ASSESSMENT OF AGRICULTURAL RESEARCH RESOURCES IN THE SAHEL

VOLUME III
NATIONAL REPORT: SENEGAL

by

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PREFACE

ASSESSMENT OF AGRICULTURAL RESEARCH RESOURCES IN THE SAHEL

This document has been prepared by DEVRES, Inc. and the Sahel Institute (INSAH) in accordance with the terms of a contract with the U.S. Agency for International Development.

The national agricultural research resources assessments which provide the necessary background information for this document were conducted by national agricultural research scientists from Sahelian countries under the guidance of DEVRES and INSAH with financial support from the U.S. Agency for International Development (under Contract No. AFR-0435-C-00-2084-00) on behalf of the member countries of the Cooperation for Development in Africa (CDA).

The results of the assessment are contained in the following reports:

Volume I - Regional Analysis and Strategy

Volume II - Summaries of National Reports

Volume III - National Reports:[1]

Cape Verde
Chad
The Gambia
Mali
Mauritania
Niger
Senegal
Upper Volta[2]

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[1]Each national report is printed separately.

[2]As this report was going to the printers in August 1984, the change of name of "Upper Volta" to "Burkina Faso" was announced. While Upper Volta was the correct name of the country as of the date of the inventory (December 1983), readers should take note of this recent change.

LIST OF ACRONYMS AND ABBREVIATIONS

ADRAO	See WARDA
AGRHYMET	Regional Center for Training and Application of Agricultural Meteorology and Hydrology
ANVAR	National Association for the Application of Research
ASECNA	Housing
BEI	Elementary Industrial Certificate
BHS	Bank of Senegal
BICIS	International Bank for Commerce and Industry in Senegal
BNDS	National Development Bank of Senegal
BOM	Bureau of Organization and Methods
BSK	Senegalese-Kuwaiti Bank
BT	Technical Training Certificate
BTS	Senior Technical Training Certificate
CAP	Vocational School Diploma
CAPAS	Small Fisheries Supply Center
CDH	Horticultural Development Center
CEI	International Electrotechnical Commission
CEP	Public Establishment Center
CEREEQ	Experimental Center for Equipment Studies and Research
CERER	Center for Renewable Energy Studies and Research
CILSS	Permanent Inter-State Committee on Drought Control in the Sahel
CIMMYT	International Center for Maize and Wheat Improvement
CLAD	Applied Linguistics Center of Dakar
CNDST	National Center for Scientific and Technical Documentation
CRA	Bambey National Agricultural Research Center
CNRF	National Center for Forestry Research
CPSP	The Price Equalization and Stabilization Fund
CRDI	International Development Research Center
CRDS	Research and Documentation Center of Saint-Louis
CRODT	Oceanographic Research Center of Dakar-Thiaroye
CSPT	Senegalese Phosphate Company of Thiès
CSS	Senegalese Sugar Company
CTFT	Technical Center for Tropical Forestry
DEFC	Directorate of Water, Forestry and Hunting
DGPA	General Directorate of Agricultural Production
DPV	Directorate of Vegetable Protection
DSPA	Directorate of Animal Health and Husbandry
DUT	University of Technology Diploma
EDF	European Development Fund
EEC	European Ecological Commission
EISMV	Interstate School of Science and Veterinary Medicine

ENCR	National School for Rural Trades
ENEA	National School of Applied Economics
ENSUT	National University School of Technology
EPT	National Polytechnic of Thiés
FAC	Fund for Cooperation and Aid (France)
FAO	Food and Agriculture Organization of the United Nation
FED	See EDF
FMDR	Rural Mutual Development Fund
FRG	Federal Republic of Germany
GAIPES	Shipping and Ocean Fishing Industries Group
GEDTEL	Study Group for the Development of Remote-Leasing
GERDAT	Group for Studies and Research on the Development of Tropical Agriculture
GDP	Gross Domestic Product
GOPEC	Permanent Operational Study and Cooperative Group
ICRAF	International Center for Forestry Research
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ICS	Chemical Industries of Senegal
IDEP/CEA	African Institute for Economic Development and Planning/Economic Commission for Africa
IEMVT	Institute of Livestock Production and Veterinary Medicine in Tropical Countries
IFAN	Fundamental Institute of Black Africa
IGN	National Geographic Institute
IITA	International Institute of Tropical Agriculture
ILCA	International Livestock Center for Africa
INRMP	National Institute for Medical and Pharmaceutical Research
IRAT	Institute for Research in Tropical Agriculture and Food Crops
IRMIA	Institute for Research in Mathematics and Applied Statistics
IRRI	International Rice Research Institute
ISN	Standards Institute
ISO	International Standardization Organization
ISRA	Senegalese Institute for Agricultural Research
ITA	Institute of Nutritional Technology
LNERV	National Livestock and Veterinary Research Laboratory
MAE	Ministry of Foreign Affairs
MC	Ministry of Commerce
MAC	The Chinese Agricultural Commission
MDR	Ministry of Rural Development
MEF	Ministry of the Economy and of Finance
MEN	Ministry of National Education
MFPET	Ministry of Public Services, Employment and Work
MIRCEN	Microbiology Research Center

MPC	Ministry of Planning and Cooperation
MUHE	Ministry of Housing, Urban Areas and the Environment
NOAA	National Oceanography and Aerospace Agency
NGO	Non-Governmental Organization
OAPI	African Intellectual Property Organization
OCAM	Common African and Mauritian Organization
OECD	Organization for Economic Cooperation and Development
OHLM	Subsidized Housing Office
OMM	See WMO
OMPI	See WIPO
OMVG	Gambia River Basin Commission
OMVS	Senegal Riven Basin Commission
ONCAD	The National Office for Development, Cooperation and Assistance
ONG	See NGO
OPEC	Organization of Petroleum Exporting Countries
ORANA	Organization for Research on Food and Nutrition in Africa
ORSTOM	Office for Scientific and Technical Research Overseas (France)
ORTS	Senegal Office of Radio and Television
PAPEM	Assistance Point for Multi-Site Experiments
PBE	Equipment Budget Appropriations
PDESO	Animal Husbandry Project of Senegal-Oriental
PEROSE	Oil Companies of Senegal
PIDACO	Integrated Development Project of the Lower Casamance
PNAT	National Land Management Plan
PNUD	See UNDP
PRAS	Senegal Agricultural Research Project
SAED	Organization for the Development and Operation of the River Deltas of the Senegal and Falémé River Valleys
SAFGRAD	Semi-Arid Food Grains Research and Development
SANAS	Senegal Food and Applied Nutrition Service
SAR	African Refining Company
SEEF	State Secretariat of Water and Forestry
SEIB	Baoulé Electric and Industrial Company
SENELEC	Senegalese Electric Energy Distribution Company
SEPM	State Secretariat of Ocean Fisheries
SERAS	The Senegalese Animal Research and Development Association
SERST	State Secretariat of Scientific and Technical Research
SGBS	General Association of Senegalese Banks
SGG	General Secretariat of the Government
SICAP	Cap-Vert Real Estate Company
SODAGRI	Organization for Agricultural and Industrial Development

SODEFITEX	Fiber and Textile Development Organization
SODESP	Association for the Development of Animal Husbandry in the Sylvo-Pastoral Zone
SODEVA	Agricultural Extension and Development Organization
SOFISEDIT	Financial Association for Development and Industry
SOMIVAC	Agricultural Development Organization for Casamance
SONACOS	Senegalese National Oil-Seed Marketing Company
SONAGA	National Guarantee and Insurance Company
SONAR	National Association for Rural Supply
SONED	National Development Studies Association
SONEPI	National Industrial Study and Promotion Association
STN	New Lands Organization
TECASEN	Senegalese Surveying and Cartography
TANISEN	Senegal Industrial Tanneries
UNDP	United Nations Development Program
USB	Senegalese Banking Union
WARDA	West African Rice Development Association
WIPO	World Intellectual Property Organization
WMO	World Meteorology Organization

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INTRODUCTION

A. Background

The Agricultural Research Resources inventory and assessment for Senegal was also conducted in the remaining seven countries of the Sahel (Cape Verde, Chad, Mali, Mauritania, Niger, the Gambia and Upper Volta), all of which are member countries of the CILSS, the Permanent Interstate Committee for Drought Control in the Sahel. The eight national reports taken together comprise Volume III of this report. They are bound separately and are available from the United States Agency for International Development in Washington.[1]

The inventory and assessement was carried out within the framework of the high priority accorded by the member countries of the CDA (Cooperation for Development in Africa) and the CILSS to the need to develop and strengthen agricultural research capability in the region. As the World Bank noted in its September 1983 report entitled "Sub-Saharan Africa: Progress Report on Development Prospects and Programs"[2]:

> "Even within the present state of technical knowledge, improved incentives and marketing arrangements would permit very large increases in agricultural output [in Africa]. However, for the longer term, increased output will depend on the development of effective technical packages, pest and disease control and developments in animal husbandry... In a situation of budgetary stringency and of immediate crises, expenditure on research having a possible, but uncertain payoff, ten years or more in the future is frequently seen as dispensable. This danger is increased when research programs are manifestly weak and unfocused. It is, therefore, essential that these programs be formulated and implemented in ways which will enable them to contribute more effectively to the process of development...,"

The CDA is an informal association of donors including Belgium, Canada, France, Italy, West Germany, the United Kingdom and the United States. The United States, assisted by other CDA donors, was assigned

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[1] Volume II, Summary of Agricultural Research in the Sahel, contains summaries of each of the eight countries' national reports. Volume I is a "Regional Analysis of Agricultural Research Resources in the Sahel". Both may be obtained from AID as well.

[2] World Bank, Sub-Saharan Africa: Progress Report on Development Prospects and Programs, Washington, D.C., World Bank, (September 1983, pp. 30-31.

the specific responsibility for coordinating the development of CDA-supported agricultural research programs in the Sahelian and Southern African regions.

This CDA initiative responds to initiatives already undertaken by many national governments and regional entities (such as the OAU, and CILSS) to emphasize the development of a strong capability in the Sahel to increase agricultural productivity. The donors, therefore, joined with African regional agencies such as INSAH in the Sahel and the Southern Africa Development Coordination Conference (SADCC) in Southern Africa to develop country-specific, regionally-sensitive analyses of existing resources and to identify medium- to long-term needs and opportunities in support of agricultural research that will lead to increased agricultural productivity.

The assessment and preparation of this report were financed by the U.S. Agency for International Development (AID) and carried out by DEVRES, Inc., a U.S.-based private contractor located in Washington, D.C. engaged by AID. DEVRES was assisted by two sub-contractors, the Institut du Sahel (INSAH) and the Midwest Universities Consortium for International Activities (MUCIA). INSAH was established in 1976 and given prime responsibility by CILSS for the collection, analysis and dissemination of research results; for the promotion and coordination of research; for the training of researchers and technicians; and for the adaptation and transfer of technology. The MUCIA consists of seven universities, with administrative headquarters at Ohio State University. Michigan State University was identified by MUCIA as its lead institution for this assessment due to its experience in Africa.

The CDA mandate for the assessment and this report preparation was to consider programs up to 20 years in duration. Few specific project ideas were developed with this timeframe in mind. However, in developing proposals for future programs, this long term emphasis maximized flexibility to focus on the needs of agricultural research regardless of the timeframe involved. Ultimately, the research priorities and activities were set out as needed, while remaining sensitive and responsive to the severe budgetary constraints in the Sahelian countries.

B. Methodology

Sahelian participation in the process of carrying out the inventory and assessment--the collection of data, the preparation of national reports, and the subsequent regional assessment--has been a central aspect of the design and implementation of this study. In May 1983, INSAH, cooperating with DEVRES, invited agricultural researchers from Senegal and other Sahelian countries to INSAH headquarters in Bamako, Mali to discuss the study and examine the first draft of a series of questionnaires intended to inventory the resources (both

physical and human) available for agricultural research in the region. The questionnaires were then revised in light of the researchers' knowledge of the technical areas and local conditions.

Senior researchers from each of the Sahelian countries were hired by INSAH as National Coordinators and placed in charge of obtaining the answers to the questionnaires and preparing the national reports for their respective countries. National Coordinators in turn hired experienced researchers for short periods of time in their respective countries to help with the completion of the questionnaires in specific subject matter areas such as export and food crops, livestock, agro-forestry, fisheries, and farming systems. The questionnaires included not just the research institutions in these fields, but also the training institutions, and the extension institutions which provide the link between the research and the farmers who utilize the research results.

DEVRES fielded a team of experienced agricultural researchers and development specialists to assist the National Coordinators and their staffs, help with the establishment of a data bank at INSAH on research resources, and develop the regional program. The DEVRES staff consisted of a team leader, a regional coordinator, a technical consultant, one sub-regional coordinator for Cape Verde, The Gambia, Mauritania and Senegal, and another for Chad, Niger, and Upper Volta. Mali was assisted by the technical consultant stationed in Bamako. In addition, INSAH made available two of its senior staff--the Director of its Research Department and the Coordinator of the Research and Documentation network (RESADOC)—who were responsible for coordination between the DEVRES staff and the National Coordinators. MUCIA participated in the design of the questionnaire, furnished country background data for the survey and the sub-regional coordinator for the Eastern Sahel.

INSAH, because of its regional responsibilities for coordination of agricultural research and dissemination of the results, became the repository of the results of the questionnaires in the form of a data bank located at INSAH headquarters. The data collected from the study has been organized using a standard software package--"dBase II"--and can be accessed on the microcomputers available at INSAH headquarters.

More information on potential uses of the data bank can be found in Volume I. The survey has been an important first step in creating a data bank which (when combined with other information available at INSAH) will provide a foundation of practical, useful data that can be updated and refined. It will be a valuable tool for those designing programs and projects in agricultural research in the Sahel and it will also be a source of providing information for researchers in the Sahel and in other neighboring countries.

The inventory and assessment were carried out from May 1983 to April 1984. The bulk of the data collection and the writing of the national reports were carried out from September to December 1983 by the National Coordinators and their consultants in cooperation with the DEVRES/INSAH staff. The national reports are essentially the product of the work of the National Coordinators, assisted by their consultants, based on the responses to the questionnaires. The regional analysis and research strategy were developed by the DEVRES staff in consultation with INSAH in light of the national reports, the questionnaire, and contacts with international research organizations, bilateral and multilateral donors and developement organizations (such as the Club du Sahel, the various UN agencies, and the World Bank) and other written information available to the team. The DEVRES/INSAH staff collaboratively designed the proposed regional projects and activities to carry out the strategy elements.

In carrying out the inventory and analysis and in preparing recommendations for programs and projects in this report, the national Coordinators team made special efforts to take into account research work already carried out, underway or proposed. This is consonant with one of the principal objectives of the assessment--to seek ways to strengthen existing national and regional research activities. Further, specific recommendations are placed in a wide context, involving not only the research institutions, but also the training of researchers and the dissemination of research results to the farmers.

II. GENERAL INFORMATION ON SENEGAL

A. Geography and Ecology

1. Location and description

Senegal, one of the eight Sahelian countries, is located from 18°N to 25°N in latitude, and from 11°W to 17°W in longitude. (See Figure 1.) Its land area totals 196,840 km^2. It is bounded by the Atlantic Ocean to the west, Mauritania to the north, Mali to the east, and Guinea-Bissau and the People's Revolutionary Republic of Guinea to the south. The state of The Gambia is an enclave surrounded on three sides by Senegal.

The major rivers are the Senegal, along the northern boundary with Mauritania, the Sine and the Saloum in the center of the country, the Casamance in the south, the Gambia in the east and the Falémé along the eastern border. The Senegal is navigable to Podor throughout the year, and for three months as far as Kayes in Mali. The Saloum is navigable as far as Kaolach, and the Casamance as far as Ziguinchor.

Senegal's major cities are Dakar, the capital, in the Cap-Vert region (population 900,000), Ziguinchor, in the Casamance region (population 85,000), Diourbel (population 60,000), Louga (population 50,000), Saint-Louis in the River region (population 100,000), Tambacounda in the Senegal-Oriental region (population 50,000), Kaolack in the Sine-Saloum region (population 125,000) and Thiès (population 140,000).

2. Agro-ecological zones

a. Groundnut basin

The groundnut basin comprises the regions of Louga, Diourbel, Thiès and Sine-Saloum. It covers all the central plains, as far as Ferlo in the east and The Gambia in the south. This region, with sandy soils in the north and heavier soils in the south, is responsible for 80 percent of the country's peanut production. There is a distinct north-to-south gradient in annual rainfall.

b. Casamance region

The Casamance, located between The Gambia and Guinea-Bissau, is a "Guinean savannah" type of country, with a very well developed hydrographic system. It is subdivided into three natural zones:

(1) Upper Casamance

The Upper Casamance consists of plateaus covered by dry forests, predominantly bamboo, and drained by a seasonal hydrographic system. Transhumance livestock raising is the main activity

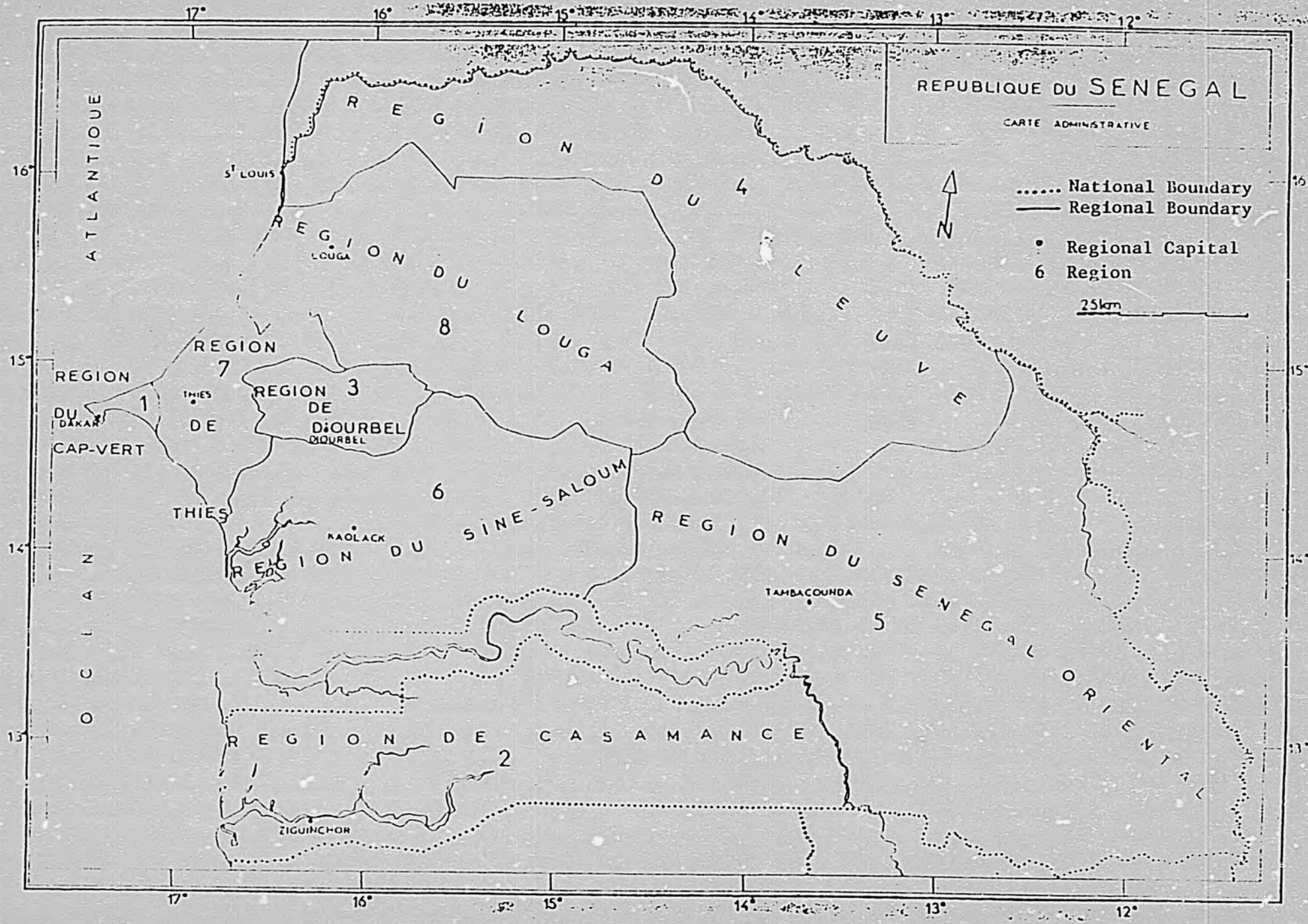

REPUBLIQUE DU SENEGAL
CARTE ADMINISTRATIVE
..... National Boundary
—— Regional Boundary
• Regional Capital
6 Region
25km
N
ATLANTIQUE
OCEAN
REGION DU 4 LEUVE
REGION DU LOUGA
8
REGION 7
REGION DU CAP-VERT
1
REGION DE THIES
REGION 3 DE DIOURBEL
6
REGION DU SINE-SALOUM
REGION DU SENEGAL ORIENTAL
5
REGION DE CASAMANCE
2
ST LOUIS
LOUGA
THIES
DAKAR
DIOURBEL
KAOLACK
TAMBACOUNDA
ZIGUINCHOR
17°
16°
15°
14°
13°
12°

Figure 1 : [illegible]

of the resident Peulh people, with trypanotolerant strains of cattle and sheep herds migrating between summer and winter pastures. Crops requiring adequate rainfall, such as millet, sorghum and maize, are increasingly replacing cotton.

(2) Middle Casamance

The Middle Casamance has open plateaus and a more humid climate (1,200-1,400 mm), favoring a diverse range of crops (millet, rice, maize, groundnuts and arboriculture). This region is notable for the gender division of crop management (cultivation of field crops by men, of rice by women).

(3) Lower Casamance

The Lower Casamance or Maritime Casamance comprises the Casamance River estuary with its swamps and mangrove forests. The climate is very humid and rice is the main crop.

c. Senegal-Oriental

Senegal-Oriental is a diverse region, with its main agricultural activities located in Upper Gambia, which occupies 30 percent of the country's total area. However, it is greatly underpopulated, because the tsetse fly and onchocercosis limit both human and livestock activities. Annual rainfall varies greatly, from 700 mm in the north (wooded savannah) to 1,200 mm in the south (dry forest), favoring a wide range of crops: maize, cotton, rice, groundnuts, cowpeas, and cassava. Farming operations here are extensive and itinerant.

d. Niayes

Niayes consists of a coastal strip from Saint-Louis to Dakar. This is a sandy, sometimes marshy, zone, generally suitable for market gardening because of good supplies of surface water and a sub-canarian climate.

e. Ferlo

Ferlo is the region between the Senegal River and Upper Gambia. It is a flat, semi-desert region with thornbush and sparse grasslands where numerous herds of zebus graze, tended by the local inhabitants, the Peulh and Maure peoples.

f. Senegal River Valley

Senegal River Valley is a 450 km long stretch of land from Saint-Louis to Bakel. It has a Saharan climate and is used mainly for livestock, but has a great potential for irrigated farming. When irrigation is possible, it is done on the low areas where the soil is dense. Where it is not possible to irrigate, sorghum, a flood-recession crop, is grown along the river banks. Millet has also been grown very sporadically since the beginning of the current

drought. Average annual rainfall varies from 500 mm down to 200 mm. Sugarcane, rice and vegetables are grown in irrigated areas. A program of the Organization for the Improvement of the Senegal River (OMVS-Organisation pour la mise en valeur du fleuve Sénégal) to control the river flow by a series of dams will increase the possibilities for intensive agricultural operations.

3. Natural characteristics

a. Geology

The major portion of Senegal is made up of Quaternary and Continental Terminal deposits (alluvial soils, sand and rocky outcroppings). Senegal-Oriental is a notable exception, with its older and more varied soil formations. In summary, there are three main types of geologic formations:

- o Very old soil layers, with paleozoic covering;
- o Sedimentary basin; and
- o Quaternary.

b. Geomorphology

Despite the generally monotonous terrain of only slight variations in elevation, geomorphological data play an important role in development of the Senegalese territory. That land altitudes do not exceed 30 m, with the exception of Cap-Vert and the southeastern zone of Senegal-Oriental, is the result of a long history of geologic structures and paleo-geographic evolution. Four large regional groupings based on the factors of climate, natural vegetation and human activities have been defined in Senegal:

- o Senegal-Oriental, with its paleozoic formations and distinct soils;
- o The plateaus of the Sedimentary basin;
- o The Senegal River valley and delta; and
- o The coastal region.

c. Pedology

The only complete map available (scale 1:1,000,000) identifies eight soil groups: three zonal and five azonal, subdivided into 30 families based on their pedological and lithological characteristics. In practice, the soils are very heterogeneous and overlap in associations or in toposequences, according to structure and hydrography.

