.5*	*100*	*168.5*	*100*

Source: 0999.
Note: Non-allocatable economics and soil science research were included in the "other" category.

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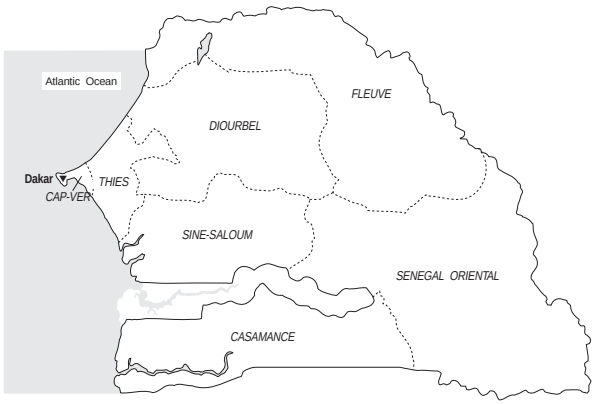
Appendix 1: Country background information



Geography

Area: 19.7 million ha
Location: The most westerly state of Africa bordering on the south with Guinea-Bissau, on the north with Mauritania, to the east with Mali and the west with the Atlantic Ocean.

Agroecological features: Sahelian/sahelo- soudanian zone. North: sahel (300-500 mm); Center-West: intermediate (900 mm); South: tropical (1100-1500 mm).

Population

Total (1991): 7.6 million
Annual growth rate (1981-90)[a]: 3.0%
Literacy (1990): 38.3%
Life expectancy (1991): 48 years

Economy *(values reported in 1985 PPP dollars)*

Gross Domestic Product (1991): 9,186 million dollars
Per capita GDP (1991): 1,205 dollars

Agricultural GDP (1991): 1,707 million dollars
Share of agriculture in GDP (1991): 18.6%

Annual growth rates (1981-90)[a]
- GDP: 3.1%
- GDP per capita: 0.2%
- AgGDP: 2.9%

Trade *(values reported in current prices)*

Net surplus total trade (1991): -830 million dollars
Net surplus agricultural trade (1991): 52 million dollars
Percentage of agricultural imports in total imports: 28.6%
Percentage of agricultural exports in total exports: 64.0%

Major agricultural import commodities (1991)[b]: rice (24%), wheat (14%), fishery products (10%), rape/mustard oil (8%), dry milk (7%) and forestry products (5%)

Major agricultural export commodities (1991)[b]: fishery products (71%), groundnut oil (17%) and groundnut cakes (8%)

Agriculture

Agricultural land (1990): 5.5 million ha
- Annual growth rate (1981-90)[a]: 0.0%
- Percentage arable: 42.8%
- Percentage permanent crop: 0.3%
- Percentage permanent pastures: 56.9%

Percentage irrigated arable and permanent cropland: 7.7%

Economically active agricultural population (1991): 2.5 million
- Annual growth rate (1981-90)[a]: 1.9%
- Percentage in total economically active population: 78.2%

Fertilizer use per ha arable land (1990): 5.0 kg
- Annual growth rate (1981-90)[a]: 2.6%

Major crops (in order of importance): groundnuts, millets, paddy rice, and cotton lint

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, 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; and (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). The following is the equivalence between degrees from a French and Unites States system: Diplôme d'Ingénieur des Travaux, des Sciences Appliquées = technician; Licence, Maîtrise = BSc; Diplôme d'Etudes Approfondies, Diplôme d'Ingénieur (Agronome, Vétérinaire, etc) = MSc; Doctorat (de IIIème Cycle, d'Ingénieur, de Thèse Unique ou d'Université), Doctorat d'Etat = 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 167,000 "1985 PPP dollars". This figure represents the costs of expatriate researchers working in Niger under USAID contracts as estimated by Mazzucato and Ly (1993) using detailed USAID expense accounts. It includes the costs of salaries and benefits such as housing, shipping, travel to and from country, an so on. This approximation makes the assumption that the personnel-cost for expatriates in Niger is a reasonable proxy for the cost of internationally recruited staff working in the NARSs throughout Francophone West Africa.

Deflators and Exchange Rates

All expenditure figures were first compiled in current local currency units (appendix 5b). 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).