(1) Zonal soils

(a) Isohumic soils

Isohumic soils developed under semi-arid climatic conditions and the growth of the plains grasses. The group includes brown sub-arid soils and brown-red "riverbank" sub-arids.

(b) Tropical ferruginous soils

Tropical ferruginous soils are of highly individualistic character and iron content, with the group subdivided into:

- Unleached tropical ferruginous soils of the diorite type, extending from 15° to 14°30W on subsoils of dune sands or Continental Terminal sandstone deposits; and
- Leached tropical ferruginous soils developed under annual rainfalls from 750 to 1,200 mm. Four variants are identified in this group.

(c) Slightly ferralitic soils

Slightly ferralitic soils are present in the southern isohyet of 1,200 mm average precipitation (Lower Casamance).

(2) Azonal soils

(a) Vertisols

Vertisols (grey-black clays) are developed in poorly-drained zones from limestone and basic rock formations. They are found in Upper Casamance, Senegal-Oriental, Cap-Vert and the Thiès cliffs.

(b) Hydromorphic soils

Hydromorphic soils are characteristic of temporary or permanent engorgements. They are found in the deltas of the Sine-Saloum, Gambia, Casamance, Senegal River valley, and Anambe Basin.

(c) Halomorphic soils

Halomorphic soils are of marine origin and rich in soluble salts, Halomorphic soils are found in the delta zones of the Senegal, Sine-Saloum, Gambia and Casamance rivers. Factors limiting their use for agricultural purposes are the high salinity of the soil and the low-lying nature of the land.

(d) Less developed soils

Young soils of non-climatic origin that consist of organic matter with very little surface decomposition are found in the Ferlo Region.

(e) Heavy mineral soils

These are soils that are hardly distinguishable from their native rock, such as water-eroded soils or wind-eroded sands.

d. Hydrology

(1) Surface waters

Senegal is traversed by two large hydrographic systems--the lower Senegal River and the middle reaches of The Gambia. These two tropical rivers (cresting in August-September) are fed by abundant rainfalls in the Futa Jallon region of Guinea. Two other smaller basins, the Casamance and Kayanga, drain the southern area of the country. Vast areas, traversed by the dry valleys of the Sine-Saloum and Ferlo, are characterized by a sporadic or non-existant water flow due to the lack of precipitation and the permeability of the chalky and sandy soils. Finally, the Guiers and Niayes lakes provide large open areas of water used for human consumption and for the irrigation of market gardens in the vicinity.

Overall, water resources appear to be more than sufficient for the country's needs. However, their development is limited by constraints linked to:

- High interseasonal and interspatial variations;
- Flooding by seawater;
- The low-lying nature of land and high flood levels; and
- A great amount of evaporation.

(2) Underground waters

Senegal is one of the West African countries best provided with underground water reserves, consisting of:

- An underground water table fed principally by sources in part of the Upper Gambia massif, and also by infiltration from heavy rainfalls. This table exists in most parts of the country except in the forest/pasture zone and in the zone bounded by the 15°30 meridian in the west, the Tambacounda parallel in the south, and by a line running from Boghé Dendouli to Tambacounda in the east. This water table varies in depth from south to north, ranging from 5 to

10 m at Kédougou to 20 to 25 m at Tambacounda and to as much as 80 to 100 m near Louga-Linguère;

- The Maestrichien water table, from 500 to 550 m in depth, in sedimentary and chalky terrain dating from the Eocene period;
- Aquifers in tertiary and quaternary sandy and alluvial soils, of quite good quality; and
- Aquifers in the old geological strata in Senegal-Oriental (See Table 1.).

4. Climate

a. Rainfall

Variations in rainfall throughout the year are governed by the intertropical front.

The year is divided into two periods: a dry season broken only by some "heug" rainfalls, and a rainy season that varies in length from south to north and from year to year.

Precipitation decreases sharply from south to north. Following drought years, a very definite regression in isonyets has been noted, particularly in the north. (See Figure 2.)

In the northern part of the country, annual rainfall variations result in even greater insecurity because the total rainfall is light and the rainy season is shortened.

A map is being prepared to define the rainy seasons in each area. This will be useful in determining the irrigation needs of crops according to their biological cycles.

b. Temperatures

Average temperatures in Senegal are very high, increasing (along with minimum and maximum temperatures) with distance from the ocean. A minimal temperature which is too low can be a constraint for some crops. Temperatures of 40°Celsius, which are frequent in all regions, can cause drying of and consequent loss of cereal crops.

c. Relative humidity

Location and the harmattan wind are the principal factors affecting humidity, accounting for great differences between the interior and the coastal areas, where the trade winds blow from December to April. Too low minimal along with very high maximum temperatures can result in serious losses of crops and withering of tree seedlings.

Table 1 : Summary of Senegal's Aquifer Resources

Aquifers	Type of Resources	Mobilization (m/day)	Present Outflow	Available Reserve
I. Aquifers of good or average quality				
Alluvials and quaternary sands				
Senegal River	renewable	110,000	low	100,000
Cayar to Saint Louis	"	115,000	70,000	45,000
Cayar to Dakar	"	45,000	45,000	0
Infrabasaltic layer	"	15,000	18,000	0
Saloum lens formations	"	4,000	low	4,000
Casamance lens formations	"	5,000	low	5,000
Continental Terminal				
Upstream Isoplestic	renewable	950,000	?	
Downstream Isoplestic	exploitable	600,000	?	
Miocenic in Casamance	renewable	105,000	5,000	105,000
Eocenic (Louga - Bamney)	exploitable	14,000	low	14,000
Paleocenic (Pout-Sebikhotane-M'Bour)	renewable	58,000	59,000	
Maestrichtien				
Deep water layer	exploitable	100,000	10,000	160,000
Supply zone	renewable	420,000	low	400,000
II. Aquifers with mediocre to very poor resources				
Socle (sands, fissures)	renewable	50,000	low	low
Eocene (East Louga - Bambey)	exploitable	(50,000/n)	low	low
Paleocene (East Cayar - Bambey)	exploitable	(20,000/n)	low	low
Various superficial formations	renewable	very low	very low	very low

Source : D.E.H. Hydrogeological Synthesis (1982)

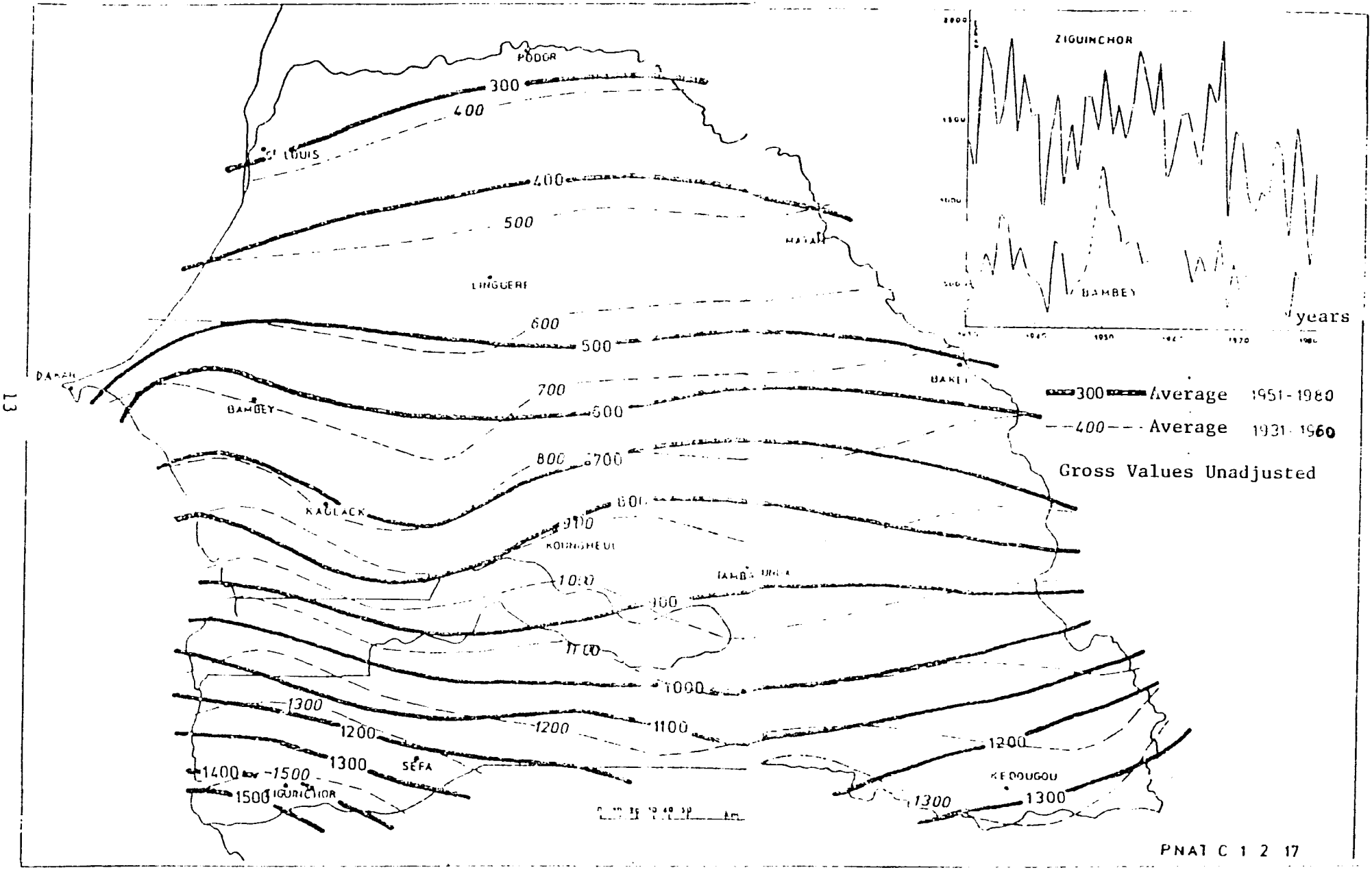


Figure 2 : Average Annual Rainfall
(mm)

d. Winds

Trade winds in the coastal regions provide an important potential source of energy but have an unfavorable effect on soil (wind erosion), as well as on crops and vegetation. It is therefore necessary to put up wind breaks to protect the irrigated areas and nurseries. Away from the ocean, the dry, less violent harmattan winds restrict the off-season cultivation of crops by increasing moisture loss in vegetables.

e. Seasons

(1) Rainy season

From June to October varying by 2 to 5 months from north to south) is the most active, season for growing vegetables (seeding in June-July, harvesting in October-November) and the period of maximal biomass production for pastures and forests.

(2) Dry season

The dry season is divided into the cold dry season (November-February) and the warm dry season (March-June). This is the off-season for crops dependent upon rainfall, and the period of greatest activity for irrigated crops production.

B. Demography

The most recent national census, dated April 15, 1976, placed the population of Senegal at 5,068,000.

Other studies made by the Senegal statistical service include the Senegalese Fertility Survey (1976), the Study of Manpower Migration (1979), and the Senegalese Survey of Infant and Child Mortality. This last, conducted in the Thiès Region, was designed to improve existing knowledge of Senegalese demographic characteristics, which are still incomplete in certain areas.

1. Total population

Total population was estimated at 5,860,000 in 1981 and 6.2 million in 1983, with an annual growth rate of 2.8 percent (compared with 2.3 percent during 1960-1970 and 2.6 percent during 1971-1976). A population of some 7.3 million is projected for 1990.

2. Analysis by age and sex

Analysis by age and sex shows that the Senegalese population is young--53 percent are less than 20 years of age, while only 6 percent are 60 or over. The youthfulness of the population is due mainly to a very high birth-to-death ratio, and also to a decline in infant mortality. The very large number of young people forming the base of this age pyramid has important socio-economic consequences, considering the very low (theoretical) participation by youth in

economic activities, compared with their needs to be educated, fed, housed and prepared for active working lives. Population is well balanced by sex, with a slightly greater proportion of females (100 females: 98 males).

3. Main ethnic groups

The Senegalese population (1976 census) includes numerous ethnic groups, the principal ones being:

- The Wolof and Lebou, 41 percent of the population and by far the largest ethnic group, who live mainly in the central and northern sectors of the peanut growing basin, and in the Cap-Vert area;
- The Sérères, the second largest group, at 14 percent, who live along the short coastline and in the Sine-Saloum region;
- The Peulhs, 13 percent of the population, who are spread throughout the entire country;
- The Toucouleurs, 11 percent of the population, occupying the Senegal River valley;
- The Diolas, the Balantes, and the Manjacques, about seven percent of the Senegal population, living in the Casamance Region;
- The Mandingues, five percent, in the Casamance Region; and
- The Soninkés, about two percent, who are located in Senegal-Oriental.

All other ethnic groups together represent about seven percent of the population. The geographic distribution of ethnic groups makes it possible to establish homogeneous ethnic zones which can be defined on a map.

4. Population density

Senegal has an average population density of 29 inhabitants per km^2, which makes it a country of moderate population density. This figure, however, conceals the uneven population distribution throughout the country. Generally speaking, the heaviest concentrations are found in regions with small land areas, such as:

- The Cap-Vert region, with only 0.30 percent of the entire country, has 21 percent of the population, with a density of 2,310 inhabitants/km^2. This clear variance from the norm in other regions is explained by Dakar's role as the political and economic capital of Senegal;

- The Thiès region, with three percent of total land area, has 14 percent of the country's population and an average density of 115 per km^2;

- The Diourbel region, with 12 percent of the land area and eight percent of the population, has a density of 108 per km^2; and

- The remainder of the country, which is very sparsely populated, especially in the Senegal-Oriental, Louga and River regions, with a density of only five inhabitants per km^2.

5. Languages

The official language is French, but the most widely used languages are Wolof, Pulaar, Diola and Mandingue. There are also a great number of other local dialects.

6. Religions

Seventy-five percent of the population is Moslem, five percent is Christian, and the rest is Animist.

7. Population distribution and dynamics

a. Urban population

For more than three decades, an accelerating movement into the cities has been observed. The pace of urbanization has increased steadily, from six percent in 1930 to 23 percent in 1960, 26 percent in 1970 and 32 percent in 1980.

In 1976, urban areas represented 27.6 percent of the total active population, which is divided into the modern sector, informal sector and unemployed. Permanent employees of the modern sector comprise 26.8 percent of urban population, and seasonal modern sector employees 4.6 percent. The informal sector (artisans, small businesses) totals 49.5 percent of urban population, with the unemployed totalling 19.1 percent.

In 1980, 72 percent of public sector employees were in civil service jobs. In the private sector, there were 109,000 employed and 150,000 unemployed persons.

b. Rural population

Despite this trend toward urbanization, Senegal is still essentially rural, with 65 percent of the population living outside of the cities. The active rural population, 1,650,000 in 1980, shows there is a pronounced need for workers in this sector.

This partially explains the large population movements which can take such forms as:

(1) Inter-regional migrations

Inter-regional migrations are movements of people from areas where they were born. The most popular destinations for such migrants are the Cap-Vert, Sine-Saloum, Senegal-Oriental and Casamance regions.

(2) Seasonal migration

Seasonal movements of rural residents to urban centers occur, for example, especially during the dry season, when farmlands cannot be worked, young girls from the Thiès, Sine-Saloum and Casamance regions head for the cities to take temporary jobs as domestic helpers. They generally do not stay in the cities, however; this is therefore not the same as the rural exodus described below.

(3) Rural exodus

The rural exodus is the most obvious phenomenon, and it continues to grow as the drought persists. There are numerous causes, which deserve to be studied more exhaustively, but the most important factors are insufficient incomes from agriculture, the lack of programs and facilities for young people, unemployment during a large part of the year, and the difference in quality of life between the rural areas and urban centres.

C. Educational System

On the eve of its independence, Senegal was confronted with the thorny problem of restructuring and adapting its educational system to the socio-cultural and economic realities that confront all young nations. Simultaneously, the state had to develop the basic educational framework, put a professional training system in place, substantially increase its ability to accommodate secondary and higher education students, and partially redefine the school curricula in order to fulfill the new objectives.

After two decades of purposeful effort, a partially positive balance sheet can be presented, but from all evidence some problems still remain.

1. Evolution of the educational system

a. Pre-school and special education

In 1980, there were almost 6,200 pre-school educational institutions, 62 percent of them in Cap-Vert (75 percent of these schools were linked with the private sector).

Special education includes such activities as the education of visually-handicapped youth and the re-education of children with hearing disabilities.

b. Primary education

Primary education lasts for six years. From 1961 to 1980, the number of students tripled, from 123,000 to 392,000 (an average annual increase of six percent). By 1980, only 35.8 percent, or one-third, of school-age children were attending classes. Overall, about 85 percent of these students can expect to finish their elementary education.

Despite some improvement, the regional and inter-regional disparities persist. Cap-Vert, with 67.1 percent enrolled, is far ahead of the less favored regions such as Louga and Diourbel.

Within each region, the urban school attendance rate (60 percent) is much higher than the rural rate (15 percent on the average). The proportion of girls attending school increased from 32 percent in 1961 to more than 40 percent in 1980. The private sector's share of total enrollment is decreasing.

c. Intermediate education

Since 1973, the intermediate education system has continued through the first cycle (premier cycle) to the second degree level (a four-year period). It includes a general education network (91 percent) and technical instruction. The number of students enrolled grew from 9,800 in 1964 to 70,000 in 1980 (average rate of increase, 10.1 percent). It is estimated that 75 percent complete the intermediate cycle.

d. Secondary education

From 1961 to 1980, the number of students at the general and technical level rose from 1,300 to 17,000, for an average annual increase of 14.5 percent. Technical education, long a marginal operation, increased more rapidly than the general sector, representing 20 percent of total students by 1980. At the same time, scientific studies were expanded in the general education curriculum, but this has had little impact to date on the number of baccalaureates issued. Between 1970 and 1979, for example, 21,034 baccalaureates were awarded to Senegal nationals: 53 percent in literature, 37 percent in science and 10 percent in technical subjects. The percentage of students completing their studies is lower than in the preceding cycles. The private sector role stabilized at 20 percent in 1980 (of which 25 percent were foreign).

e. Professional education

This sector has several types of teaching institutions, with varied vocations and distinctively different objectives.

- o 12 conventional establishments have admitted nearly 1,300 students for commercial, industrial, crafts, marine, or home economics training (two years following the intermediate cycle) or for training in agriculture or horticulture (three years following the intermediate cycle);

- o An advancement program is available to active workers who want to improve their skills. In 1979, some 3,000 students attended the four training schools; and

- o In 1980, the 29 regional technical training centers for women had 2,000 students enrolled in home economics courses.

f. Higher education

Higher education facilities include:

- o The University of Dakar with four faculties and six university colleges and institutions: Teachers' Training College, National School for Librarians, Archivists and Documentalists, the Inter-State School of Veterinary Medicine and Science, National University Technological College, French Institute for Foreign Studies, and Study Center for Information Sciences and Techniques; and

- o Eight specialized schools: Business Management College, National School for Social Assistants and Specialized Educators, National Administration and Public Office Training School, National School of Applied Economics, Polytechnical Institute, National Institute for Rural Development, National School for Rural Administrators, and Administrative Training and Proficiency Center.

The Ministry of Higher Education also organizes permanent training activities for staff of the ministries, public establishments and training institutes.

Only 1,018 students attended the University in 1961, but by 1980 enrollment had grown to 11,644 (an annual growth rate of 13.7 percent overall, with a 17.7 percent increase for nationals and an 8.5 percent increase for foreign students). Table 2 presents a breakdown of total attendance at institutions of higher education, by subject.

The University of Dakar maintains a regional balance, especially at the levels of its colleges and institutes, and at the Faculty of Medicine and Pharmacy. Completion rates for studies at the university have not yet been thoroughly analyzed, but a clear improvement is noted in the university courses given.

Table 2: Total Attendance at Institutions of Higher Education, by Subject, 1980

Subject	Number of Students		
	Male	Female	Total
Education	10,062	2,311	12,373
Humanities and Religion	665	119	784
Law	1,635	379	2,014
Social Sciences	1,994	442	2,436
Commerce	260	7	267
Communications	221	31	252
Services	117	32	149
Biology	1,054	85	1,139
Mathematics	163	23	191
Medicine	1,381	215	1,896
Engineering	464	27	491
Agriculture, Forestry, Fisheries	136	6	142
Others	112	61	173
Totals	18,269 (82 percent)	4,038 (18 percent)	22,307

2. Agricultural training institutes

a. Agricultural sector

This sector includes several training levels. At the senior management level (cadres de conception), there are the following training institutes:

- o National Institute for Rural Development (Agriculture, Water and Forest Resources); and
- o Inter-State School of Veterinary Medicine and Sciences (livestock raising);

At the senior technician level, the National School for Rural Administrators offers training in the areas of agriculture, water and forest resources and livestock raising.

At the operating technician level, the following institutions offer agricultural training:

- o National School for Agricultural Technical Agents;
- o National School for Forestry Technical Agents;
- o National School for Livestock Technical Agents;
- o National School for Fisheries Technical Agents;
- o National Marine Training School; and
- o National Horticultural School.

For farmers, herdsmen, fishermen, and craftsmen, the following training institutes exist:

- o National Administrative Training and Proficiency Center; and
- o National Center for Training Home Economics Instructors.

b. Para-agricultural sector

This sector includes two levels: in the first, the Senior Management level, the following institutes offer training:

- o Business Administration School;
- o Polytechnic College; and
- o Faculties of Science, Literature, etc.

At the Senior Technician level, the training institutes are:

- o The National University College of Technology;

- The School of Applied Economics; and
- The National School for Librarians, Archivists and Documentalists.

D. Political and Administrative Organization

1. Principal political structures

Senegal became a republic on November 25, 1958, and an independent state on August 20, 1960. The constitution was adopted and approved by referendum in 1963 and amended in February 1970, March 1976 and April 1983. A presidential system was established by the constitution. In November 1981, it was proposed to create a Senegambian Confederation.

a. Political parties

The constitutional revision of 1981 inaugurated an unlimited multi-party system. There are now 15 parties:

- "Parti socialiste sénégalaise" (PS), in power since independence;
- "Parti démocratique sénégalaise" (PDS)--in opposition;
- "Parti africain de l'indépendance" (PAI)--in opposition;
- "Mouvement démocratique populaire" (MDP)--in opposition;
- "Mouvement républicain sénégalaise" (MRS)--in opposition;
- "Parti de l'indépendance et du travail" (PIT)--in opposition;
- "Ligue démocratique mouvement pour le travail" (LD/MPT)--in opposition;
- "Union démocratique populaire" (UDP)--in opposition;
- "Rassemblement national démocratique" (RND)--in opposition;
- "Parti populaire sénégalaise" (PPS)--in opposition;
- "Organisation sociale des travailleurs" (OST)--in opposition;
- "Parti pour la libération du peuple" (PLP)--in opposition;
- "Parti african pour l'indépendance des masses" (PAIM)--in opposition; and

- "And jef/mouvement révolutionaire pour la démocratie nouvelle" (AJ/MRDN)--in opposition.

b. Political powers

Executive power is vested in the President of the Republic; Legislative power is held by the National Assembly, whose 120 members are elected for five years by a proportional voting procedure.

An Economic and Social Council serves the National Assembly in an advisory capacity.

c. Principal government ministries

The principal government ministries are the following:

- Foreign Relations;
- Interior;
- Planning and Cooperation;
- Economy and Finance;
- Higher Education;
- National Education;
- Scientific and Technical Research;
- Rural Development;
- Environmental Protection;
- Hydraulics;
- Public Health;
- Industrial Development and Crafts;
- National Development; and
- Commerce.

2. Administrative organization

a. Territorial administration

Territorial administration is structured by regions (eight in all, each headed by a governor), by departments (30 in number, each headed by a prefect), and by districts. The districts are the basic administrative areas in close contact with the people, and each is headed by a district chief who has authority over the village chiefs.

b. Municipal administration

Senegal has 15,000 villages based on traditional ethnic groupings, each with its own internal organization.

A reform of local administrations designed to provide rural people with public responsibilities was initiated in 1972. The structures making up this new administrative system are the rural "commune", or parish organization, and the advisory councils at each level (region, department and district). There are also 34 active communes administered by a mayor and a municipal councilor.

3. Judiciary

Justice is administered in Senegal through the following institutions:

- Supreme Court: Guarantees constitutional rights, ensures the legality of elections, rules on abuses of power by executive authorities and hears appeals against arrests and sentences;
- Court of Appeal: Hears and rules on appeals from judgements rendered in the magistrate's courts;
- Courts of Assizes: Four in number, they handle criminal cases;
- Magistrate's Courts: There are eight of these, which hear cases dealing with all civil law matters;
- 18 Justices of the Peace: and six Labor Courts, also sit at the regional level; and
- Military Justice, High Court of Justice, Court of Budgetary Control, and Court of State Security which are listed as special tribunals.

4. Government budget

The national budget is divided in two separate parts, directed at different objectives: the operating budget, dealing with administrative needs, and the national capital budget, designed to promote the country's economic and social activities. (See Table 3.) The fiscal year runs from July 1 to the following June 30. For over a decade, Senegal has had insufficient financial resources to cover the required investments, and the budget deficit has had to be covered by foreign loans. During the Fifth Plan, the requirements have been primarily for financial investments (compsensation payments and subsidies to the Caisse autonome d'amortissement), than for "administrative capital", followed by social and community development programs.

Table 3: General Budget Year by Year

(in millions of FCFA)

	Operating Budget			Capital Budget			Overall Balance
	Income	Expenses	Balance	Income	Expenses	Balance	
1961-62[a]	29,843	29,197	646	4,830	4,831	- 1	645
1962-63	34,548	29,888	4,660	1,714	5,502	-3,788	872
1963-64	33,906	31,815	2,091	4,000	6,900	-2,900	- 809
1964-65	36,735	32,533	4,202	1,281	8,469	-7,188	- 2,986
1965-66	35,825	33,072	2,753	223	2,877	-2,654	99
1966-67	35,379	33,263	2,116	168	4,085	-3,917	- 1,801
1967-68	35,840	34,235	1,605	224	3,881	-3,657	- 2,052
1968-69	35,193	36,185	8	2,674	5,924	-3,250	- 3,242
1969-70	38,933	36,954	1,979	75	1,669	-1,594	385
1970-71	41,417	39,518	1,899	30	2,784	-2,754	855
1971-72	45,126	40,759	4,367	2,030	5,801	-3,771	596
1972-73	46,169	45,257	912	1,373	5,721	-4,348	- 3,436
1973-74	51,610	48,695	2,915	20,146	20,603	- 457	- 2,458
1974-75	68,728	60,313	8,415	1,578	8,853	-7,275	1,140
1975-76	80,466	74,557	5,889	4,748	16,224	-11,476	5,587
1976-77	86,014	81,652	4,362	-	26,112	-26,112	-21,750
1977-78	98,623	90,976	7,647	2,847	5,838	- 2,991	4,656
1978-79	107,411	100,526	6,885	5,515	10,943	- 5,428	1,457
1979-80[b]	119,819	116,737	3,082	12,368	27,409	-15,041	-11,959

[a] Fiscal year of 18 months adjusted to 12-month period.

[b] Provisional figures.

Between 1960 and 1980, ordinary income grew at a slightly faster rate (0.2 percent annually) than operating expenses.

One of the principal objectives of the Fifth Plan is to ensure the required growth of government income, while trying to hold down current expenditures, to achieve larger budget savings and to eliminate the capital budget's chronic deficit.

5. Rural Sector development policies

The basic elements of Senegal's new economic, social and cultural development policy are:

- o Effective participation by the people in making decisions concerning the economic and social development of their sector;
- o Organization of economic and social development within the framework of a territorial development policy; and
- o Control of production factors through technological readaptation, promotion of Senegalese capital and development of raw materials.

a. General policies affecting this sector

(1) Savings

Improving the national savings, primarily by:

- o Controlling growth of regular expenditures;
- o Increasing regular government income;
- o Improving the management of special accounts; and
- o Promoting family savings.

All these measures should help reduce the chronic budget deficit.

(2) The role of the State in the economy

Revising the State's direct role in the economy by establishing:

- o A policy of varying prices to stimulate local production;
- o A policy of maintaining the purchasing power of salaried workers while also protecting the purchasing power of rural people (lucrative farm product prices); and
- o A policy to correct the problems of quasi-public enterprises (restrictions on job creation, reorganization and possibility of transfers to the private sector).

(3) Balance of payments

Improving the balance of payments so that the deficit does not exceed seven percent of the gross domestic product (GDP). Ways to do this are:

- o Reduce imports and increase exports;
- o Diversify and intensify trade exchanges; and
- o Limit the cost of servicing foreign debt to 15 percent of the value of exports.

(4) Employment policy

Implementing an employment policy oriented towards:

- o More rational use of human resources to make optimal use of the labor factor; and
- o More judicial distribution of income between salaried and non-salaried workers, and between urban and rural work.

(5) Other

Consolidating the policies of:

- o The advancement of women;
- o The reduction of regional disparities and the improvement of territorial development; and
- o The protection of the environment and natural resources.

b. Policies and positions affecting the agricultural sector

(1) Satisfying food demands

The search for self-sufficiency in food supplies and reduced dependency on outside sources is the first priority of the agricultural sector. Strategies will therefore be sought to increase and diversify production and reorient consumption towards national products, especially by means of pricing policies and by having processing done within the country.

(2) Increasing the standard of living in rural areas

This will be done by improving incomes, through pricing policies and higher productivity, through integrating operations within a monetary economy, and through organizing a distribution network for the products.

(3) Providing secure conditions for agricultural production.

This can be accomplished through better control of water resources and increased development of irrigation facilities.

(4) Safeguarding the environment

The battle against erosion, maintenance of soil fertility, and preservation of vegetation to protect the topsoil are essential activities which must be linked to agricultural practices on a permanent basis.

(5) Encouraging rural people to take part in managing their activities

This can be achieved by reactivating the cooperative movement, which will first have to be restructured. It is also envisaged that the private sector will play an increased role in the farm products processing and marketing networks.

c. Policies and positions affecting agricultural research

Research institution organizations and operations should be strengthened by studying the concerns of users of animal and vegetable products, and by responding to the needs of Senegal's different farming systems and ecological regions.

The present fragmentary and undisciplined approach should be replaced by a more coordinated procedure, calling on multi-disciplinary teams to study as a whole the problems presented by each product and each production system.

Research programs on systems now operating in the country's four main regions--the River Valley, the Peanut Growing Basin, the Casamance and Senegal-Oriental--should be launched.

Research into the economics of production, marketing and human resources should be accelerated.

The procedures for evaluating and applying innovations, notably the efficiency of the links with extension and training, should be expanded.

Long-term training and refresher courses for researchers and technicians should be established and personnel management policies and procedures should be improved.

The links of cooperation between the country's research institutions and outside organizations (at the sub-regional and international research institute levels) should be strengthened.

6. List of international organizations connected with Senegal

- o United Nations (UN) and related agencies;
- o Organization of African Unity (OAU);
- o Economic Community of West African States (ECOWAS);
- o West African Economic Community (CEAO-Communauté économique de l'Afrique de l'Ouest)
- o Common African and Mauritian Organization (OCAM-Organisation commune africaine et mauricienne);
- o West African Monetary Union (UMOA-Union monétaire ouest-africaine);
- o Permanent Interstate Committee on Drought Control in the Sahel (CLISS-Comité permanent inter-états de luttre contre la sécheresse dans le Sahel);
- o Organization for the Development of the Senegal River (OMVS-Organisation pour la mise en valeur du fleuve Sénégal); and
- o Organization for the Development of the Gambia River (OMVG-Organisation pour la mise en valeur du fleuve Gambie).

E. Economic Situation and Prospects

1. GDP and economic growth

Growth of GDP in constant and current values between 1959 and 1980 is shown in Table 4.

During this period, GDP grew at a relatively slow rate: 2.2 percent annually in constant values (1971), which represents 6.4 percent in current values. This slow growth (interrupted by a net loss in 1973) was due essentially to:

- o Lack of proper water control, which made the economy very vulnerable;
- o Weak economic growth of Senegal's principal trading partners (the countries of the Organization for Economic Cooperation and Development (OECD) and the countries of the sub-region); and
- o Low productivity of project investments, due essentially to the fact that these investments were directed towards non-productive sectors.

A careful analysis of the relative balance between resources and the uses made of goods and services, as shown in Table 5, demonstrates

Table 4: Gross Domestic Product by Sources and Uses, 1959-1980
(billions of FCFA)

A. In Current FCFA Values

Aggregates	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977*	1978*	1979*	1980*
1. Primary sector	35,0	34,4	40,3	43,5	43,0	45,3	50,6	53,8	48,1	56,3	50,7	57,8	51,8	67,4	62,8	80,7	122,8	138,8	132,2	118,3	132,4	142,1
2. Secondary sector	16,7	27,8	30,8	32,6	33,5	36,7	38,4	40,0	42,6	42,9	47,4	51,7	54,5	58,0	58,3	84,3	87,5	106,9	121,5	115,3	128,2	121,1
3. Tertiary sector	58,2	65,3	69,3	71,7	77,4	80,2	81,8	82,8	84,2	84,7	91,6	101,8	109,8	115,3	132,0	134,4	138,8	157,1	164,2	169,7	187,6	187,8
4. Total Goods & Services	127,9	129,6	140,6	147,8	153,8	162,4	170,8	176,6	175,9	188,9	189,7	211,3	216,1	240,7	263,1	299,4	339,2	402,8	419,9	403,7	458,2	450,7
5. Salaries paid by Administration	18,5	18,8	19,5	21,7	22,5	23,2	24,0	27,1	27,5	26,2	24,8	26,6	28,8	30,6	32,8	37,6	43,9	54,1	58,6	54,2	59,8	61,5
6. Wages - domestics	1,5	1,5	1,6	1,7	1,8	1,8	2,0	2,0	2,1	2,1	2,1	2,2	2,2	2,3	2,3	2,4	3,3	4,1	4,4	4,3	4,6	4,8
7. Total GDP	143,8	150,0	161,7	171,2	178,2	188,5	198,8	205,7	205,5	217,2	214,6	240,1	247,2	273,6	278,2	338,8	406,4	458,3	480,9	465,4	532,6	517,8
8. Domestic Capital Formation (DCF)	23,3	23,6	21,7	23,3	21,2	23,6	23,6	21,0	23,0	25,0	29,1	37,7	40,2	46,5	52,6	73,1	72,3	75,7	76,9	80,0	87,0	107,5
9. F.B.C.F.	22,8	22,5	21,2	22,3	20,2	22,4	22,1	22,8	20,0	21,0	22,7	30,0	31,2	37,5	39,6	51,8	56,6	61,4	61,5	78,0	81,0	87,5
10. Inventories	0,5	0,8	0,5	1,0	1,0	1,0	1,5	2,5	3,0	4,0	6,4	7,7	9,0	9,0	13,0	23,3	15,7	14,3	15,4	12,0	16,0	20,0
11. Trade deficit	- 0,2	- 1,5	- 0,4	- 2,4	- 7,5	- 8,3	- 8,0	- 2,8	- 6,5	- 15,8	- 17,7	- 11,0	- 17,7	- 10,0	- 28,4	- 21,6	- 22,2	- 36,9	- 32,3	- 77,0	- 59,0	- 65,0
12. Domestic savings	23,1	21,8	21,3	20,8	13,7	14,1	15,6	18,4	16,5	9,1	11,6	26,7	22,5	36,5	24,2	51,7	50,1	38,8	44,6	13,0	28,0	22,5
13. Consumption	120,8	128,1	140,4	150,3	164,5	173,4	183,2	187,3	189,0	208,1	205,2	213,4	224,7	237,1	254,1	285,1	356,3	420,5	436,3	453,4	460,2	494,5
14. Public sector	25,3	25,8	26,7	28,4	30,6	33,8	34,5	35,7	35,1	34,0	33,6	35,7	38,8	40,8	43,8	50,0	61,8	71,7	75,2	83,5	81,1	91,8
15. Private sector	89,5	102,2	113,7	120,8	134,1	141,8	148,7	151,6	153,9	174,2	171,6	177,7	185,9	196,3	210,3	235,1	294,5	348,8	361,1	369,9	358,1	403,5

(*) Estimate

B. In Constant FCFA Values, 1971

1. Primary sector	43,8	47,2	48,9	51,5	52,6	52,6	58,7	62,5	57,2	57,5	55,6	62,0	51,6	64,1	53,6	66,2	72,3	79,2	73,5	63,9	80,7	69,8
2. Secondary sector	32,8	33,8	35,9	37,9	39,1	41,8	43,2	46,1	46,1	47,3	48,8	53,1	54,5	55,6	54,5	60,7	63,6	68,6	71,7	64,1	70,4	64,6
3. Tertiary sector	82,0	80,1	83,8	86,1	91,3	92,3	93,0	94,3	83,6	100,2	96,7	102,8	109,8	111,9	108,9	102,1	108,5	116,3	117,9	112,0	117,8	111,5
4. Total Goods & Services	158,4	161,1	160,6	175,5	183,0	186,9	194,9	203,9	186,8	215,5	206,2	217,8	216,1	231,6	217,2	229,6	244,7	262,1	263,1	240,0	268,9	246,3
5. Salaries paid by Administration	24,4	23,6	23,5	26,1	26,3	25,4	25,6	29,2	30,3	26,2	21,6	27,3	28,8	28,1	28,8	28,0	29,9	34,4	35,9	34,9	34,6	33,8
6. Wages - domestics	2,1	2,0	2,1	2,2	2,3	2,3	2,4	2,5	2,4	2,3	2,2	2,5	2,8	2,8	2,8	2,7	2,8	2,8	2,8	2,6	2,6	2,5
7. Total GDP	181,9	183,7	187,3	203,8	211,6	217,6	225,0	232,6	229,6	244,0	228,0	243,5	247,2	263,0	248,3	258,7	274,8	298,8	301,3	277,3	305,9	282,6
8. Domestic Capital Formation (DCF)	32,6	32,1	28,6	29,9	26,6	28,8	28,6	24,7	27,8	29,5	32,1	33,2	40,2	46,2	45,1	48,8	35,0	50,8	48,5	47,6	47,9	48,6
9. F.B.C.F.	32,2	31,5	28,0	28,6	25,5	27,5	26,0	25,3	25,0	24,0	24,5	30,3	31,2	35,5	34,7	37,6	39,1	39,2	38,5	42,5	43,1	40,4
10. Inventories	0,6	0,8	0,6	1,3	1,3	1,3	2,0	3,6	4,0	5,5	7,6	8,4	9,0	8,7	10,6	11,2	8,8	10,3	7,0	5,1	4,8	8,2
11. Trade deficit	- 17,4	- 10,5	- 8,6	- 20,4	- 24,6	- 23,1	- 20,5	- 22,5	- 22,8	- 16,9	- 10,2	- 13,1	- 17,7	- 4,0	- 18,4	- 20,2	- 8,0	- 2,6	- 15,2	- 26,0	- 17,0	- 18,3
12. Domestic savings	20,0	21,6	20,0	8,8	2,0	5,7	7,5	5,2	1,4	12,6	21,9	25,6	22,5	40,2	26,7	28,6	27,8	47,6	31,3	21,6	30,8	30,3
13. Consumption	164,0	167,1	177,2	193,9	209,6	212,1	218,4	226,2	231,4	236,1	221,8	224,7	222,8	221,6	230,1	249,8	251,4	238,0	255,7	235,0	252,5
14. Public sector	33,4	33,8	33,8	37,8	38,7	40,6	41,1	43,1	43,4	38,4	33,7	37,1	38,8	38,3	38,2	41,1	43,2	42,9	51,4	47,1	52,6	46,4
15. Private sector	131,5	133,3	143,4	156,0	170,9	171,5	177,3	183,1	188,0	197,6	188,1	187,6	184,0	183,3	191,9	208,7	208,2	195,1	204,3	187,9	200,1	206,1
Implicit Indices																						
Consumer Prices	75,7	76,7	78,2	77,5	78,5	82,2	83,9	82,8	82,8	88,8	89,5	94,2	100,0	106,4	114,7	124,4	142,6	153,2	146,4	135,9	160,1	169,6
GDP	80,0	78,5	82,0	84,0	84,2	87,0	88,0	88,5	89,5	89,0	95,0	97,0	100,0	104,0	112,0	131,0	148,8	153,7	159,6	168,2	174,1	183,2

Table 5: Balance of Resources and Use of Goods and Services, 1977
(billions of FCFA)

Aggregates	1980	1981	1982	1983	1984	1985
Sectors						
Primary	105.2	99.3	123.4	126.5	128.5	129.8
Secondary	96.2	100.8	109.5	114.1	119.0	122.8
Services	221.0	205.3	217.9	224.8	233.1	237.3
Total GDP Goods and Services	422.4	405.4	450.8	465.4	480.6	489.9
Salaries	81.5	86 6	89.2	91.0	92.4	93.8
GDP	503.9	492.0	540.0	556.4	573.0	583.7
Imports	204.3	214.6	222.7			
Total Resources	708.2	706.6	762.7			
Consumption						
Total	497.9	510.3	516.2			
Private Sector	390.6	392.3	403.9			
Public Sector	107.3	109.0	112.3			
F.B.C.F.	70.5	74.4	79.6			
Variations in Inventories	1.3	9.0	5.9			
Exports	138.5	121.9	161.0			
Trade Deficit	65.8	92.7	61.7			
Deficit as % of GDP	13	18.8	11.7			

that the GDP structure will remain relatively constant over the five-year period covered.

- The primary sector (2.24 percent annual growth) is dominated primarily by agriculture, consisting of cash crops and subsistence crops. Despite the climatic fluctuations, growth in this sector has been stabilized by the dynamism of the fisheries segment;

- The secondary sector (3.6 percent annual growth) declined during this period, due to a lack of activity in the crop-related industries (oil processing plants, textiles, etc.) and deterioration of rural purchasing power; and

- The tertiary sector (1.8 percent annual growth), although more difficult to analyze, retains its relative importance in the GDP structure.

An analysis of the GDP movement shows:

- A consumption growth trend almost equivalent to the GDP growth rate;

- A constant flux in the rate of domestic capital formation (Primitive accumulation of fixed capital + inventory variations);

- A chronic trade balance deficit (which plays a major role in exchange rate deteriorations); and

- A very low domestic savings rate.

2. International trade

The pattern of Senegal's international trade is characterized by a rapid growth of imports and relatively static exports. (See Table 6.) The trade balance deficit has been growing each year, and since 1980 exports have amounted to less than 50 percent of imports.

This imbalance is the direct result of an economy dominated by regular increases in imports (oil, rice, manufactured products) and a lack of diversity in exports. In addition, export products are subject to climatic risks and the fluctuations of world markets (groundnuts, phosphates, etc.)

The export product mix is changing. Groundnut products are accounting for a steadily decreasing share, while phosphates, second in importance to peanuts, are dropping due to decreased demand on world markets. By contrast, re-exports of petroleum products and sea fisheries products are increasing.

Imports have increased steadily during the past decade, led by food products (rice, wheat, fruits and vegetables: FCFA 40.8 billion

Table 6: Trade Balance Pattern

Years	Current Values			Export/Import Ratio
	Exports	Imports	Balance	
	(billions (FCFA)			(percent)
1960-1964	29.3	39.9	- 10.6	73
1965-1969	34.3	42.5	- 8.2	80
1970-1974	53.3	76.7	- 23.0	70
1975	99.1	124.6	- 25.5	80
1976	115.9	153.9	- 38	75
1977	152.9	187.5	- 34.6	82
1978	95.3	170.3	- 75.0	56
1979	97.9	188.8	- 90.9	52

in 1980), petroleum products (crude oil: FCFA 38.9 billion in 1980), and manufactured and semi-finished products: FCFA 42.3 billion in 1980).

Senegal's principal trading partners are:

- Export customers (as percent of total exports--FCFA 87.6 billion): France (33.7), Ivory Coast (7.6), Mauritania (6.6), United Kingdom (6.3), Mali (5.6), F.R.G. (2.8), Finland (2.5), Greece (2.5), Japan (2.5), and Italy (1.9); and

- Import suppliers (as percent of total imports--FCFA 199.3 billion): France (40), Iraq (7.7), Thailand (6.6), Nigeria (5.7), USA (4.8), United Kingdom (3.8), F.R.G. (3.7), Italy (3.5), Ivory Coast (3.2), and Netherlands (2.5).

The countries of the European Economic Community (EEC) are, generally speaking, Senegal's principal trading partners, while trade with the countries of the Economic Community of West African States (ECOWAS) is now increasing appreciably. Crude oil is the main import from the countries of the Organization of Petroleum-Exporting Countries (OPEC), and rice from the countries of Asia and Latin America. Senegal had a trade deficit in 1980 with all monetary zones (dollar, sterling, and franc) except the West African Monetary Union (UMOA-Union monétaire ouest-africaine).

3. Currency and credit

a. Structures

Senegal is part of the franc zone and the UMOA zone. The latter features:

- A common monetary unit, the CFA franc (FCFA), which is freely transferrable;

- A common currency-issuing institution, the Central Bank of West African States (BCEAO-Banque Centrale des Etats du l'Afrique de l'Ouest); and

- Free conversion between the CFA franc and the French franc, without limit, at the rate of one FCFA to 0.02 FF.

b. Bank network

There are five development banks:

- The National Development Bank of Senegal (BNDS--Banque nationale de développement du Sénégal), with assets of FCFA 2.4 billion (government share, 73 percent), which gives short-term loans for agriculture and industry;

- The Senegalese-Kuwaiti Bank (BSK--Banque Sénégalo-Koweitiènne), with assets of FCFA two billion (government share: 25 percent, Senegalese private sector share: 25 percent), which gives long- and medium-term loans;

- The Financial Association for Development and Industry (SOFISEDIT--Société financière pour le développement et l'industrie), with assets of FCFA 650 million, which gives medium- and long-term loans to industries and tourism promoters;

- The Bank of the Habitat of Senegal (BHS--Banque de l'habitat de Sénégal), with assets of FCFA 1.1 billion, and 9 percent of capital subscribed by government; and

- The Islamic Development Bank.

There are seven commercial banks:

- The Senegalese Banking Union (USB--Union Sénégalaise de banque), with assets of FCFA two billion (government share: 62.2 percent);

- The General Association of Senegalese Banks (SGBS--Société générale des banques du Sénégal), with assets of FCFA 2.156 billion (Senegalese private sector share: 38.2 percent);

- The International Bank for Commerce and Industry in Senegal (BICIS--Banque internationale pour le commerce et l'industrie au Sénégal), with assets of FCFA two billion (government share: 35 percent);

- B.I.A.O.-Sénégal, with assets of FCFA 3.1 billion (government share: 35 percent); and

- Citibank, Chase Manhattan Bank of Credits and International Commerce (BCCI), and branches of American banks.

There are four financial institutions:

- The National Guarantee and Insurance Company (SONAGA--La société nationale de garantie et d'assurance), with assets of FCFA 923 million;

- The General Association for Automobile Financing (SOGECA), with assets of FCFA 240 million;

- The Dakar Equipment Company (SDE--La société dakaroise d'équipment); and

- The West African Leasing Company (Lacafrique), with assets of FCFA one billion.

4. Money supply

a. Money and quasi-money supplies

Monetary and quasi-monetary supplies are growing strongly compared with real production, resulting in devaluation of

the country's currency. Total deposits in 1984 will show a decrease to FCFA 86.2 billion, while savings accounts and term deposits will total about FCFA 47.4 billion, an increase over the previous year.

b. Compensatory payments

The deficit in net foreign assets is increasing annually: from FCFA 43.3 billion in 1978 to FCFA 69 billion in 1979 and FCFA 104.5 billion in 1980. Economic credits for 1981 were estimated to be FCFA 280 billion. In 1980, the Public Treasury owed the banking system FCFA 38.7 billion.

The economic and financial recovery plan now underway will attempt to eliminate at least part of the private debt.

Total public debt in recent years was as follows: US$ 824.8 in 1978, US$ 1,119.1 in 1979, and 1,026.4 in 1980. In 1981, the debt was US$ 829.0 (rescheduled) and in 1982, US$ 1,193.0 (also rescheduled).

The inflation rate was 16 percent in 1980, 21 percent in 1981, and 17 percent in 1982.

5. Credit

The different credit organizations are:

- The BCEAO;
- Commercial and Development banks: USB, BICIS, BIAO, SGBS, BSK, SOFISEDIT, BNDS, and BHS;
- Business banks (e.g. Citibank); and
- Special financial institutions, i.e. SONAGA and SOGECA.