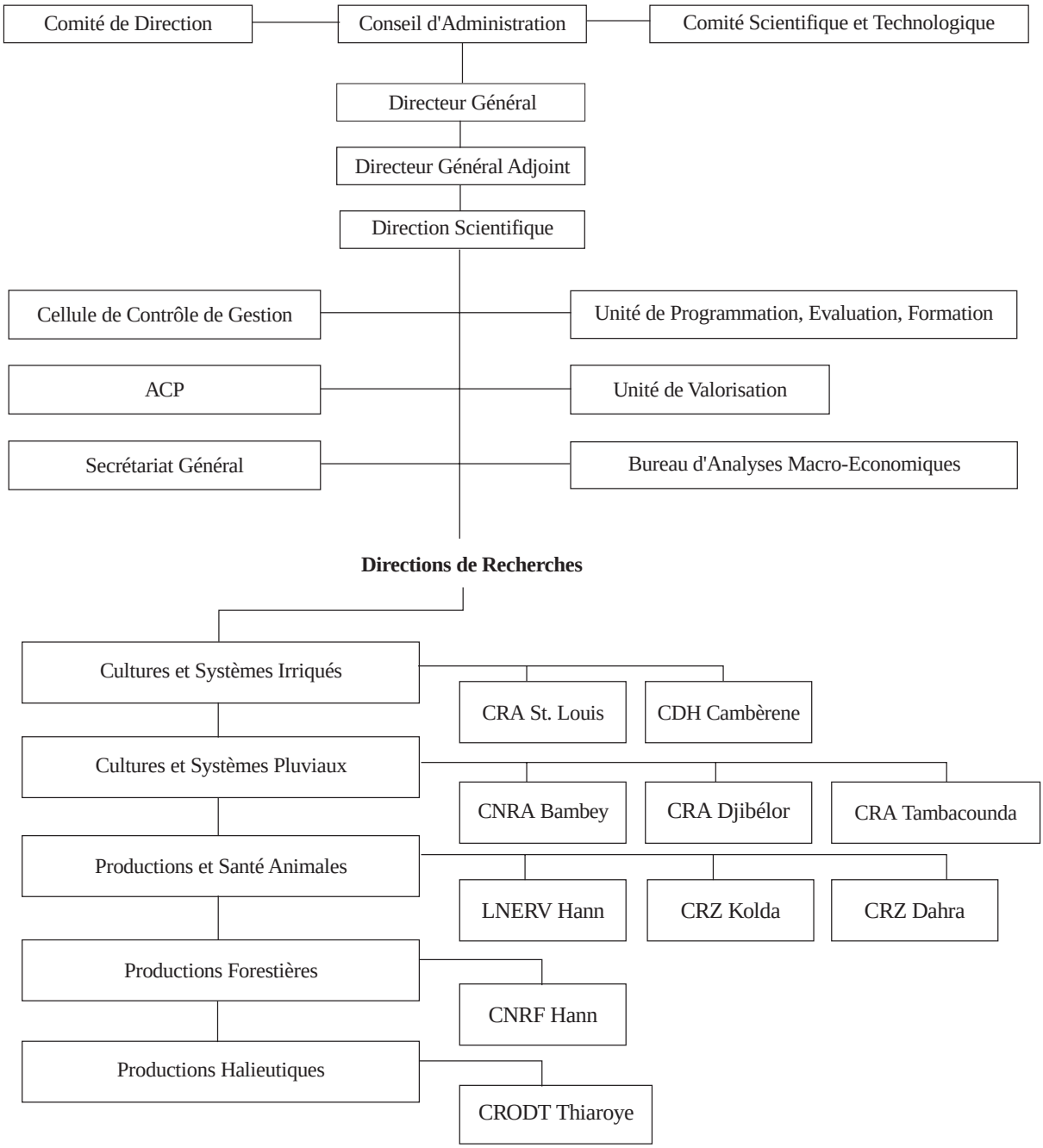
Nomenclature for tables in text

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 Sénégalais pour la Recherche Agricole (1993)



Appendix 4: Names and addresses of the agricultural research institutes

Directeur Général
ISRA
B.P. 3120
Dakar
SENEGAL

Directeur Général
ITA
B.P. 2765
Dakar
SENEGAL

Recteur
Université Cheikh Anta Diop
B.P. 5005
Dakar
SENEGAL

Head
EISMV
B.P. 5077
Dakar
SENEGAL

Directeur
Ecole Nationale Supérieure d'Agriculture (ENSA)
B.P. A 296
Thiès
SENEGAL

ORSTOM
B.P. 2089
Dakar
SENEGAL

du CIRAD
37, Avenue Jean XXIII
B.P. 6189

SENEGAL

Appendix 5a: Researcher totals, 1961-92

Total Number of Researchers — Units: full-time equivalent

Category	Name institute	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Government	ISRA															90.0	105.0
	ITA			*2.2*	*2.4*	*2.7*	*3.1*	*3.5*	*3.9*	*4.4*	4.9	*5.4*	*6.0*	*6.7*	*7.4*	*8.3*	9.1
	GERDAT (a)	*60.0*	*60.0*	60.0	*61.2*	*62.4*	*63.7*	*64.9*	*66.2*	*67.6*	69.0	*66.0*	63.0	63.0	67.0		
Subtotal government		60.0	60.0	62.2	63.6	65.2	66.7	68.4	70.1	71.9	73.9	71.4	69.0	69.7	74.4	98.3	114.1
Academic	ENSA																
	ENSUT																
	ISE																
	CREA																
Subtotal universities		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
Total		60.0	60.0	62.2	63.6	65.2	66.7	68.4	70.1	71.9	73.9	71.4	69.0	69.7	74.4	98.3	114.1
Sources				852							532		431	589	152	1175	95
															1076		1175
															1262		