6. Sixth four-year plan for economic and social development

a. Options and priorities

While retaining the basic national planning options, the Sixth Four-Year Economic and Social Development Plan has been designed so that changes can be made on a progressive basis at both the structural level and the level of policy implementation. In addition, a commission has been set up and given responsibility for regional, environmental and territorial development planning, so that the regional aspect of the Sixth Four-Year Plan can be given priority.

The overall framework of the plan addresses the directly productive and the indirectly productive sectors (reducing training costs, strengthening relationships between training program and employees, improving public health) and living standards (sanitation, water supply and purification, electricity and housing). The fundamental problems that the Sixth Plan will attempt to resolve will be to balance

the budget (increasing government receipts assigned to the national development budget, together with borrowing to cover a possible deficit) and to achieve a trade balance (by increasing exports and selectively reducing imports).

The total amount of investment budgeted for the Sixth Plan is FCFA 464 billion. Of this amount, 96 percent (FCFA 447.7 billion) will be devoted to national projects, with the remaining 4 percent (FCFA 16.3 billion) to community and local projects.

By sectors, the investments will be allotted as follows:

- Primary sector--FCFA 106,652 billion, 24 percent of total investment: 52 percent for agriculture, 10 percent for livestock raising, 11 percent for fisheries, 10 percent for forestry and environmental protection, and 17 percent for rural and village water projects;

- Secondary sector--FCFA 151,851 billion, 34 percent of total investment: 81 percent for industry, 16 percent for energy, and 10 percent for crafts projects;

- Tertiary sector--FCFA 99.276 billion, 22 percent of total investment: 85 percent for transportation and communications, 12 percent for tourism, and 3 percent for commerce; and

- Quaternary sector--FCFA 39.969 billion, 20 percent of total investment: 25 percent for education, 18 percent for housing, 17 percent for urban water supply and purification, 11 percent for research and studies, 6 percent for health, 7 percent for social advancement, and 4 percent for culture, youth and sports.

b. General orientations and objectives

(1) Primary sector

The major goal of the rural development planners is to gradually correct the current food shortages by diversifying agricultural production and putting more emphasis on food crops.

The principal approaches are to:

- Intensify the production of export crops, establish a sufficiently remunerative pricing policy to raise the living standards of rural people, and put farm production to better and more profitable industrial use;

- Build a dense network of rural water supply projects;

- Battle the spread of the desert throughout the country, by planting vegetation to provide a ground cover and soil stabilizer and by controlling water resources; and

- Develop cooperative and farm credit systems so that rural people can participate in their communal activities.

The principal projects to be carried cut under the Sixth Plan are:

- Continued development of the Organization for the Development and Management of the Senegal and Falémé River Deltas (SAED--Société d'amenagement et d'exploitation des terres du delta des fleuves Sénégal et Falémé), which will be expanded from 17,600 hectares at the beginning of the Plan to 25,800 hectares by the end of the Plan;

- Start of work on the Diama and Manantali dams;

- Construction of the Guidel and Bignona dams;

- Start of work on the integrated Senegal-Oriental and Upper Casamance development project;

- Continuation of livestock-raising projects in the forest/pasture zone (SODESP) and in Senegal-Oriental (PDESO);

- Construction of regional slaughterhouses in Diourbel, Tambacounda, Ziguinchor, Louga and Kaolack, a market in Thiès and dairy barns in the various regions;

- Development of zones of cynegetic interest in the River, Senegal-Oriental, Casamance, Sini-Saloum and Louga regions;

- Development and replanting of the northern zone of the forests in the east-central part of the country, the Bandia forest and those in the Groundnut Growing Basin;

- Improvement of the Casamance forest; and

- Establishment of a fisheries credit program and opening of a "small fishermen's assistance center" at Thiaroye.

(2) Secondary sector

Principal projects for the secondary sector include:

- Building an integrated textile complex at Kaolack (SOTEXKA) at an estimated cost of FCFA ten billion, to create 1,500 jobs;

- Establishing a chemical industries plant (ICS-Industries chimque du Sénégal) to make it possible for Senegal to process into fertilizers some of the phosphates now exported in the raw state;

- o Expanding production capacities of the SOCOCIM, CSS and SAR facilities (cement, sugar and gasoline);
- o Developing of the Falémé iron deposit;
- o Continuing the search for uranium in Senegal-Oriental; and
- o Installation, improvement and development of the arts and handicrafts centers in the regions and district departments.

(3) Tertiary sector

Principal projects involved are:

- o Construction of hotels at Cap-Vert (520 beds) and Casamance (400 beds);
- o Construction of highways linking Louga to Dahra, Tambacounda to Dianke and Mankan, and Kédougou to Saraya;
- o Improving 200 km of national highways;
- o Upgrading the rail line to Tambacounda, starting at PK271; and
- o Modernizing and expanding the Dakar telephone system and development of the Casamance-Senegal-Oriental link.

(4) Quaternary sector

In the social sector, the principal activities planned are:

- o Construction of 2,000 economy-type classrooms in the elementary school system (about 600 more than were built during the Fifth Plan);
- o Establishment of technical training schools; and
- o Creation of four professional training establishments to provide intermediate qualification instruction (CAP level) at Kaolack in Senegal-Oriental and at Louga in Casamance.

As well, there are plans to open a teachers' training school at Kolda and inaugurate the Technical and Professional Teachers' Training College, to complete the Business Administration College at Dakar and the National Institute for Rural Development at Thiès, and to open the University of Saint-Louis.

Continuation of primary health care operations and construction of regional cultural complexes at Kaolack, Saint-Louis, Tambacounda and Ziguinchor are other important objectives.

The primary objectives for 1985 are as follows:

- o 3.5 percent overall economic growth (3.4 percent in the primary sector, 5.0 percent in the secondary sector and 2.8 percent in the tertiary sector);
- o 5 percent reduction of the trade deficit;
- o 1 percent reduction in the domestic consumption rate, which would be sufficiently lower than the population growth rate (2.8 percent) to reach a net domestic savings rate of 15 percent by the end of the Plan;
- o 16 percent increase in the amount of investments; and
- o Holding debt-servicing costs to 15 percent of the value of goods and services exported, by the end of the Plan.

c. Sources of financing

Domestic financing sources will provide FCFA 117,875 billion. These funds come from the National Development Budget (FCFA 48.824 billion), regional and community budgets (FCFA 16,381 billion), and from private sources, including the banking system, and capital investments self-financed by private enterprises.

External financing sources will provide FCFA 346 billion, including 168 billion already committed for the Sixth Plan projects previously described and for certain other projects. Senegal can also count on some annual support which does not involve foreign debt-servicing charges. Some FCFA 130 billion is being sought from multilateral and bilateral sources. Large loans have been excluded from the Sixth Plan so as not to add unduly to foreign debt-servicing requirements.

Preference has been given to small loans with interest rates of less than 9 percent and with repayment deferred for several years. If unable to obtain small loans on these terms, medium-sized loans will be sought.

d. Goals of the Sixth Plan specifically affecting agricultural research

These goals include the identification and quantitative and qualitative evaluations of technical, social and economic constraints on research operations. Research on solutions to the above problems, the regionalization of research activities, especially the formation of multi-disciplinary teams to conduct research on products and on production systems, and the development of agricultural products.

e. Projection of the Sixth Plan for 1984-1985

Projection of the Sixth Plan for 1984-1985 are contained in Tables 7a (agricultural production), 7b (livestock), and 7c (fisheries).

f. Appraisal of the Fifth Plan

(1) Agriculture

During the Fifth Plan, agricultural production was seriously affected by disastrous climatic conditions. Only 64 percent of the production objectives set were reached, although general objectives were attained. The returns expected were all overestimated. In addition to the drought, other factors responsible were:

- o Insufficient application of technical themes;
- o Poor organization at the rural level; and
- o Lack of farm credit.

(2) Livestock

At the end of the Fifth Plan, national production was not sufficient to satisfy needs. Available meat supplies amounted to 69,800 tons, or 12 kg per capita. Only 51 percent of the hog production objective was reached in 1980. Aside from the climatic factors, the underlying reasons for this poor performance are of a structural nature.

(3) Fisheries

Although this is the most dynamic sector, only 69 percent of the objectives set were achieved during the Fifth Plan. The difficulties facing fishermen (both ocean and inland) involved financial resources, along with organizational and management problems.

(4) Forestry

As a result of massive aid from foreign sources, this sector's objectives were partially attained. Forest areas replanted each year increased from 2,000 ha in 1977 to 5,000 ha in 1980. An average of 250,000 seedlings were distributed annually and replantings were carried out along 180 km of highways.

7. International assistance

Despite a difficult international situation, total aid received reached US$ 245 million in 1980. This was up by 15.6 percent over 1979, and 47.6 percent higher than in 1978.

Table 7a: VIth Plan Projections: Period 1984-1985: Agriculture

	Reference Year (1980-81)		1984-1985		Percentage Increase
	Area (ha)	Production (tons)	Area (ha)	Production (tons)	
Millet/Sorghum	978,000	573,000	1,069,000	71 000	4.6
Rice	79,000	112,000	103,000	220,000	14.5
Maize	25,000	46,000	190,000	285,000	124.0
Wheat	--	--	500	4,000	--
Groundnut Oil	1,140,000	763,000	1,204,000	930,000	4.0
Shell groundnuts	24,000	10,000	43,000	36,000	29.2
Cotton	40,000	35,000	48,000	49,000	6.9
Cowpeas	58,000	14,000	67,000	16,000	3.0
Soya	--	--	2,000	3,800	--
Garden Produce	5,900	81,000	7,300	100,000	4.3
Cassava	19,300	80,000	22,000	90,000	43.0
Fruit	4,400	46,000	4,700	53,000	2.8
Sugarcane	4,600	490,000	7,200	790,000	32.6

Table 7b: VIth Plan Projections: Period 1984-1985: Livestock
(Projected Production in 1984-85)

	Total Number		Total Animals Raised for Slaughter	Kg/Capita Year
	1980	1985		
Cattle	2,235,000	2,530,000	330,000	8.2
Sheep/Goats	3,170,000	3,970,000	1,200,000	2.7
Hogs	180,000	210,000	160,000	1.5
Poultry	8,000,000	14,000,000	14,000,000	2.7

Table 7c: VIth Plan Projections: Period 1984-1985: Fisheries
(total fish caught)

	Reference Period	1984/85 Objectives
Small-scale Fisheries	209,000	250,000
Industrial Fisheries	124,000	220,000
Inland Fisheries	11,000	40,000

Technical assistance, US$ 107 million in 1979, was unchanged in 1980. The major portion of this assistance was assigned to the sectors of planning and development policy (33.8 percent) and agriculture, forests and fisheries (32.8 percent). Food and humanitarian programs received 10 percent of all technical assis ance.

Financial investment totalled US$ 145 million in 1980, with 66 percent of that provided by multilateral sources, 11 percent from United Nations organizations and 23 percent from bilateral sources. During this period, the industrial sector received nearly 25 percent of total investment, with 21 percent going to international trade activities.

F. Rural Sector

1. Natural potentials

a. Soil

(1) Studies

A series of studies based on acquiring knowledge of the different soils, as well as their evolution and suitability for different crops, livestock raising, forage production, etc., have been made over the entire Senegalese territory during the past four decades.

- The River Region has been the most thoroughly studied, as part of the OMVS irrigation development projects;
- Senegal-Oriental has been studied systematically and a map prepared on a scale of 1:200,000;
- The Casamance Region has been almost entirely mapped, on various scales;
- Other sectors accurately surveyed and mapped are Cap-Vert, the Thiès Region and Lower Saloum; and
- The remainder of the country has been surveyed, but not systematically, as part of sylvo-pastoral development projects, such as in Ferlo.

These various surveys have been mapped on a scale of 1:1,000,000; the latest, on a scale of 1:500,000. is now being prepared. The 1:1,000,000 scale maps identify eight major soil groups: three zonal and five azonal, as described earlier in this report. However, maps drawn to a larger scale show greater diversification and a more precise differentiation of the soil units. An ORSTOM-FAO-UNESCO correlation categorizes soil structures in seven classes, 16 groups and 29 sub-groups, resting on some 30 native rock formations. These soil units have been grouped into five classes according to their agricultural suitability.

- o Class 1: Good soils without serious limitations, occupying 6 percent of the entire area surveyed. These are mostly hydromorphic soils in valleys;

- o Class 2: Average to good soils (8 percent) with few limitations to reduce their agricultural suitability. Included among them are mangrove soils, the lithomorphic vertisols of Senegal-Oriental, and certain more or less hydromorphic arid brown soils of Ferlo and the Louga-Linguère region;

- o Class 3: Poor to medium (34 percent) with some limitations, low natural fertility and low to moderate crop yields. This class includes mainly leached tropical ferruginous soils and ferallitic soils predominant in the southern half of the country;

- o Class 4: Very poor soils (36 percent) with moderate to very severe limitations, producing mediocre yields when farmed by traditional methods. There is a diversity of soils in this class, including soils very little affected by erosion, as found in North Senegal, some lithomorphic vertisols on the Upper Casamance massif, and, especially, the unleached tropical ferruginous soils (diorites) in the entire central-northern part of the country; and

- o Class 5: Soils unsuitable for cultivation of any kind, covering 16 percent of the entire area surveyed. They have extremely severe limitations making them completely unusable, or only marginally so, for agricultural purposes. They consist of heavily mineralized and halomorphic soils.

(2) Potentials

An analysis of soils and climate conditions oriented towards pedoclimatic crop needs gives an idea of regional potentials.

- o The river region is the most disadvantaged area, where most soils are agriculturally unsuitable, or only slightly suitable. Only 13 percent of the region (the Valley itself) is cultivable. Climatically, the Departments of Podor and Dagana prove completely unsuited for growing crops that require guaranteed rainfall. The Department of Matam offers better possibilities for fast growing crops over more than half its area;

- o The Louga region has crop possibilities similar to those of Matam, except that only 20 percent of the soils are good to average;

- o The Diourbel region has remarkably homogeneous soils and climatic condition. More than 80 percent of the egion's

soils (low productivity diorite type) are in a zone suited to fast growing crops;

- The Thiès region is very similar to Diorbel, but with 13 percent of soils unsuited for agricultural production;

- The Sine-Saloum region, where pedoclimatic conditions are improving and the season of assured rainfall permits good development of the region's important soil resources;

- The Casamance region is well provided with water and suitable soils. Three-quarters of its surface consists of either tropical ferruginous soils or relatively good quality, slightly ferallitic soils; and

- The Senegal-Oriental region. Although the region has better water resources, its rough and rocky terrain provides limited soil resources for farming.

Finally, it should be noted that those regions possessing the best soil/climate conditions are at present the ones being least exploited. Figure 3 describes projects attempting to correct this.

b. Water and climatic resources

The greater part of Senegal has a sahelian or sub-sahelian climate, with fairly flat terrain and assured precipitation of less than 700 mm annually. Surface water flows are therefore very limited, resulting in reduced year-long water resources, apart from the underground tables and the Senegal and Gambia. By combining all the hydraulic potentials and integrating the three functions of supplying water for human use, supplying water for livestock, and providing irrigation for crops, Senegal can be divided into four large zones, each suitable for specific water resource developments:

- The Senegal River Valley. The river is the zone's major water resource, with an average flow at Bakel of 783 m^3s over the 77-year period from 1903 to 1980. Completion of the OMVS development project will regulate the flow to a permanent minimum of 300 m^3s, producing as many as 300,000 ha of irrigable areas. The Diama Dam will halt the upriver flow of salt water and raise the level of the Lac de Guiers to provide additional water storage of 1.2 million cubic meters;

- Upper Gambia, to which can be added the Kayanga Basin. The average annual flow of the Gambia, estimated at 172 m^3s (1953-1980), will be regulated. The area which can be irrigated by these surface waters are estimated at 100,000 ha. Underground reserves are estimated at 500,000 m^3/day, of which 1/10 are potentially available;

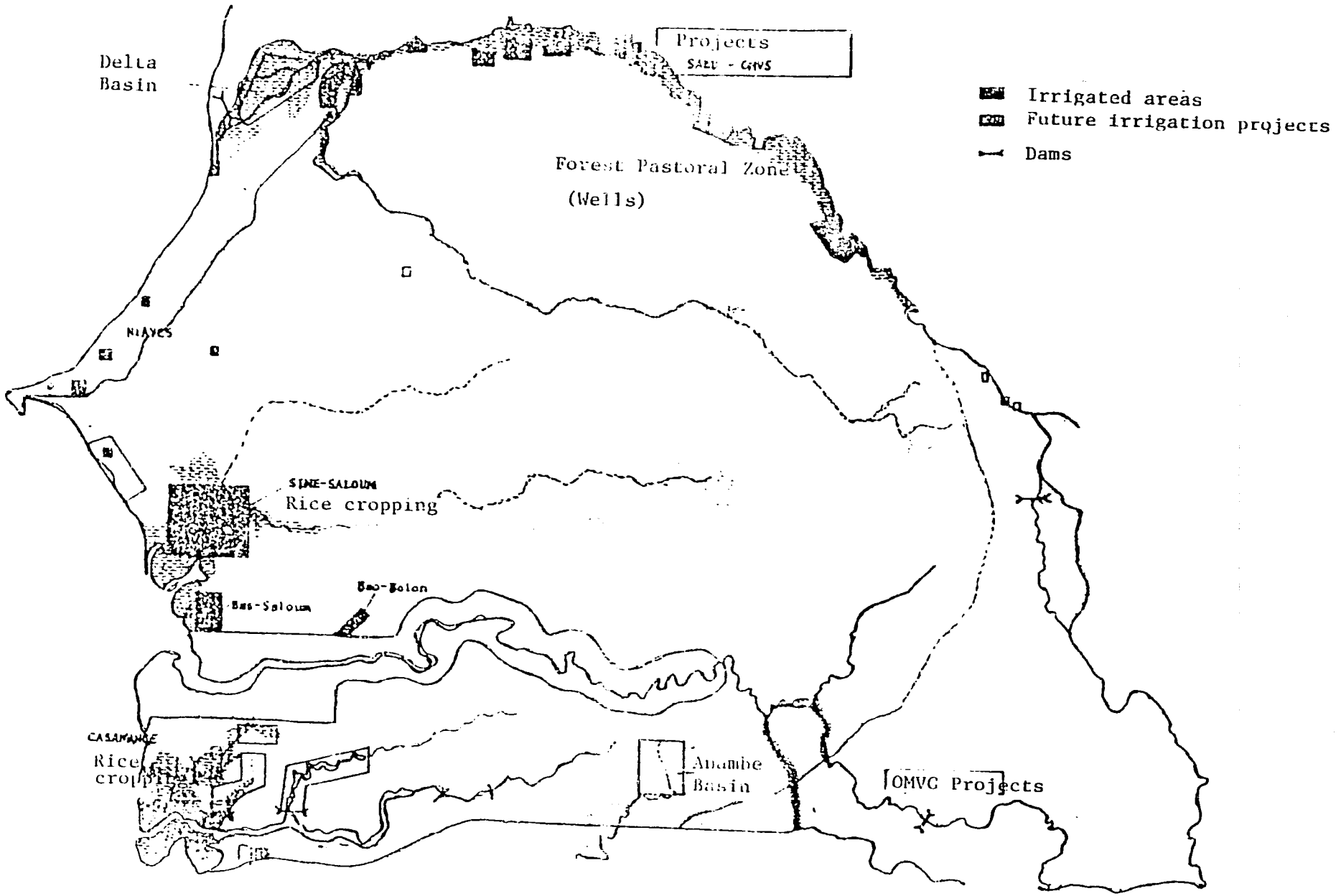


Figure 3 : Irrigation Development Projects

- The Casamance, where annual rainfall ranges from 800 to 1,200 mm, offers important water resources despite the weak flow and upriver penetration of salt water. The miocene aquifers, which can easily be tapped, are estimated at 105,000 m^3/day; and

- The remainder of country, comprised mainly of the Groundnut Basin, Senegal-Oriental and Cap-Vert, where only the underground water reserves are exploitable with any degree of security, and it is difficult to evaluate their ability to renew themselves.

A recent audit of underground water resources estimated renewable resources to be 1,900,000 m^3/day and exploitable resources to be 700,000 m^3/day for a 200-year period and 600,000 m^3/day for 50 years. This adds up to theoretical mobilizable reserves of 3.2 million per day for a 50-year period, 2.6 million per day for 200 years, and after that, exploitable reserves of 1.9 million m^3/day.

Water requirements are estimated at 80,000 m^3/day for the rural population and 150,000 m^3/day for livestock.

Resources in relation to climate are shown in Table 8.

2. Agricultural lands

a. Utilization of available land

For Senegal as a whole, estimates of cultivable land are in the range of 3.73 million ha. Considering that between 2.5 and 2.7 million ha are now being cultivated, the rate of utilization is 72 percent. Table 9 shows that most of the available uncultivated lands are located in the least populated regions, Casamance and Senegal-Oriental.

Protected lands are divided as follows:

- Protected forests which occupy vast areas of land in the southern half of the country (26 percent in Senegal-Oriental, 25 percent in Casamance);

- National parks, predominantly in Senegal-Oriental, (22 percent of area); and

- Sylvopastoral reserves, set aside for grazing lands, are located mostly in the northern part of the country, especially in the Department of Linguère, where they occupy more than 50 percent of the surface area.

b. Soil erosion

All soils throughout Senegal, whether of recent or ancient origin, are subject to more or less serious risks of erosion according to their nature, the climate, topography or land use.

Table 8: Climatic Conditions in Senegal

Weather Stations	Annual Rainfall			Temperature			Evapotranspiration	Hours of Sunlight
	1982	Average 1968-82	Average pre-1968	Average	Maximum	Minimum	Annual Average	Annual Average
	(mm)			(°C)			(mm)	(hours)
Saint-Louis	-	-	350	24.2	30.8	16.4		2,993
Podor/Richard-Toll	109	218	311	28.5	-	-	3,610	-
Matam Guédé	129	19	540	28.7	42.1	13.8	470	3,358
Louga	215	288	44	-	-	-	-	-
Linguère Dahra	-	-	530	28.2	-	-	-	-
Diourbel /Bambey	452	487	670	27.1	35.8	19.1	2,324	3,210
Dakar	303	-	570	24.3	30.4	16.8	1,560	3,030
Kaolack/Nioro du Rip	542	680	915	28.0	39.3	15.4	2,484	2,981
Tambacounda	643	-	940	28.2	40.6	15.1	-	2,665
Vélingara	893	810	1,101	-	-	-	-	-
Sédhiou/Séfa	861	965	1,088	27.1	34.6	16.7	2,080	3,030
Ziguinchor	944	1,106	1,546	26.7	36.6	16.2	2,219	2,983

Table 9: Estimation of Agricultural and Non-Agricultural Lands
(000 ha)

Region	Total Area a	Classified Zones b	Area Under Cultivation c	Cultivable Area d	Utilization Rate (percent) c/d
Cap-Vert	55	6	7	8	87
Casamance	2,835	477	360	750	48
Diourbel	432	--	310	350	89
River	4,413	1,769	150	250	60
Louga	2,919	1,084	390	500	78
Sine-Saloum	2,874	341	860	1,150	75
Senegal-Oriental	5,960	2,331	150	350	43
Thiès	660	98	360	370	97
Totals	20,148	6,106	2,687	3,728	72

Risks of erosion from rainfall, especially serious in areas where ground cover is lacking, are also important in the well-watered southern regions. By way of illustration, it should be noted that replacement of ground cover in this zone results in runoff index readings of from one to 16.5 on fallow land, 21 on cultivated land, and 39.5 on bare soil.

Wind erosion risks are most prevalent in the northern and central regions of the country, because of the native wind patterns, heavy soil textures, lack of ground cover, extensive crop raising operations and overgrazing by livestock. The problem has been aggravated by increasing population pressures, with accompanying needs to clear new land for cultivation, cut wood for energy needs, and establish forage areas and, above all, by the cycles of dry years.

The Quaternary soils of the coastal area, which are subjected to successive flooding and draining away of seawater, have deteriorated from excessive exposure to salt and from waterlogging. Development of these formations results in oxydation, which transforms them into "sulfate acid soils", unsuitable for vegetation of any kind in the absence of special precautions.

Chemical erosion of soils as a result of cultivation causes extensive acidification, with the risk of toxification by aluminum and magnesium elements. Destruction of the physical properties of the soils and disturbance of their moisture and thermic systems is encountered after destruction of the ground cover.

Figure 4 evaluates the actual rate of soil erosion in tons per ha annually, based on the most prevalent erosion process.

c. Appraisal of farming operations

Tables 10 and 11 provide precise data on the current use of land for crop raising and grazing purposes.

- Estimates of the possibilities for expanding the cultivated areas are based on the following criteria: cultivable land area available, quality of the soil, irrigation possibilities, present rate of erosion, and erosion risks; and

- Theoretical land use capacity (calculated from the map of farming and grazing potentials), use presently being made of the land, water availability (during the dry season) and possible agricultural by-products are all evaluated.

3. Land ownership

a. Farming systems

Almost all agricultural production in Senegal has rural and family origins. The "production unit" generally still in use is the carré, which combines the notions of family and farm.

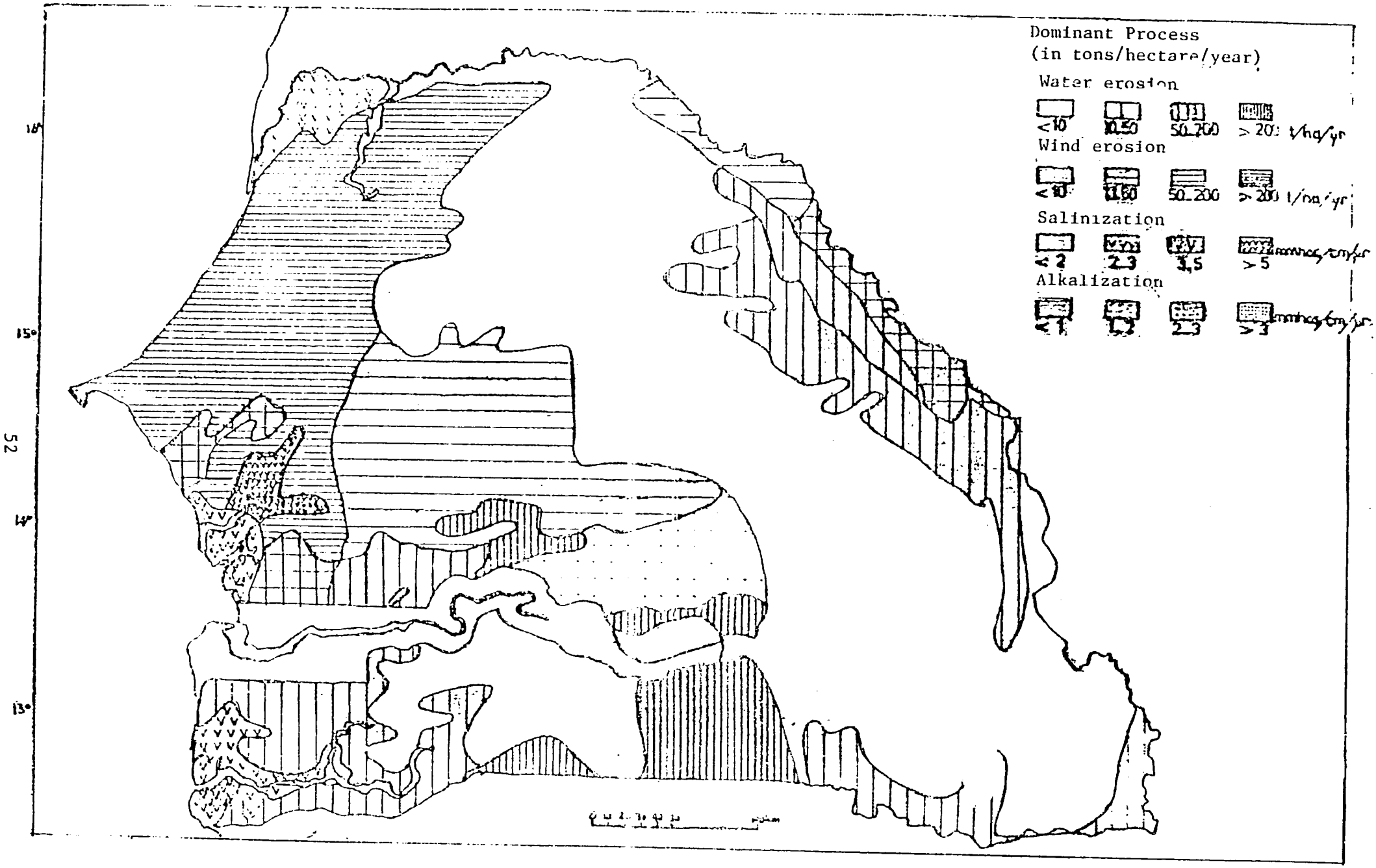


Figure 4 : Current Rate of Soil Erosion

Table 10: Principal Rainfed Crops, 1972-1978

Crop Season		Grains						Groundnuts			Cotton
		Total	Millet/ Sorghum	Paddy Rice	Maize	Cowpeas	Cassava	Total	Oil	In Shell	
1972/73	S[a]	1,022	936	42	32	86	41	1,087	1,071	15	20
	R[b]	-	344	741	625	233	3,695	540	532	1,104	1,145
	P[c]	380	322	31	20	11	150	597	570	17	23
1973/74	S	1,207	1,103	57	35	53	29	1,043	1,025	18	28
	R	-	463	972	963	288	4,206	645	641	892	169
	P	619	510	56	34	15	120	674	657	17	33
1974/75	S	1,279	1,145	76	49	59	33	1,074	1,052	22	38
	R	-	699	1,360	889	375	3,628	932	932	907	1,020
	P	964	800	103	43	22	121	1,001	981	20	41
1975/76	S	1,108	965	83	50	62	28	1,336	1,312	25	39
	R	-	639	1,411	886	396	3,879	1,091	331	955	180
	P	791	616	118	44	24	109	1,456	1,434	24	41
1976/77	S	1,086	949	78	49	63	25	1,312	1,295	17	44
	R	-	535	1,318	894	254	2,660	914	916	743	1,031
	P	676	507	103	43	16	68	1,199	1,186	13	45
1977/78	S	1,060	943	56	54	57	19	1,185	1,161	24	47
	R	-	446	822	617	205	3,971	438	438	471	789
	P	516	420	46	33	12	75	519	508	11	37

[a] S = Area (000 ha)

[b] R = Yield (kg/ha)

[c] P = Production (000 tons)

Table 11: Relative Importance of Crop Products and Crop Systems

Crops		Irrigated Crops	Rainfed Crops	Total
Millet and Sorghum	A[a]	--	1,100	1,100
	P[b]	--	600	600
Cowpeas	A	--	50	50
	P	--	20	20
Maize	A	2	70	70
	P	5	80	80
Rice	A	10	63	73
	P	35	72	103
Groundnut	A	--	1,050	1,050
	P	--	900	900
Cotton	A	--	30	30
	P	--	30	30
Tomatoes	A	2	--	2
	P	30	--	30
Sugarcane	A	10	--	10
	P	60	--	60
Market Gardening	A	6	--	6
	P	90	--	90

[a] Area (000 ha)

[b] Production (000 tons)

The carré is a complex social cell which most of the time includes the agricultural production sub-units, the number and nature of which vary according to the ethnic group involved, and according to the number and social status of its members. The chief of the carré is always the oldest male. The sub-units often have their own specific objectives and constraints. The average size and characteristics of the farming operations vary greatly from one region to another (with ecology, demography, and ethnic group) and even within the same region.

Crop raising procedures have some points in common. Except in irrigated zones or in areas alongside rivers, three types of fields are generally laid out in concentric circles around the dwellings: irrigated fields (vegetables, fast growing cereals such as maize), old cleared lands (groundnuts, cereal grains), and new cleared land (slow growing cereals, groundnuts). Work and spatial organization are therefore complex.

b. Land ownership structures

Land ownership structures are based largely on old customs. While differing from one ethnic group to another, the inalienable right to the land was an essential point in common. Various degrees of land rights, and several inheritance systems (matrilineal, equal rights of sons, etc.) exist. This system evolved greatly in colonial times, and even more so since independence, for numerous reasons: demography, monetization of the economy and, above all, the National Land Act.

4. Principal crops

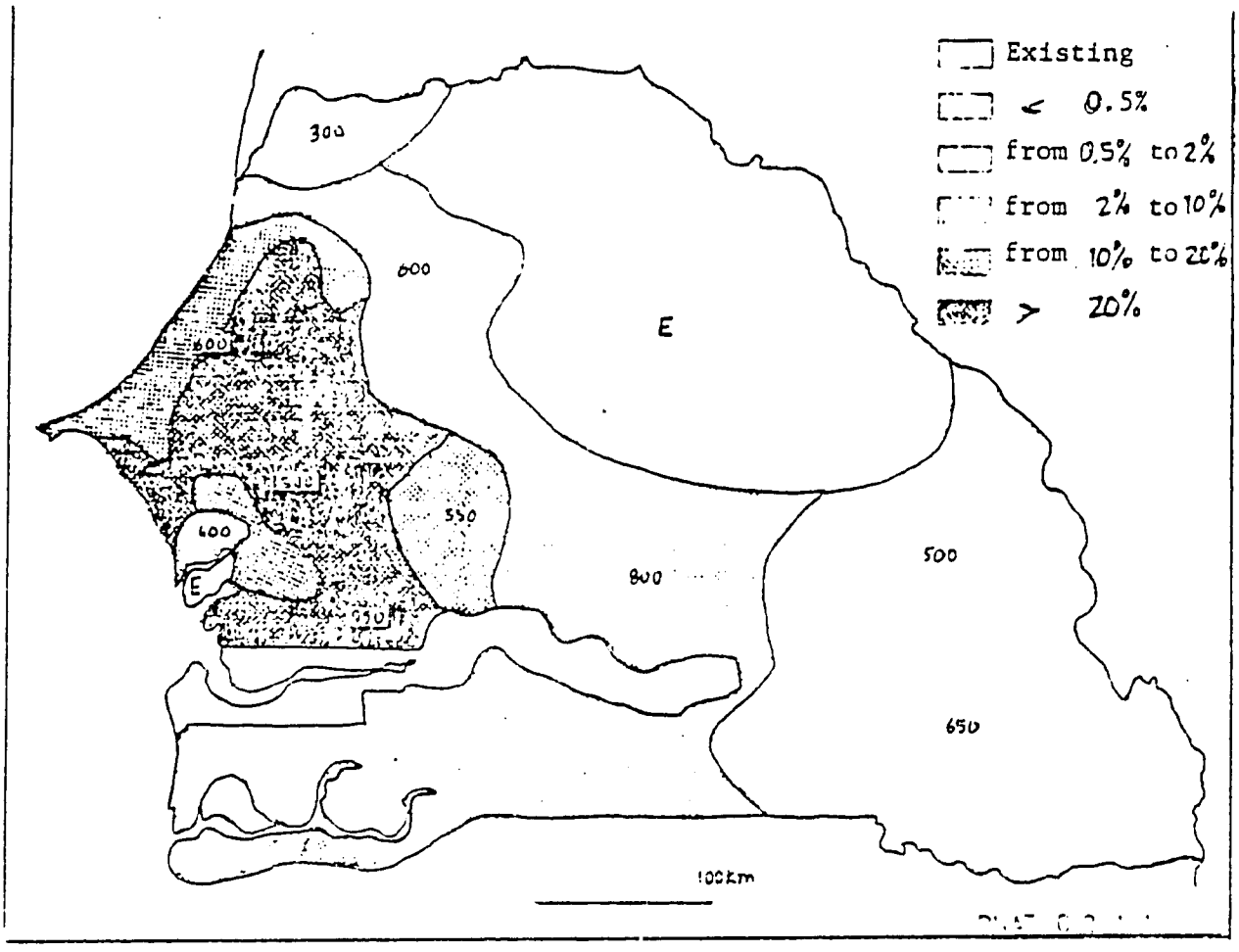
General information on the production of rainfed crops and the areas devoted to growing the various crops is outlined below and in Tables 10 and 11, and Figures 4,5,6,7,8,9,10,11, and 12.

a. Groundnuts

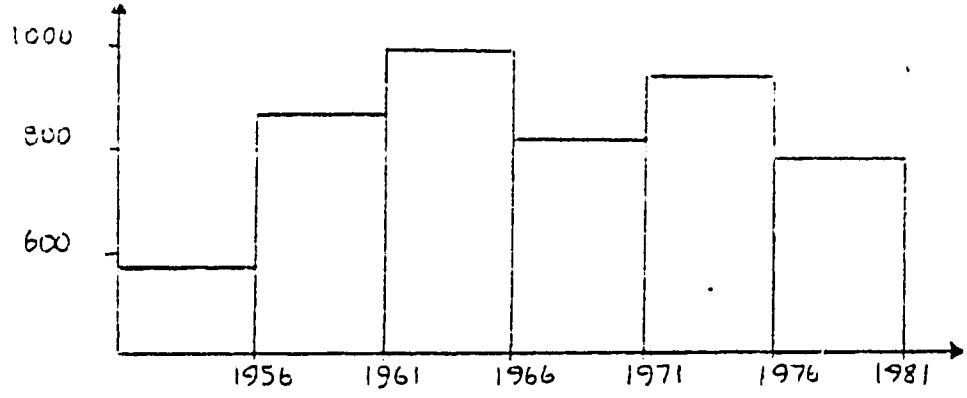
The importance of groundnuts to the economy of Senegal is well known. They provide the only assured income for three-quarters of the country's farmers, half the export revenues, 40 percent of the state's budget, and occupy one-half the cultivated lands. Planted initially in the sandy soils in the cental part of the country, they spread steadily to the similarly sandy soils in the north, then throughout the entire country. (See Figure 5.)

Deviation from average levels are more pronounced for rain-fed crops (because of climatic variations) than for irrigated crops. Irrigated crops, however, have also had less regular levels than hoped for, as a result of such difficulties as delays in the beginning irrigation service, accidents, and improper grading of land.

Production reached its highest point of almost a million tons annually in the 1960s, and then dropped off to an average of 780,000



Development of groundnut production from 1951 to 1981, 5-year averages, in tons.



Development of groundnut yields from 1951 to 1981, 5-year averages, in kg/ha.

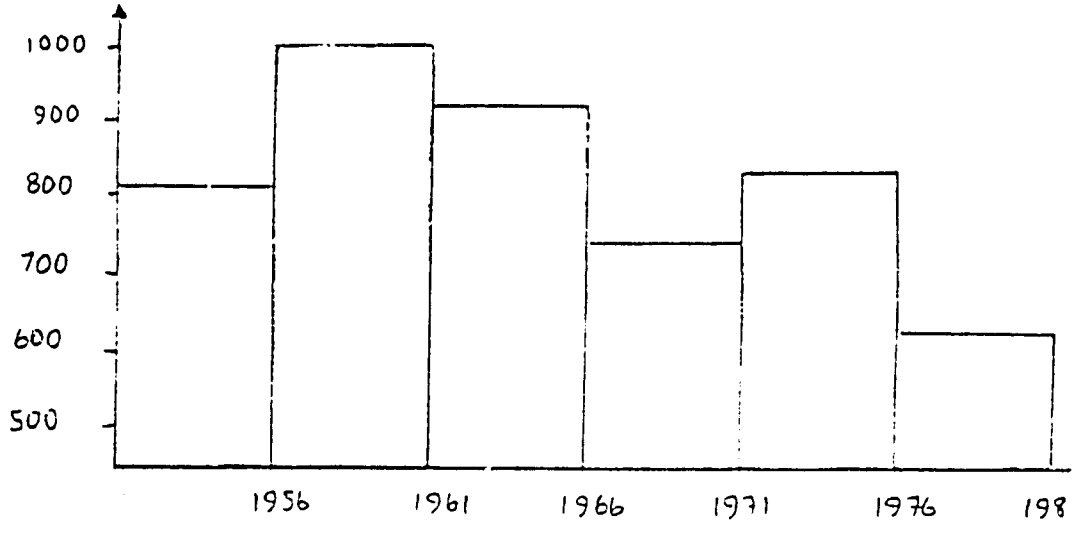


Figure 5: Distribution of Groundnut Production: Approximate Area Under Cultivation (kg)

tons a year between 1976 and 1982 (the 1983 crop is estimated at 500,000 tons). This decrease was accompanied by a slight increase in total area farmed. Although directly a result of indadequate rainfall, this decline is fundamentally the result of irrational use of the naturally poor and fragile soil, which has resulted in an almost irreversible pattern of erosion.

b. Millet and sorghum

In good years and bad years alike, sorghum and millet fields cover some 1,000,0000 hectares, 850,000 of which are devoted to millet, especially the fast-growing Souna variety. Production usually totals some 600,000 tons. Despite the drought, it has continued to increase since the 1950s, rising especially rapidly since independence. This increased production is essentially due to the larger areas being cultivated, rather than to increased yields, which run around 530 kg per ha. It is difficult to interpret the year-to-year changes of these yields, because of a number of factors (climatic, socioeconomic, etc.) can mask the variations in yield due to circumstances beyond the control of farmers. (See Figure 6.)

c. Cotton

Almost unknown before 1961, production reached 47,500 tons in 1982, with an average yield of 1.1 tons per hectare (one of the best in the sub-region). Since 1967, domestic needs have been met by production and Senegal has become an exporter. Climatically, the zones best suited for growing cotton lie between the 900 and 1,100 mm isohyets (Senegal-Oriental, Upper Casamance, and South Sine-Saloum). An analysis of the production record shows a slump between 1977 and 1980 due to several factors, the most significant being the drop in world cotton prices, increased costs of inputs, and a qualitative drop in management skills.

d. Rice

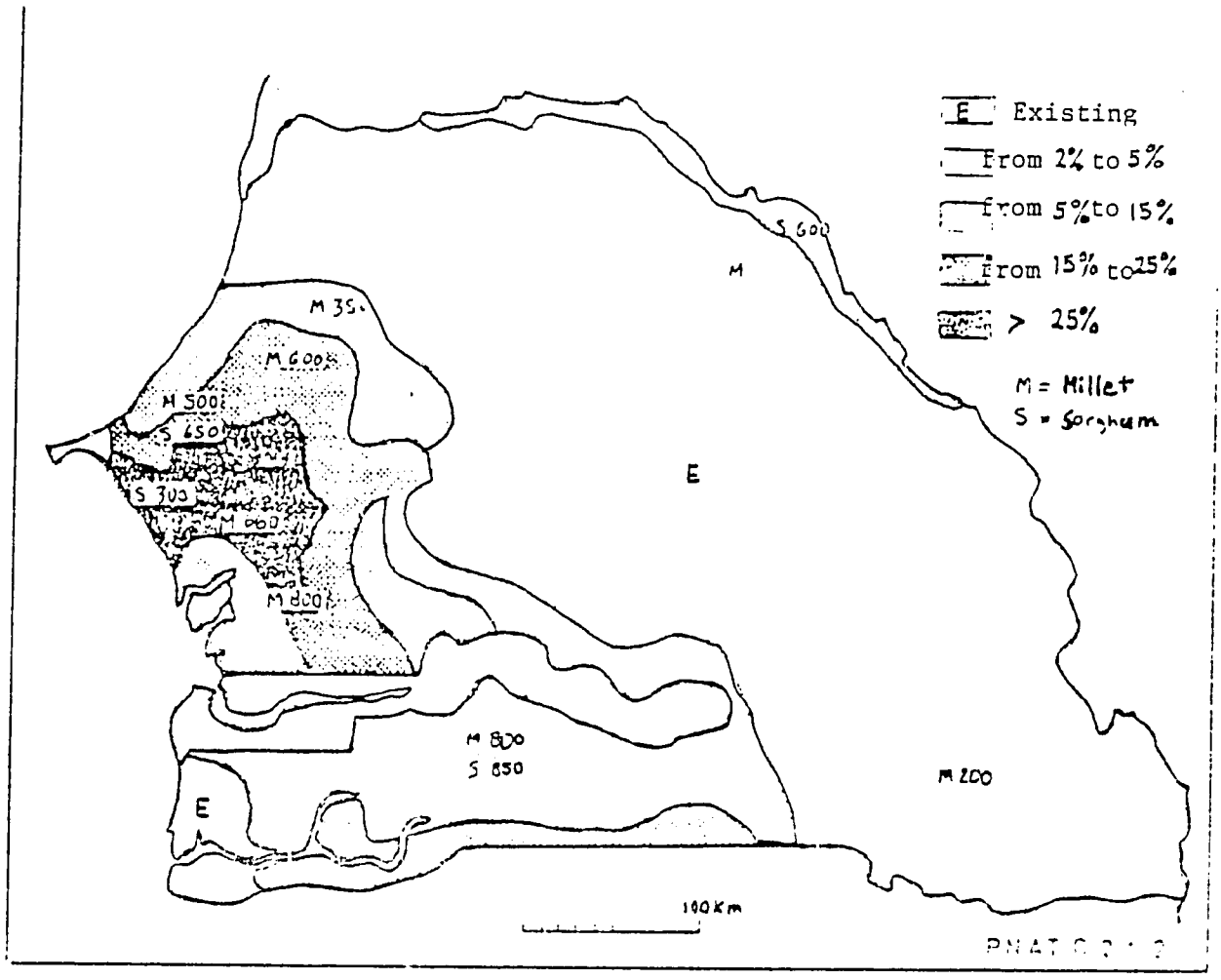
About 100,000 tons of paddy are produced annually in Senegal. Since domestic consumption totals 340,000 tons, 20,000 tons must be imported every month. Average yield does not exceed 1.3 tons per hectare in any region. Two very dissimilar agro-ecological regions must be considered for this crop. (See Figure 8.)

(1) Senegal River Valley

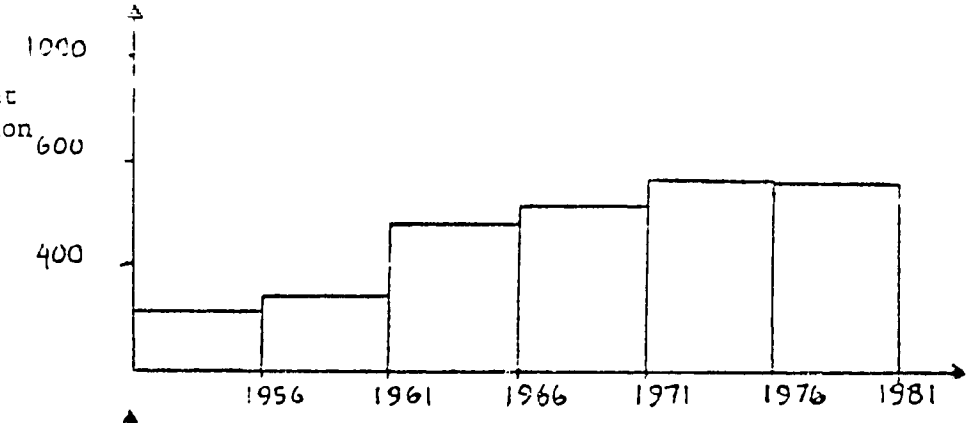
Rice cultivation was introduced here only recently, under a complete water control system. Three growing seasons can be used: winter (which represents 80 percent of production), the cold, dry off-season, and the warm, dry off-season.

Two types of farming operations also occur:

- Major farming zones, under SAED administration and field management, cover 90 percent of developed land in the delta. A yield of at least 2.2 tons per hectare is necessary to



Development of millet and sorghum production from 1951 to 1981, 5-year averages, in tons.



Development of millet and sorghum yields from 1951 to 1981, 5-year averages, in kg/ha.