Category	Name institute	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Government	ISRA	100.0	129.0	135.0	155.0	167.0	176.0	*186.0*	196.0	231.0	193.0	172.0	176.0	174.0	167.0	161.0	155.0
	ITA	*10.2*	*11.4*	*12.8*	*14.3*	*16.0*	17.5	*17.5*	*17.5*	*17.4*	16.8	16.8	16.1	14.0	13.0	10.0	10.0
	GERDAT (a)																
Subtotal government		110.2	140.4	147.8	169.3	183.0	193.5	203.5	213.5	248.4	209.8	188.8	192.1	188.0	180.0	171.0	165.0
Academic	ENSA				*1.2*	*1.2*	1.2	*2.1*	*2.9*	*3.7*	4.5	3.5	3.8	3.5	3.8	3.5	3.5
	ENSUT																
	ISE																
	CREA																
Subtotal universities		0.0	0.0	0.0	1.2	1.2	1.2	2.1	2.9	3.7	4.5	3.5	3.8	3.5	3.8	3.5	3.5
Total		110.2	140.4	147.8	170.6	184.3	194.8	205.5	216.3	252.1	214.3	192.3	195.8	191.5	183.8	174.5	168.5
Sources		1281	1281	15	1281	1281	27		1175	1175	999	999	999	999	999	999	999
				1176			979					1175	1175	1177			
							1281										

Note: Italicized figures represent data that are either constructed or interpolated.
(a) Includes the following French tropical research institutes: IRAT, IRCT, IRHO, CTFT, and IEMVT. Beginning in 1975 all researchers of the French tropical research institutes working in Senegal are counted under ISRA.

Appendix 5b: Research expenditure totals, 1961-92

Total Research Expendiutres — Units: millions of current CFA — PPP$ = 151.72 CFA (1985)

Category	Name institute	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Government	ISRA															*1809.634*	2148.628
	ITA			*15.818*	*18.366*	*20.880*	*23.547*	*26.795*	*29.912*	*35.913*	*41.189*	*46.434*	*53.938*	*64.279*	*83.458*	*103.259*	118.300
	GERDAT (a)	*664.921*	*682.955*	*684.465*	*721.445*	*744.581*	762.253	*787.417*	*797.983*	*869.731*	*906.588*	1,098.340	1,010.983	1,119.519	1,392.655		
Subtotal government		664.921	682.955	700.283	739.811	765.461	785.800	814.211	827.895	905.643	947.778	1144.774	1064.921	1183.798	1476.113	1912.893	2266.928
Academic	ENSA																
	ENSUT																
	ISE																
	CREA																
Subtotal universities		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	0.000
Total		664.921	682.955	700.283	739.811	765.461	785.800	814.211	827.895	905.643	947.778	1144.774	1064.921	1183.798	1476.113	1912.893	2266.928
Deflator (1985=100)		24.6	25.3	25.3	26.2	26.5	26.6	26.9	26.7	28.6	29.2	29.6	31.0	33.3	38.9	43.4	45.1
Constant 1985 LCU		2703.394	2703.394	2765.870	2827.659	2891.485	2957.485	3025.816	3096.648	3170.171	3250.151	3865.322	3435.972	3557.619	3792.484	4409.216	5026.667
Constant 1985 PPP dollars		17.819	17.819	18.231	18.638	19.059	19.494	19.944	20.411	20.896	21.423	25.478	22.648	23.449	24.997	29.062	33.132
Source							589					589	431	589	152		95 1175