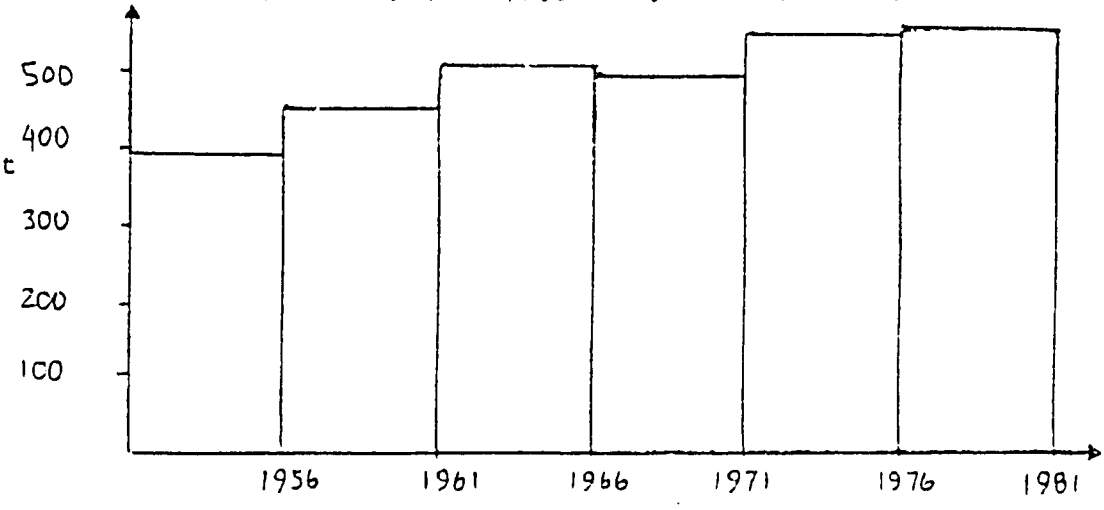
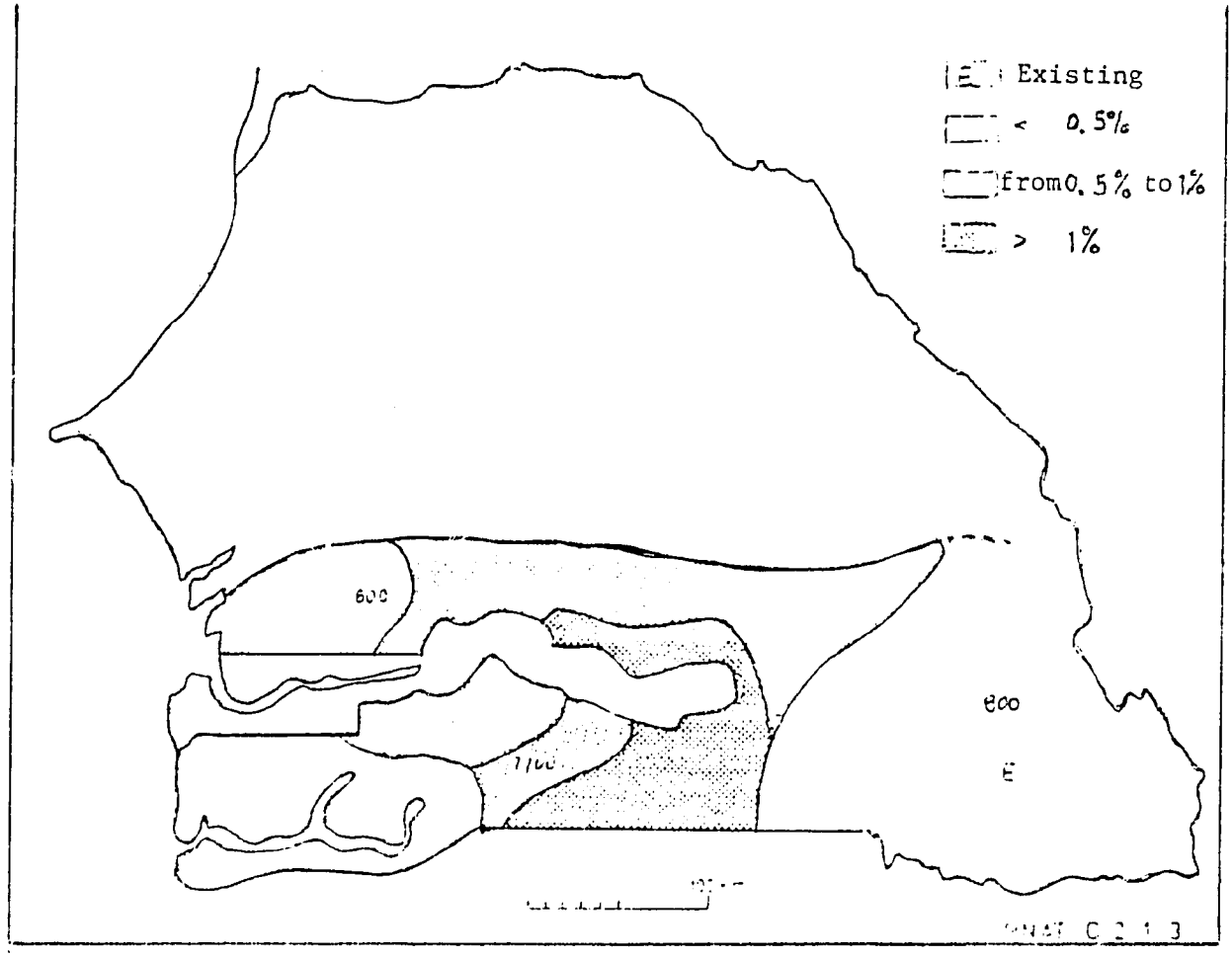
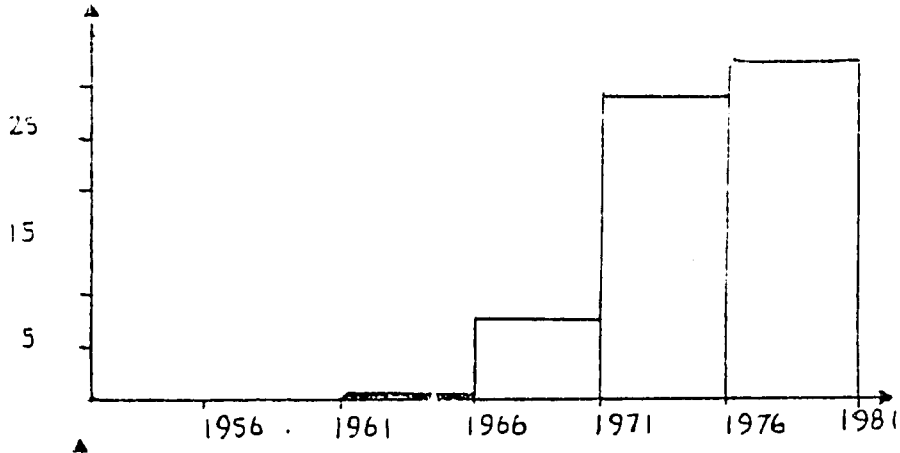


Figure 6: Distribution of Millet and Sorghum Production: Approximate Area Under Cultivation (kg)



Development of cotton production from 1956 to 1981, 5-year average, in tons.



Development of cotton yields from 1951 to 1981, 5-year averages, in kg/ha.

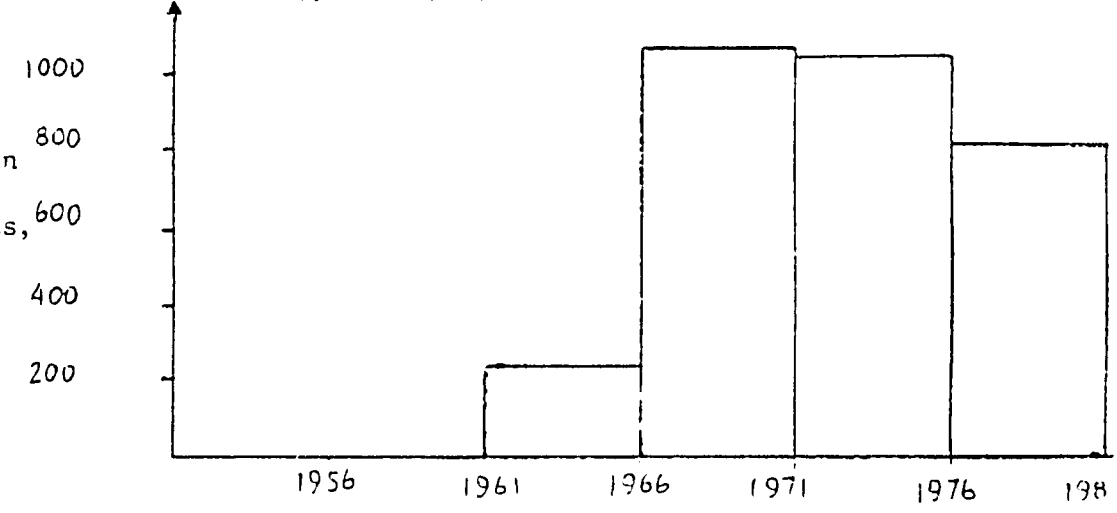
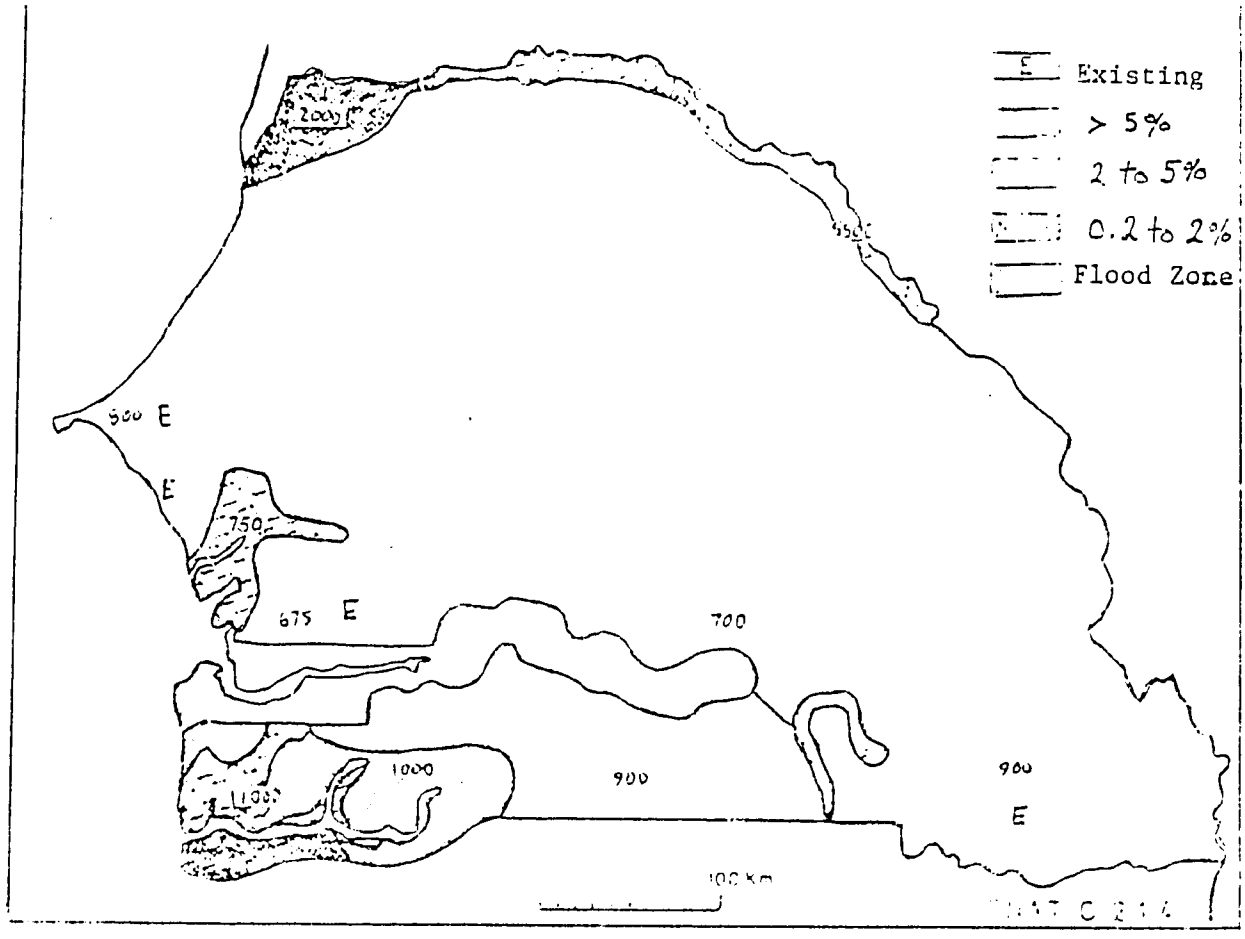
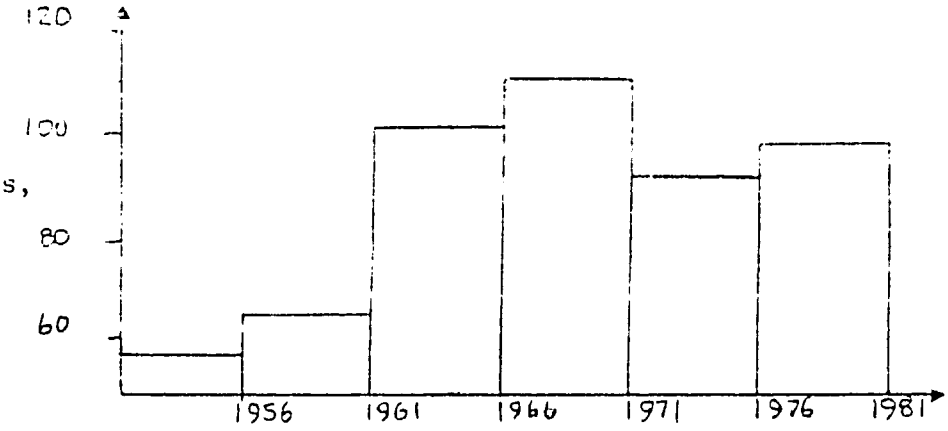


Figure 7 : Distribution of Cotton Production: Approximate Area Under Cultivation (kg)



Development of rice production from 1951 to 1981, 5-year averages, in tons.



Development of rice yields from 1951 to 1981, 5-year averages, in kg/ha.

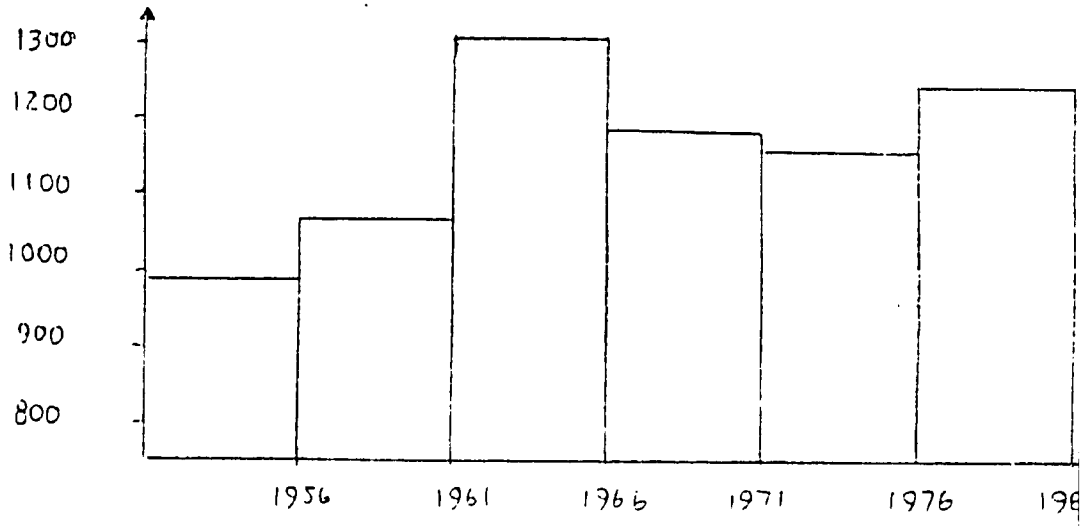


Figure 8: Distribution of Rice Production: Approximate Area Under Cultivation (kg)

cover operating costs alone. By regularly improving techniques, it is hoped that objectives can be reached; and

- Small farming zones, also under SAED administration, but managed directly by the farmers themselves. Operating costs are lower (less mechanization), but there are still some crop management problems, including growing cycles and soils. Nonetheless, average yields of four to five tons per ha are being attained, and this zone's contribution to national production is steadily increasing.

(2) Casamance and Senegal-Oriental

Rice is grown here by traditional techniques perfected over the years, but production is dependent on climatic conditions and limited by lack of fertilizer and proper water control. Eighty percent of the production occurs in the departments of Bibnona, Oussoye and Sédhiou in Casamance. Most of the Senegal-Oriental production comes from the Kédougou and Bakel departments.

Three types of rice cultivation are found:

- Strictly rainfed cultivation, most common in the central section;
- Rainfed cultivation, assisted by underground water resources (grey soils, Anambé basin); and
- Paddy rice cultivation, with or without water control, submerged or irrigated, by fresh or salt water.

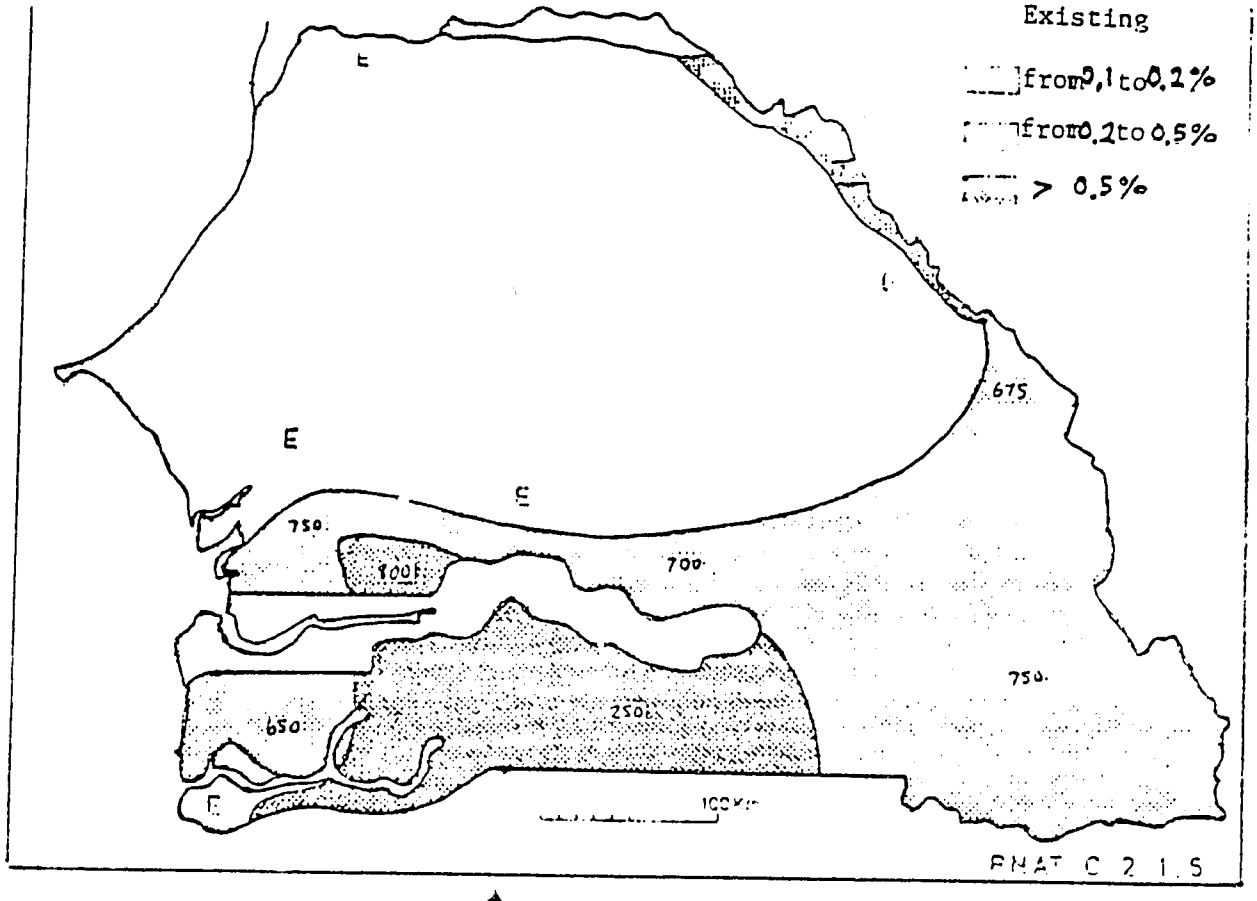
In a year of normal weather, the meridional zone produces 75 percent of Senegalese rice, and the River region 25 percent. In a poor crop year such as 1983, the northern zone's share can exceed 50 percent.

e. Maize

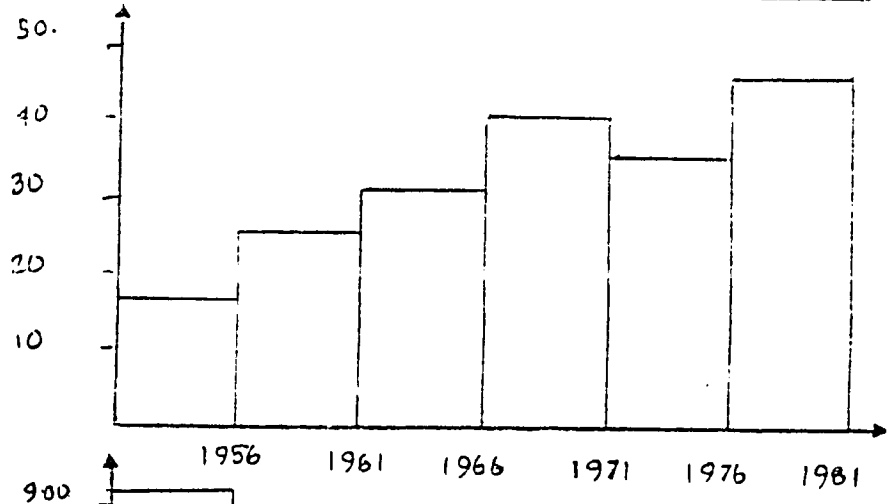
This crop is grown mainly south of the 800 mm isohyet, especially in Middle and Upper Casamance and in Senegal-Oriental (Kédougou, South Tambacounda, and Bakel). These two regions alone produced over 75 percent of the average annual crop of 43,000 tons from 1979 to 1982. Areas under cultivation have increased from just 50,000 to 70,000 ha in the past ten years (with production rising proportionally) since yields are not so dependent on rainfall variations. (See Figure 9.)

f. Cowpeas

Because of their very high nutritional value, short growing cycle and hardiness, cowpeas are an important dietary supplement. Annual production is static, about 17,000 tons, with the regional shares as follows: Louga, 55 percent; Thiès, 18 percent; River, 18 percent; Casamance, seven percent; and the remainder in



Development of maize production from 1951 to 1981, 5-year averages, in tons.



Development of maize yields from 1951 to 1981, 5-year averages, in kg/ha.

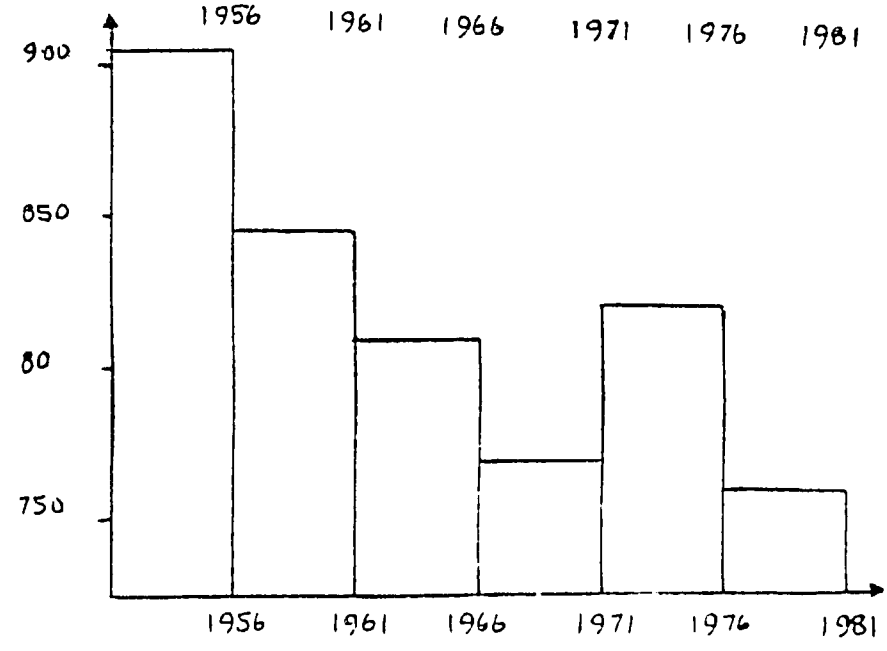


Figure 9: Distribution of Maize Production: Approximate Area Under Cultivation (kg)

Diourbel. The most productive growing area is the northern part of the groundnut basin. Extremely low yields (averaging less than 300 kg per year) are in part due to growing conditions and to insect infestation. (See Figure 10.)

g. Cassava

Statistics on the cassava crop (production, area cultivated, and yields) are generally not too reliable. One thing is certain, however--crop yields have been dropping ever since the cassava cochineal insects invaded the northern producing zones at the beginning of the 1970s. Production averaged around 50,000 tons annually between 1976 and 1981, compared with 200,000 tons a year between 1966 and 1971. Casamance is currently the best producing zone. (See Figure 11.)

h. Horticultural products

The drought and lack of organization in the market gardening sector have been responsible for an almost permanent shortage of produce. This has resulted in higher prices on the domestic market, where demand exceeds supply. Per capita consumption, although still relatively high, shows a declining trend. (See Table 12.)

The reorganization of this sector currently underway should allow 1984-85 production to return to 100,000 tons, with 10,000 tons available for export.

Production zones are defined in terms of market destinations. Crops for export are localized in the Cap-Vert region and along the coastal fringe, while production in other regions is used to satisfy local needs.

Industrial demand for tomatoes runs at 9,000 tons annually with little more than one-third produced in the country. Even though ecological conditions are favorable, this crop's market performance is poor, because of price and distribution network factors.

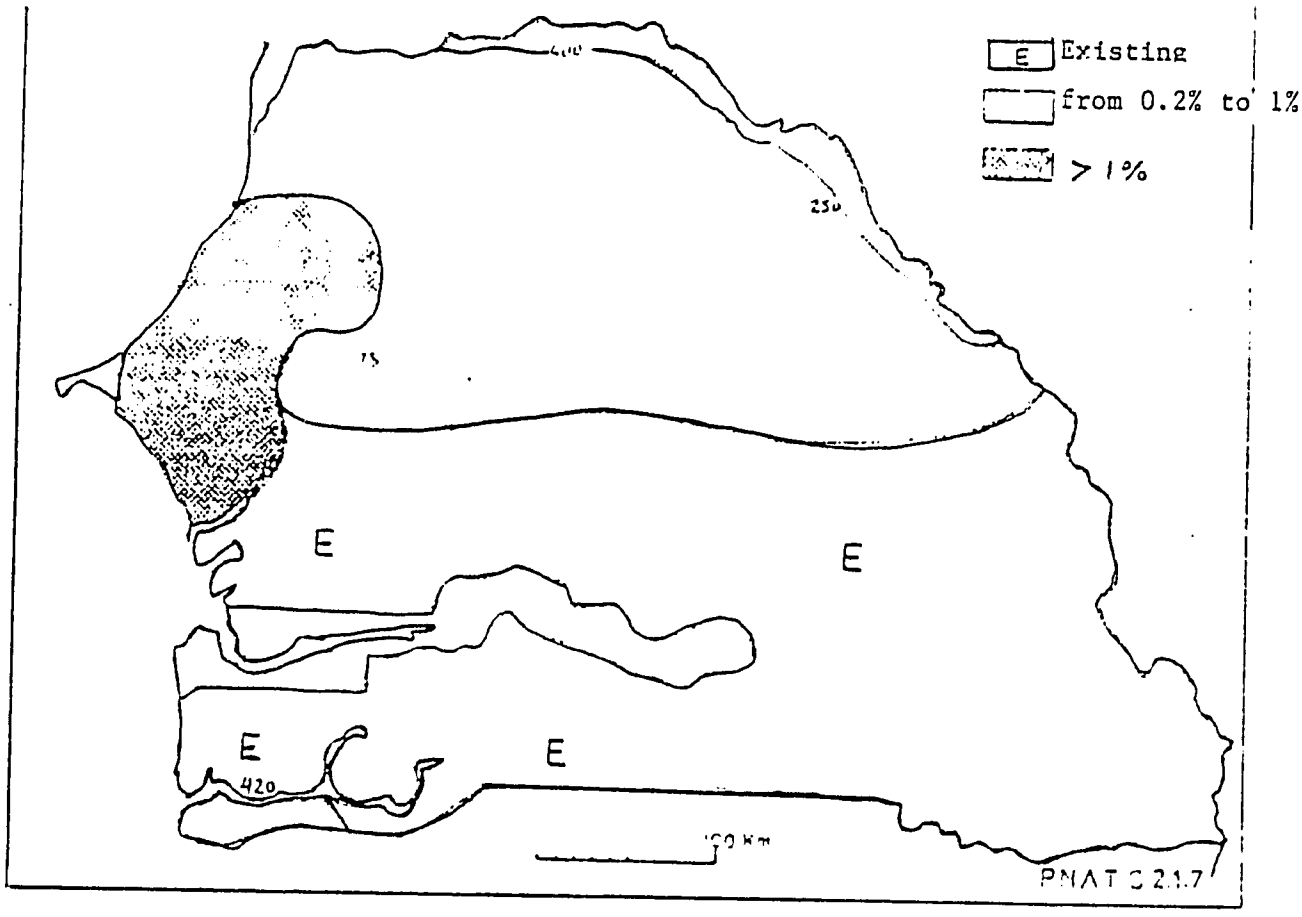
i. Sugar

With production of more than 50,000 tons in 1981, Senegal filled 65 percent of its estimated domestic needs of 80,000 tons. Recent progress, in the form of increased yields and better extraction rates, suggests that the country can completely satisfy domestic demand over the medium term.

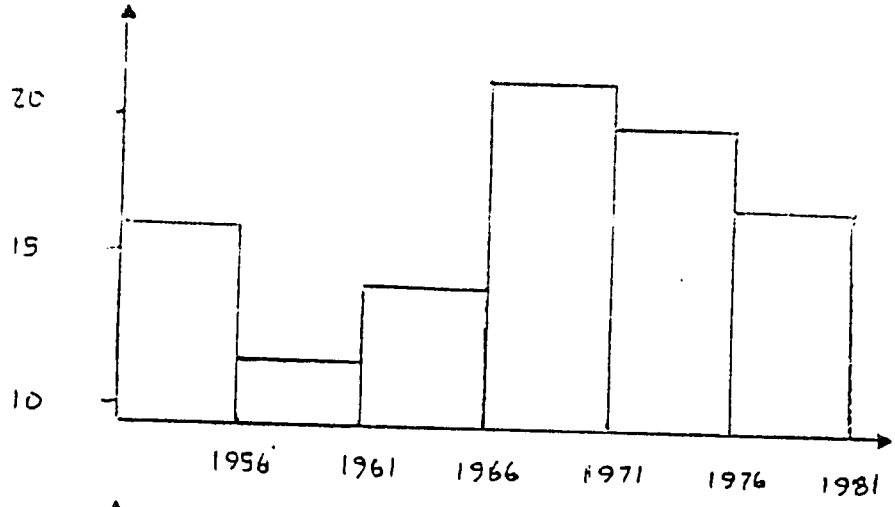
5. Principal animal products

a. Meat products

National production covers only 75 percent of domestic needs. In 1980, production of meat and offal from all species was



Development of cowpeas production from 1951 to 1981, 5-year averages, in tons.



Development of cowpeas yields from 1951 to 1981, 5-year averages, in kg/ha.

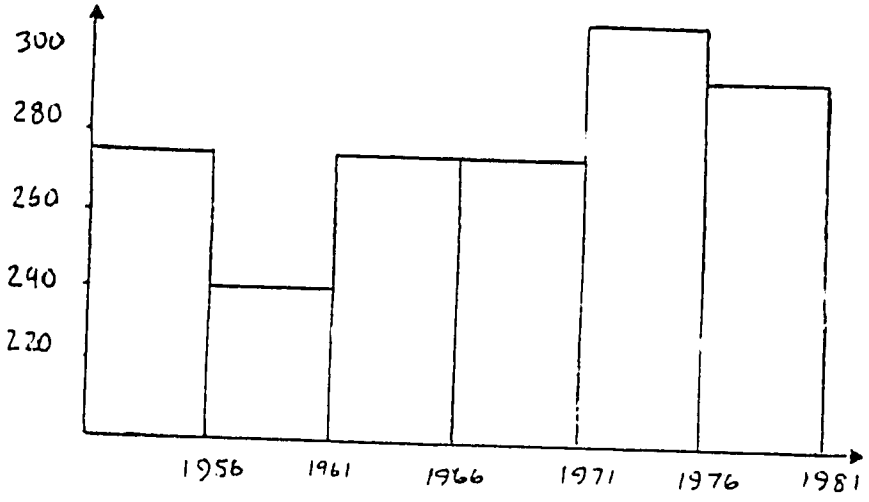
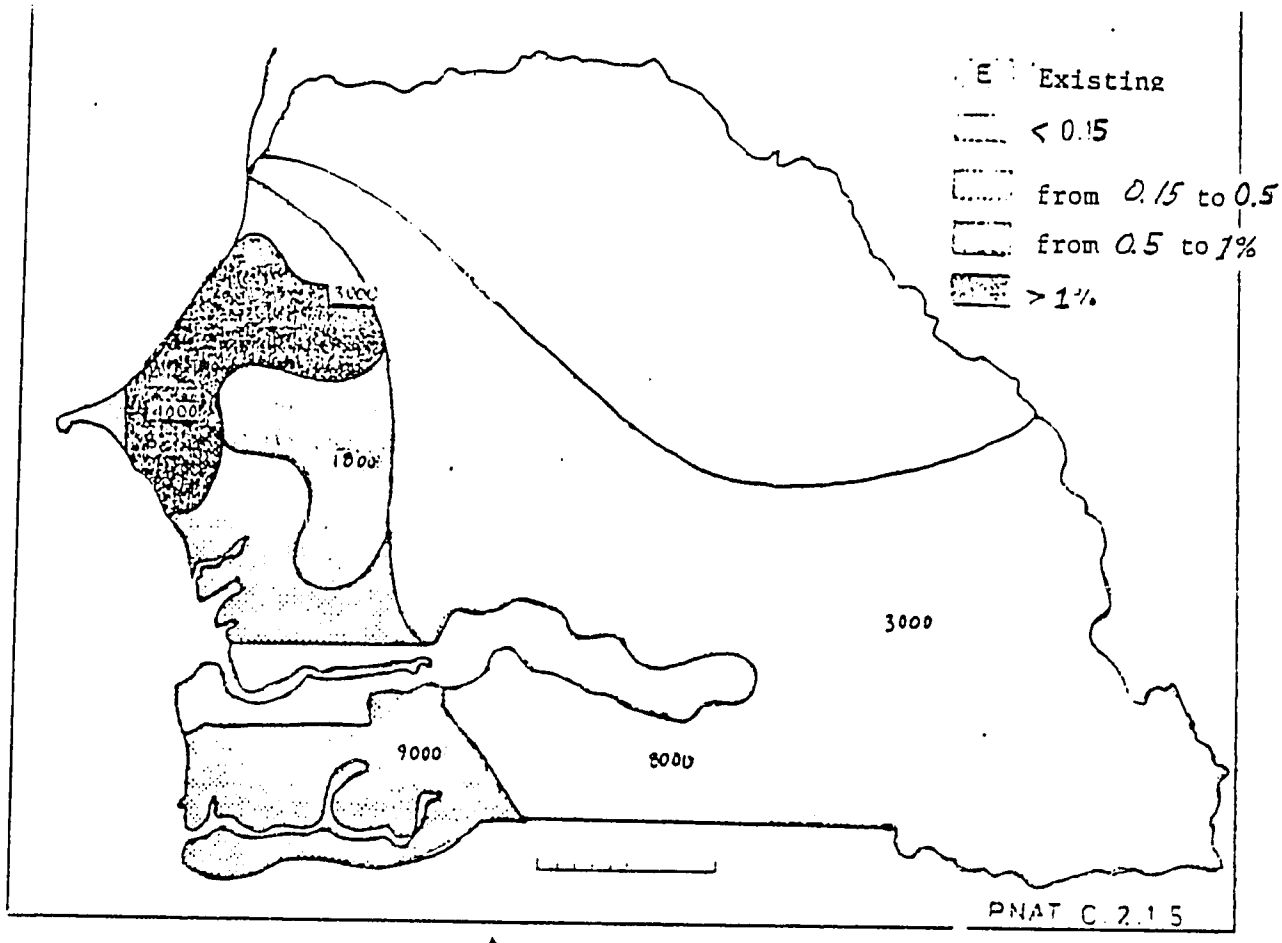
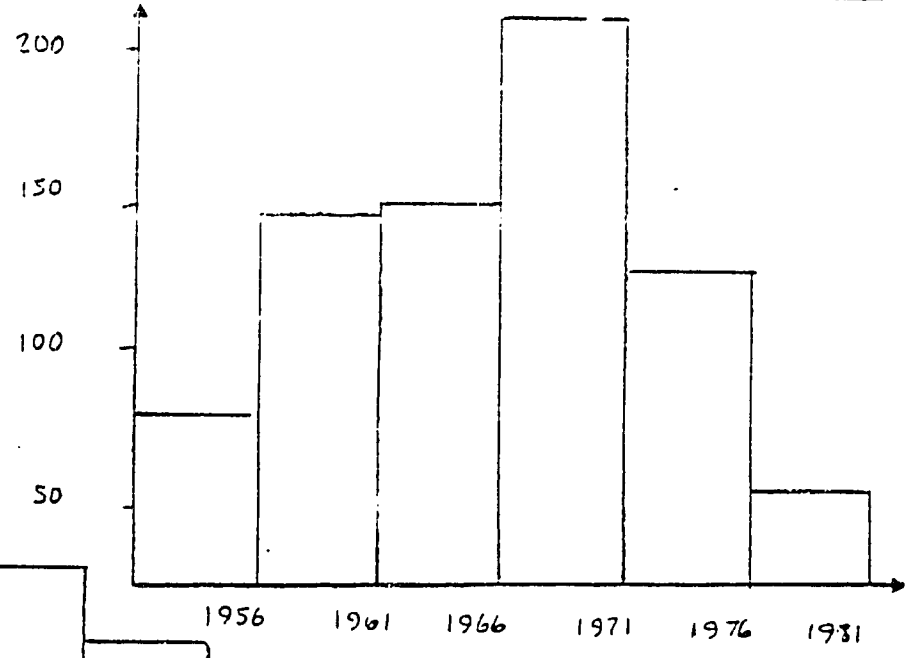
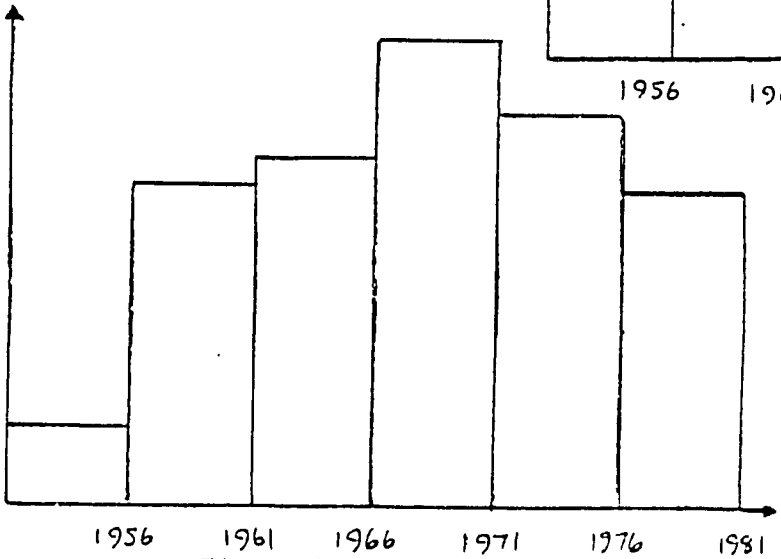


Figure 10: Distribution of Cowpeas Production: Approximate Area Under Cultivation (kg)





Development of cassava production from 1951 to 1981, 5-year averages, in tons.



Development of cassava yields from 1951 to 1981, 5-year averages, in kg/ha.

Figure 11: Distribution of Cassava Production: Approximate Area Under Cultivation (ha)

Table 12: Market Garden Sector

	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80
Area Farmed (ha)	5,380	7,092	6,690	6,940	6,310	5,875
Production (t)	85,500	102,700	103,400	102,250	85,400	81,500
Imports, total (t)	23,710	27,700	21,800	20,500	28,000	--
Potato imports (t)	12,550	14,850	8,520	9,650	12,040	--
Onion imports (t)	10,000	11,640	8,750	9,740	14,630	--
Exports (t)	6,520	10,250	8,940	9,145	5,560	4,300
Consumption Per Capita (kg)	24	23.6	21.9	21.2	19.6	--

about 69,000 tons, for a per capita consumption of 12 kg. (See Table 13.) Cattle provided 50 percent of this production; small ruminants (sheep and goats), 18 percent; poultry, 12 percent; and horses, 11 percent.

Total meat supply was equivalent to 85 calories or 6 grams of protein per capita per day.

b. Other products

(1) Milk

National production is very low (9.5 million litres), since local dairy cattle breeds produce only three or four litres per day at the most. When annual imports of 6.0 million litres are added, per capita consumption comes to 25 litres. The cost/price ratio for this product is 0.9 and the unit price, nearly FCFA 100.

(2) Honey and beeswax

In 1980-81, producers harvested 35 tons of honey and three tons of beeswax.

(3) Eggs

Annual production is about 6,000 tons, for a consumption rate of 16 eggs per capita.

(4) Leather and hides

Production is about 1,200 tons of cowhides, 115 tons of sheepskins, and 165 tons of goathides.

6. Forest products

In a country like Senegal, where the climate has both Sahelian and Sudanian components, where there is a seacoast and a large river on its northern border, and where the forests are faced with critical problems in the form of desert encroachment and energy needs, the national objectives must be to:

- Fight the desert encroachment, with the major objective of re-establishing a new balance of vegetation in the great forest areas; and
- Satisfy the population's energy and lumber needs.

These objectives and orientations make it difficult to evaluate the economic contribution of the forestry sector.

Nevertheless, 1980 revenues from forestry operations were estimated at FCFA 10.7 billion, of which 57 percent came from sales of firewood, 21 percent from charcoal, 11 percent from lumber and building materials, and the remaining 11 percent from the gathering of

Table 13: Estimated National Production in 1980/1981

Species	Average Growth (percent)	Number of Animals 1980/81 (000)	Animals Marketed (percent)	Carcass Weight Per Animal (kg)	Total Carcass Weight (MT)	Value (FCFA/kg)	Consumption (kg/capita)
Cattle	0.9	2,235	11	132	40,600	250	7.1
Sheep/Goats	1.7	3,170	26	13	12,200	320	2.1
Hogs	2.0	180	75	50	7,800	160	1.3
Horses	0.9	200	0.1	136	34	--	0.01
Poultry	6.0	8,000	100	1	8,000	500	1.5
Total					68,634		12.0

leftover forestry products. During the first two decades of the post-independence period, the forestry sector contributed 2 percent of the GDP and 7.6 percent, on the average, to the primary sector in value added.

7. Fisheries products

a. Ocean fisheries

Overall output of ocean fisheries in 1981 and 1982 is shown in Table 14.

This sector has maintained a spectacular rate of growth since 1980.

Despite constraints imposed by the rapid transformation it has had to undergo, the traditional small fisheries sector accounted for 60 percent of national production and by itself provided 15 percent of Senegalese jobs. The fleets are now more than 75 percent motorized.

The modern, industrial fishery sector operates in deep-sea waters far off the coast. Progress has recently been made among all fishing fleets except sailboats.

Statistics for foreign fishing fleets operating in Senegalese waters and not based in Dakar show a total catch of 20,500 tons in 1981, compared with a preliminary figure of 15,000 tons in 1982.

b. Inland fisheries

The past decade has been a difficult period because of the drought cycles, which have reduced river flows and damaged spawning grounds. Production dropped from 25,000 tons in 1965 to an average of 11,000 tons annually between 1977 and 1980, representing a value of FCFA 500 million. The production objective under the Sixth Plan is a return to 25,000 tons annually.

8. Principal production systems

a. Crop production

About ten crop production systems have been identified in Senegal, the principal ones occurring in the following main ecological zones:

(1) Senegal River Valley

Irrigation systems available here make rice growing the main activity. Wheat, market garden and forage crops are other possibilities for production under irrigation. Cultivation of Walo crops (in the dry season) or rainfed crops of millet can also be considered, either in association with the main crop, or separately.

Table 14: Data on Ocean Fishing, 1981 and 1982

Type of Fishing		Modern Fishing				Small-scale Fishing
Boat Types		Trawlers	Sardine Boats	Tuna Boats	Ropers	Canoes
Number of Boats	1982	144	21	29	12	4,526
	1981	135	15	30	22	4,350
Number of Catches	1982	3,120	3,254	386	282	-
	1981	3,031	2,827	341	398	-
Catch (tons)	1982	49,754	31,786	12,349	888	144,907
	1981	49,058	31,363	10,367	1,249	135,689
Value of Catch (millions FCFA)	1982	8,673	1,362	3,754	231	28,951
	1981	7,180	992	2,992	236	19,237

(2) Groundnut Basin

Systems here are based almost exclusively on rainfed crops, which are integrated with animal production. The most significant variants are:

- o A traditional system based on crop rotation (souna/millet/groundnuts) in the Louga-Linguère triangle;
- o A more intensive system using millet/groundnuts and chemical fertilizers, in the southwest zone;
- o An intensive but more diversified system: millet and groundnuts as main crops, plus sorghum, maize, cotton, and rice in south Sine-Saloum; and
- o An extensive system in the pioneer zones: millet/peanuts/fallow period.

(3) Casamance and Senegal-Oriental

Mixed crop systems (rainfed and aquatic) are prevalent here.

- o A rainfed system, with the primary crops being millet, sorghum, maize, cotton, rice (rainfed and paddy) and groundnuts is used in Upper Casamance and Senegal-Oriental. The same system (but without cotton) is used frequently in Middle Casamance and the northern part of Lower Casamance; and
- o A system with swamp rice as the main crop, and including millet and groundnuts, on the plateau.

b. Animal production

Fourteen systems based on traditional livestock raising methods have been defined. They can by summarized as follows:

- o Systems based exclusively or predominantly on transhumance livestock raising--an extensive system by Peulh tribal herds of North and Central Ferlo and the River Region;
- o Systems of mixed production dominated by livestock raising, in the Delta, Ferlo Boundou, Fouladou, and Senegal-Oriental zones; and
- o Systems of mixed production, predominantly agricultural, in the Groundnut Basin and the Lower and Middle Casamance. The livestock raisers in these zones are most often Peulhs, who combine farming and livestock (for their own use and for sale to others).

The development strategy for the sector is aimed at progressive improvement of traditional livestock raising methods, rather than on creating a modern system. Emphasis will be placed mainly on feeding and on increasing milk production by the traditional herds.

9. Marketing systems

a. Groundnuts

On average, 60 percent of production in used by the oil processing plants to supply the export market for oil and oilcake. About 15 percent (25,000 tons) of the crop is purchased by the National Association for Rural Supply (SONAR--la Société nationale d'approvisionnement rural) to build its seed inventory. The balance is accounted for by loss and spoilage (35,000 tons), domestic consumption (80,000 tons), seed for growers' own use (60,000 tons) and, increasingly in recent years, to unofficial marketing (55,000 tons).

b. Cotton

Requirements for seeds, domestic consumption and unofficial market supplies remain marginal. Marketing is no problem, since the Fiber and Textile Development Association (SODEFITEX--Société pour le développement des fibres textiles) buys 100 percent of the total production. It sells to Senegalese cotton mills from 3,000 to 3,500 tons of cotton fiber, corresponding to 9,000 tons of raw cotton production. The balance is exported.

c. Rice

The most important factor for the rice marketing network is the home consumption in the producing zones. The only significant collection and marketing is done by SAED in the major zones which it administers (and which account for 20 percent of the region's production). SAED sells its milled rice through the intermediary of the Price Equalization and Stabilization Fund (CPSP--Caisse de péréquation et de stabilisation des prix).

d. Other cereal grains

Marketing of cereals by official network is virtually insignificant in Senegal, due principally to the absence of appropriate institutions and policies. The recently created Commission on Nutritional Assistance (CAA--Commissariat à l'aide alimentaire) should play the role of cereal marketing regulator. Important marketing possibilities could be opened up if efforts to establish industrial processing facilities for such local crops as millet, sorghum and maize are successful. (See Table 15.)

e. Other agricultural products

Other agricultural products, such as "secondary local" cereal grains, fruits and vegetables, are virtually excluded, with some exceptions, from the official marketing network.