Category	Name institute	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Government	ISRA	2339.147	2672.388	2689.840	2909.640	3719.190	3305.936	4822.952	6020.417	8751.683	6718.981	5632.060	5561.373	4674.450	4347.549	3970.146	4290.211
	ITA	*94.769*	108.500	115.500	129.500	129.500	129.500	129.500	*171.170*	*181.126*	244.784	242.031	209.000	124.848	113.896	96.712	115.172
	GERDAT (a)																
Subtotal government		2433.915	2780.888	2805.340	3039.140	3848.690	3435.436	4952.452	6191.587	8932.809	6963.765	5874.091	5770.373	4799.297	4461.444	4066.857	4405.383
Academic	ENSA				*12.851*	*13.817*	*15.123*	*27.192*	*42.752*	*59.817*	*98.299*	*72.424*	*68.315*	*55.136*	*63.643*	*63.637*	*57.512*
	ENSUT																
	ISE																
	CREA																
Subtotal universities		0.000	0.000	0.000	12.851	13.817	15.123	27.192	42.752	59.817	98.299	72.424	68.315	55.136	63.643	63.637	57.512
Total		2433.915	2780.888	2805.340	3051.990	3862.507	3450.559	4979.643	6234.339	8992.626	7062.065	5946.515	5838.688	4854.433	4525.087	4130.494	4462.895
Deflator (1985=100)		48.2	52.4	56.7	63.4	68.1	74.6	81.3	91.7	100.0	107.6	109.8	112.1	112.7	115.4	116.9	118.1
Constant 1985 LCU		5050.669	5310.933	4947.126	4815.782	5668.397	4626.574	6127.070	6800.932	8992.626	6561.078	5417.021	5207.635	4307.861	3920.658	3533.800	3780.378
Constant 1985 PPP dollars		33.290	35.006	32.608	31.742	37.362	30.495	40.385	44.827	59.273	43.246	35.705	34.325	28.394	25.842	23.292	24.918
Source		26	15 259	15 259	15 26	15 26	15	15	1175	1175	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.
(a) Includes the following French tropical research institutes: IRAT, IRCT, IRHO, CTFT, and IEMVT. Beginning in 1975 all researchers of the French tropical research institutes working in Senegal are counted under ISRA.

Appendix 6: Research staff development by institute

Institute: GERDAT (French tropical research institutes)

	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Nationals																
PhD																
MSc																
BSc																
Subtotal																
Expatriates																
Total	*60*	*60*	60	*61*	*62*	*64*	*65*	*66*	*68*	69	66	*63*	63	67		
Source			852							532		431	589	152; 1076		
	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Nationals																
PhD																
MSc																
BSc																
Subtotal																
Expatriates																
Total																
Source																

Note: Includes IRAT, IRCT, IRHO, CTFT, and IEMVT.

Institute: ISRA

	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Nationals																
PhD																
MSc																
BSc																
Subtotal															25	30
Expatriates															65	75
Total															90	105
Source															1175	1175
	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Nationals																
PhD																
MSc																
BSc																
Subtotal	31	49	55	72	82	93	*98.5*	104	131	123	116	116	120	116	113	109
Expatriates	69	80	80	83	85	83	*87.5*	92	100	70	56	60	54	51	48	46
Total	100	129	135	155	167	176	*186.0*	196	231	193	172	176	174	167	161	155
Source	1281	1281	15	1281	1281	1281		1175	1175	999	1175	1175	1177	999	999	999

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

Institute: ITA

	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Nationals																
PhD																
MSc																
BSc																
Subtotal																
Expatriates																
Total			*3.1*	*3.5*	*3.9*	*4.4*	*4.9*	*5.5*	*6.2*	7	*7.8*	*8.6*	*9.6*	*10.6*	*11.8*	13
FTE			2.2	2.4	2.7	3.1	3.5	3.9	4.4	4.9	5.4	6.0	6.7	7.4	8.3	9.1
Source										532						95
	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Nationals																
PhD										5	6	6	6	6	5	5
MSc										10	11	11	11	11	10	9
BSc										9	7	6	10	8	4	5
Subtotal										24	24	23	27	25	19	19
Expatriates										0	0	0	1	1	1	1
Total	*14.6*	*16.3*	*18.3*	*20.5*	*22.9*	25	*25.0*	*25.0*	*24.9*	24	24	23	28	26	20	20
FTE	10.2	11.4	12.8	14.3	16.0	17.5	17.5	17.5	17.4	16.8	16.8	16.1	14	13	10	10
Source						27				999	999	999	999	999	999	999

Note: Between 1963 and 1988 ITA spent 70% of its time on agricultural research and 50% between 1988-92.

Institute: ENSA

	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Nationals																
PhD																
MSc																
BSc																
Subtotal																
Expatriates																
Total																
FTE																
Source																
	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Nationals																
PhD																
MSc																
BSc																
Subtotal										4	4	6	7	7	6	7
Expatriates										14	10	9	7	8	8	7
Total				*5.0*	*5.0*	5	*8.2*	*11.5*	*14.8*	18	14	15	14	15	14	14
FTE				1.2	1.2	1.2	2.1	2.9	3.7	4.5	3.5	3.8	3.5	3.8	3.5	3.5
Source						979				999	999	999	999	999	999	999

Note: It is assumed that ENSA's academic staff spends 25% of its time on agricultural research.

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