Table 15: Yearly Crop Prices (FCFA/kg) and Percentage of Groundnuts, Millet/Sorghum, Maize, Paddy Rice and Cotton Production Marketed

	68/69	70 / 71	72/73	74/75	76/77	79/80	80/81	81/82
Groundnuts								
Oil	18	19.5	23	41.5	41.5	45.5	50	70
In Shell	29	29	28 (75)	51 (65)	51 (91)	54.5 (61)	54.5	80 (48)
Millet/Sorghum	20	17	17.5	30 (5)	35 (1)	40 (14)	40 (4)	50
Maize	18	18	19	35	37	37	37	47
Paddy Rice	21	21	21	41	41.5	41.5	41.5	51.5
Cotton	28	30	31	47	49	55 50	60 55	65 55

f. Overall policy effects on marketing

The overall policy followed until now has been limited to official price setting which does not always guarantee the producers income, regardless of the quantities they offer. This system creates many difficulties throughout the chain of collection, storage and marketing. These problems result from limited and late investment of the financial resources allocated, the complexity of administrative financing procedures, and the chaotic participation by different economic agents (cooperatives, large producers, and small merchants), whose access to bank credit is often nonexistent.

g. Animal products

Only the meat marketing system for cattle and sheep is genuinely organized, and it suffers from constraints at the live animal, slaughterhouse and fresh meat levels. The cooperative, along with private sector butchers and horsetraders operate in this marketing network alongside the official organizations: The Senegalese Animal Research and Development Association (SERAS--Société d'exploitation et de recherches animales du Sénégal), The Association for the Development of Livestock Raising in the Sylvo-Pastoral Zone (SODESP--La société pour le développement d'élevage de la zone sylvo-pastorale), and The Eastern Senegal Animal Husbandry Project (PDESO--Projet de développement d'élevage en Senegal-Oriental). Prices, which are set officially and are relatively well controlled at the beginning of the chain, become very high at the consumer level, especially in the case of mutton.

Another important factor is the delay in organizing the processing and cold storage networks, with the most serious consequences being the absence of proper hygiene at the end of the chain. Very high production costs for poultry products pose serious problems in the private poultry marketing systems.

Other production sectors (milk, honey, eggs, etc.) are hindered by the lack of marketing and price setting policies, both at the planning and execution stages.

h. Fisheries products

There are two separate networks in this sector:

(1) Sale for local consumption

After the catch is landed and turned over to the fisherman's wife or to the fish trader, it passes through the hands of several intermediaries from the wholesaler to the retailer (undergoing a 50 percent to 200 percent gross markup). This system penalizes the consumers. The Small Fisheries supply center (CAPAS--Centre d'approvisionnement pour la pêche artisanale) this market network by building fish storage and sales facilities. The ultimate objective is to control speculation and extend the marketing zones to the interior of the country.

(2) Sales to industries

These sales are private and well-organized and are made through two marketing networks:

- o The African network for the sale of croakers, sardines; and
- o The European network, for the sale of all high value products such as crustaceans, squid and fishmeal.

10. Production factors

An option to transfer complete responsibility for supplying production inputs (fertilizers and seeds) might benefit suppliers, regional development companies and cooperatives. Distribution of these inputs, however, is still in the hands of SONAR, the public corporation, because all the necessary conditions have not yet been met. (See Figure 12.)

a. Chemical fertilizers

Overall quantities of fertilizer increased from 1960 to 1979 despite large yearly fluctuations. They have, however, fallen off sharply since 1979, to 98,000 tons in 1980-81, 30,000 in 1981-82, and less than 10,000 tons in 1982-83. In 1980-81, distribution by crop sector was: groundnuts, 40 percent; sorghum, 29 percent; rice, 10 percent and cotton 6 percent.

Regional distribution favors the longest-established administrative zones of Diourbel, Sine-Saloum and Louga, although Casamance is now getting an increasing share.

The theoretical percentage of each crop's fertilizer needs covered in 1980-81 was groundnuts, 24 percent; millet/sorghum, 17 percent; rice, 88 percent; and cotton, 95 percent. However, this fertilizer is often poorly used (applied too late and in too small amounts) and supplies are often diverted to other crops. For example, groundnut fertilizer is often used for growing millet, which responds better to the formula.

Fertilizer price to the producer in 1980-81 was FCFA 21 for a real cost to the economy of FCFA 51 after subsidies (which totalled FCFA 3.2 billion).

b. Pesticides

Crop protection is handled essentially by the Directorate of Crop Protection (DPV, DGPA) which in 1981-82 treated some 80,000 hectares, or 3 to 4 percent of all seeded areas. Cotton is a special case, since spraying is obligatory and under the control of SODEFITEX. Millet/sorghum, groundnuts and cowpeas are protected by HCH, 35 and DECES. Cowpeas and rice are imperfectly protected. Statistics in this area are not available. Seed protection is carried out systematically by SONAR and for collective harvests by the CAA.

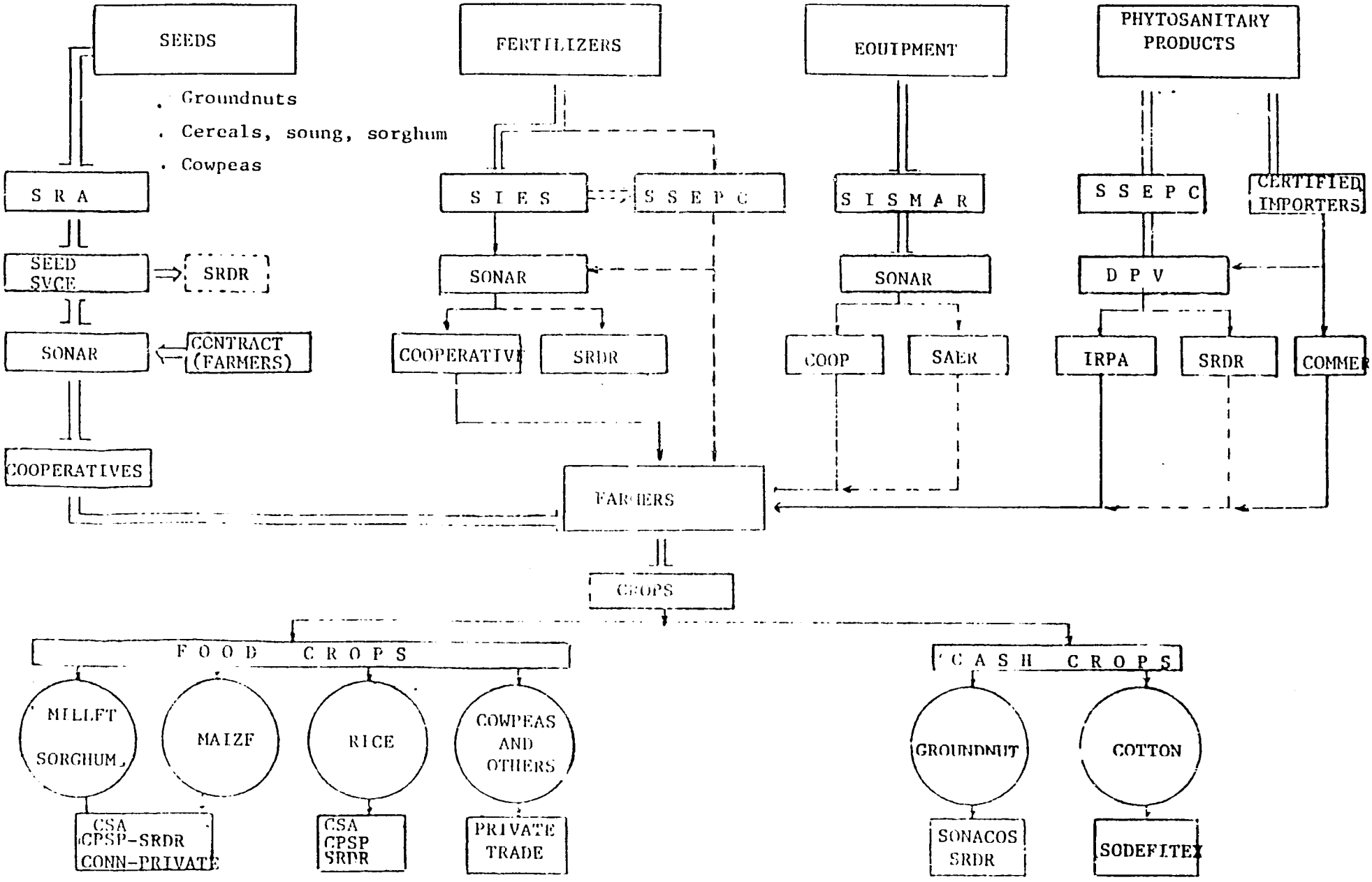


Figure 12: Interrelations of Various Agricultural Institutions Involved in the Agricultural Production Process

c. Seeds

Theoretically, seed production is organized as follows:

- The foundation seeds are produced by the Senegalese Institute for Agricultural Research (ISRA--Institut sénégalais de recherches agricoles);
- The state-run development companies are responsible for management of seed production by farmers;
- SONAR is responsible for management and distribution of the seed stocks, and has a buying monopoly; and
- The National Seed Service plans, coordinates and controls the entire operation.

Tables 16 and 17 summarize quantities distributed in recent years.

(1) Groundnut seeds

On the average, 125,000 tons per year were distributed between 1973 and 1982. Production and distribution encountered difficulties during the past three years, due in part to the slight rainfall. Peanut seeds for oil production were purchased in 1981-82 at a net price of 66.5 FCFA/kg at level one and 63.5 FCFA at level two.

(2) Food crop seeds

Quantities distributed cover only a small part of requirements for the total seeded areas in the country. The strong demand for seed rice is not satisfied; for millet/sorghum and maize, supply exceeds demand.

Prices prevailing in 1981-82 are shown in Table 18 (in FCFA/kg).

The difference between the transfer and resale price is made up by a subsidy from the Rural Mutual Development Fund (FMDR---Fonds mutualiste de développement rural).

d. Farm equipment

Only scattered and incomplete data are available. Statistics on areas farmed according to farming method are not available, nor is there any systematic inventory to evaluate how efficiently the equipment is used. Overall totals (in 000's of units) and value (in millions FCFA) of farm equipment; under the "Farm Program" in recent years are shown in Table 19.

Discontinuance of the farm equipment distribution program was one of the results of the dissolution of the National Office for Cooperation and Assistance in Development (ONCAD--Office national pour la

Table 16: Distribution of Groundnut Seeds

(000 tons)

Period	Cap-Vert	Casa-mance	Diour-bel	River	Louga	Senegal-Oriental	Sine-Saloum	Thiès	Total
1972/73	0.1	14.4	14.4	0.5	15.1	4.4	45.9	14.7	109.5
1973/74	0.2	13.3	16.1	0.5	16.3	4.7	61.0	16.1	128.2
1974/75	0.2	13.8	15.1	0.5	13.4	4.9	50.0	15.1	113.0
1975/76	0.2	15.9	22.0	0.5	19.0	5.3	55.5	16.7	135.1
1976/77	0.2	13.5	16.0	0.7	17.2	4.5	55.3	17.1	124.5
1977/78	0.1	13.3	18.9	0.8	18.7	5.5	55.1	14.1	126.5
1978/79	0.1	13.6	21.2	0.8	22.0	6.7	54.3	20.4	139.1
1979/80	0.3	14.0	20.6	0.8	21.2	6.6	44.4	20.0	127.9
1980/81	0.2	10.6	17.3	0.7	18.4	6.1	50.9	17.2	121.4

Table 17: Distribution of Various Seeds
(000 tons)

Period		Millet	Maize	Cowpeas	Sorghum	Rice
1973/74	D [a]	2.0	0.7	0.3	47	8.0
	C [b]	265	37	2	52	479
1974/75	D	12.2	0.7	1.2	7.5	20.5
	C	1403	14	5	103	829
1975/76	D	9.5	0.8	1.9	9.0	42.2
	C	948	47	34	53	1627
1976/77	D	8.7	2.2	3.3	2.0	20.5
	C	213	83	6	1	109
1977/78	D	11.6	1.4	1.4	3.5	20.3
	C	311	40	3.8	4.5	292
1978/79	D	11.3	3.5	5.3	0.3	25.3
	C	513.3	124.3	83.5	12.3	439
1979/80	D	6.3	16.7	5.7	0.8	67
	C	231.2	150	70.6	694.9	577.5
1980/81	D	0.1	5.7	2.5	1.4	55.7
	C	6.1	58.7	29.5	2.0	862.0

[a] D = Distribution (to reproducers).

[b] C = Collection (from reproducers).

Table 18: Seed Prices, 1981-1982
(FCFA/kg)

	Souna Millet	Sorghum	Hybrid Maize	Regular Maize	Cowpeas	Rice
Price Paid Producer	55	53	80	53	80	59.5
SONAR Resale Price	116	110	145	110	153	250
SRDR Transfer Price	70	65	100	65	70	--

Table 19: Overall Totals (000 of Units) and Value (millions FCFA) of Farm Equipment Under the "Farm Program"
(000 Units)

	Seeders	Hoes	Plows	Cultivators	Carts	Total Value	Subsidy	Credit
1974/75	14.5	18.5	4.2	6.4	5.6	814	123	691
1975/76	19.9	31.1	6.1	8.1	4.4	1,395	551	844
1976/77	30.3	35.6	6.2	21.0	19.4	2,710	-11	2,721
1977/78	24.8	42.1	7.1	14.5	18.5	2,765	75	2,690
1978/79	18.1	47.8	8.7	27.4	28.7	3334	275	3,062

coopération et l'assistance au développement) in August 1980. Except for the SODEFITEX management zone, there is an equipment shortage everywhere in the country, and the existing equipment is deteriorating. This machinery has not always been used or maintained properly.

11. Rural sector administration

In a general sense, rural development is controlled at the national level by several ministries or state secretariats. (See Table 20.)

- o Ministry of Rural Development and its various Branches or "Directorate": Directorate-General of Agricultural Production (DPGA--Direction générale de la production agricole), DPV, etc.
- o Ministry for Nature Protection (Water, Forests, Environment);
- o Ministry of Scientific and Technical Research;
- o Ministry of Waters and Irrigation; and
- o State Secretariat for Ocean Fisheries.

To these should be added the three ministries in charge of agricultural training institutions:

- o Ministry of Higher Education;
- o Ministry of National Education; and
- o State Secretariat for Professional Training.

a. Ministry of rural development

This ministry plays an important role in developing farm crops and animal production activities.

b. Directorate-General of Agricultural Production

The DGPA is directly responsible for certain farm production projects and programs (maize, fruits, seeds) and has authority over the regional rural development companies. Since August 1980, the cooperative movement has been managed by the Directorate of Cooperation. DGPA is represented in the different regions by the Farm Production Inspection Services.

c. The Directorate of Animal Health and Husbandry (DSPA--Direction de la santé et des productions animales

The national department in charge of animal health and production coordinates the various activities of the animal management companies (SODESP, PDESO) and organizes vaccination programs.

Table 20: Administrative and Management Structures for Rural Organizations

Level	General Administration	Agricultural Cooperation: Cooperative Structures	Agricultural Cooperation: -Assistance -Management -Control	Rural Development	Study and Agreement Components		
Country	Ministry of the Interior	National Union	-Ministry of Rural Development -Cooperation Management	-DGPA (Trusteeship) -Headquarters of Certain Organizations	Ministry of Social Development	--	--
Region	Governor	Regional Union	Regional Cooperation Controller		Operational Arrangement for Studies and Agreements (GOPEC)	Assistant Operational Agreement for the Elaboration of Projects	Regional Development Committee
Department	Chief Administrator	Departmental Union	--		--	--	Departmental Development Committee
Division	Assistant Chief Administrator	Local Union	Assistant to the Cooperative Foundation		Rural Polyvalent Expansion Centers (CERP)	--	Local Development Committee
Rural Community	President of Rural Community Council	Cooperative	--		--	--	--
Village	--	Village Section	--		--	--	--

REGIONAL DEVELOPMENT OR INTERVENTION ORGANIZATIONS (Appropriate Breakdown for Each Organization--Does Not Always Correspond With the Administrative Breakdown)

d. Development committee

These exist at the local, departmental and regional levels to facilitate consultations between administrations concerned. All projects are studied by two authorities: GOAEP, presided over by the regional governor, and the Operational Group for Studies and Coordination, which is run by the Ministry of Social Development Services.

e. Multi-Purpose Rural Extension Centers

These centers, under the authority of the Social Development Ministry, are responsible for managing local community projects.

f. Regional rural development and intervention organizations

These organizations are listed in Table 21. Their purpose is to promote one or several types of activity in a specified zone.

The intervention organizations have precise missions, limited in time and space. They are responsible for launching special projects and, once the objectives have been attained, passing them on to the regional development company in charge of the zone in question.

The regional development organizations, which originally had limited mandates (for example, SODEFITEX was at first involved only in the development of cotton growing), have considerably broadened their fields of activity. They now are called upon to work for integrated development or, at the very least, to ensure coordination of the various activities. Theoretically, no zone in their regions, no category of individual (livestock raiser, native farmers, women), and no crop is beyond their jurisdiction.

Official commissioning documents specify the objectives to be pursued, the reciprocal obligations of the government and the organization, procedures to be followed, and the financing. While the principle behind it is excellent, setting the machinery in motion is difficult, especially when the government is unable to follow through on its commitments, particularly with regard to financing.

The MDR does not always have the means to practically exercise its theoretical responsibility.

g. Cooperatives

There were 2,500 cooperatives in 1981, with 1,750 of them in the groundnut sector, 178 in fisheries and 113 serving the cereals sector. A restructuring program is now underway, both to reduce their numbers to a more viable 500 or so, and to decentralize responsibilities to improve basic operations. They must perform the following functions:

Table 21: Regional Development Organizations (SRDR), Intervention Organizations (SI), and Other Rural Sector Organizations

	Organizations	Zone of Activity
SRDR	SAED (Organization for the Development and Operation of the River Delta)	River region and a part of the Senegal-Oriental (north of the Bakel region)
	SODEVA (Agricultural Extension and Development Organization)	Groundnut basin: Thiès, Diourbel, Louga, and Sine-Saloum regions
	SOMIVAC (Agricultural Development Organization for Casamance)	Casamance region
	SODEFITEX (Fiber and Textile Development Organization)	Senegal-Oriental, Sine-Saloum and the Upper Casamance regions
	SODESP (Association for the Development in the Sylvo-pastoral Zone)	Sylvo-pastoral zone
	PDESO (Animal Husbandry Project of Senegal-Oriental)	Senegal-Oriental region (subsidiary of SODEFITEX)
SI	SODAGRI (Organization for Agricultural and Industrial Development)	Casamance region (Velingara zone)
	STN (New Lands Organization)	Senegal-Oriental region (colonization zones of Maka and Koumpentou)
		Niayes zone (horticulture)
Others	SONAR (National Association for Rural Supply)	National
	CPSP (Price Equalization and Stabilization Fund)	National (part of the Ministry of Commerce)

- o Provide their members with necessary farm inputs (seeds, fertilizer, farm equipment, pesticides);
- o Obtain the necessary loan credits from banking institutions; and
- o Market the harvested crops.

h. Ministry of Environmental Protection

The Directorate of Water and Forests, the national body responsible for forest control and management, supervised some 10 reforestation projects through its representatives at regional levels. Activities in the inland fisheries sector are limited.

i. State Secretariat for Ocean Fisheries

Directorate of Oceanography and Ocean Fisheries is the national body in charge of coordinating activities in the ocean fisheries sector. Direct management of the small fisheries sector is in the hands of CAPAS, while industrial fisheries management is the responsibility of the Shipping and Ocean Fishing Industries Group (GAIPES--Groupement des armateurs et des industriels de la pêche maritime).

12. Food supply analysis

Average per capita food consumption for Senegal as a whole is 2,200 calories daily, 92 percent from products of vegetable origin and 8 percent from animal products. Protein supply is generally not a problem, although there are differences between the cities and rural areas.

a. Cereals

The cereal supply analysis in Table 22 is calculated on the basis of 210 kg per capita, for a 2.7 percent population growth rate. It indicates that requirements are generally being satisfied, with the help of imports. Imports have fluctuated enormously: from 271,000 tons in 1975 to as much as 708 thousand tons in 1979. National production has covered from 39 percent to 76 percent of domestic need during that period, while food aid shipments have represented 15 percent of total imports, on the average.

b. Animal products

National production provided 69,000 tons of the 71,300 tons of meat products available for distribution in 1980, while 600 tons of refrigerated meat and poultry were imported. Live animals imported for processing provided an additional 200 tons.

Between 10,000 and 15,000 tons of dairy products, honey and eggs are imported annually to compensate for the deficit in national production.

Table 22: Cereal Supply Analysis for 1975-1983
(000 tons)

Cereal Supplies	1975	1976	1977	1978	1979	1980	1981	1982	1983
Production (P)	663	566	429	852	604	535	624	-	-
Imports (I)	271	525	547	573	708	631	521	-	-
Aid Shipments	18	28	50	159	53	96	144	-	-
Supply Available(S)	934	1091	1096	1425	1312	1116	1145	-	956
Demand (D)	1039	1068	1096	1125	1157	1169	1085	-	1263
o (S-D)	-105	+ 23	-120	+300	+155	-23	+ 60	-	-307
o S/D percent	90	102	89	127	113	98	106	-	75
o (P-D)	-376	-502	-667	-273	-553	-654	-461	-	-
o P/D percent	64	53	39	76	52	45	50	-	-

Because this increasing debt load became an enormous burden, imperilling the entire agricultural system, rural credit was discontinued in 1980; debt incurred to that date was rescheduled over a five-year period. A reorganization of cooperative accounts was undertaken, in preparation for a restructuring of these organizations. The progressive transfer of seed production management to the cooperatives will eliminate seed credits, which account for two-thirds of the debt. Credit ceilings will be set to ensure that debt maturing each year will not exceed 25 percent of average annual production value. Credit terms will be adapted to the size of farm operations, and efforts to recuperate credits will be intensified at the marketing level.

The new rural credit program will involve not only activities related to crop production, but also to livestock raising, to fisheries and to crafts. It will also be extended to all stages of each production/marketing chain.

c. Market garden produce

Traditional vegetables, in particular, provide a large share of proteins in the Senegalese diet, along with cereals. Their actual contributions are difficult to evaluate, since no reliable statistics are available. About 80,000 tons of traditional African vegetables and new types of crops were produced locally in 1980, with 45,000 tons imported to fill domestic needs.

d. Fisheries products

The small fisheries annual catch of more than 140,000 tons covers overall needs. However, this figure conceals some quite marked differences in production between the coastal zones on the one hand and the inland areas, where animal protein needs are generally not too well satisfied, on the other.

e. Water

In rural areas and on the perimeters of urban zones, the minimum needs, in terms of both quality and quantity, are not always met.

13. Farm credit

Table 23 below shows rural farm credit figures for the three fiscal years preceding the August 1980 Reform (in millions of FCFA).

About 60 percent of the credits distributed by BNDS were channelled to the rural sector. More than 80 percent of these went to various organizations, primarily ONCAD, and from there to the cooperatives. As a result of this process, the Groundnut Basin received more in comparison with other regions.

Table 23: Principal Rural Credit Figures
(millions FCFA)

Loan Sources	Fiscal Year 1977/78	Fiscal Year 1978/79	Fiscal Year 1979/80
Cooperatives			
Loans Issued up to 9/30	11,751	10,103	9,297
Line of Credit	6,111	2,095	1,758
Credit Used	4,979	2,296	1,338
Individuals			
Loans Issued up to 9/30	343	388	435
Line of Credit	179	19	16
Credit Used	179	19	16
Large Producers			
Loans Issued up to 9/30	--	26	26
Line of Credit	--	70	--
Credit Used	--	26	--
Various Organizations (including ONCAD)			
Loans Issued up to 9/30	21,217	44,073	48,259
Line of Credit	36,628	51,018	32,580
Credit Used	33,677	48,440	31,982
Total Rural Sector			
Loans Issued up to 9/30	33,311	54,590	58,017
Line of Credit	42,918	53,202	34,354
Credit Used	38,835	50,781	33,336
Total All Sectors			
Loans Issued up to 9/30	58,807	89,405	97,854
Relative Importance of Rural Sector (percent)	57	61	59

14. Institutions involved in agricultural research

The Ministry of Scientific and Technical Research includes the following institutions involved in agricultural research:

- Senegalese Institute for Agricultural Research (ISRA--Institut sénégalais de recherches agricoles); and
- Institute of Nutritional Technology (ITA--Institut de technologie alimentaire).

The Ministry of Higher Education contains the center and institution of agricultural research listed below:

- National University School of Technology (ENSUT--Ecole nationale supérieure universitaire de technologie);
- Center for Research in Applied Economics; and
- Faculty of Sciences, University of Dakar.

The Ministry of Public Health includes the:

- Food and Applied Nutrition Service.

Regional international organizations involved in agricultural research in Senegal include:

- French Office of Overseas Scientific and Technical Research (ORSTOM--Office de recherche scientifique et technique outre-mer),
- Organization for Research on African Food and Nutrition (ORANA--Organisme de recherche sur l'alimentation et la nutrition africaine);
- Common Organization for the Control of Insects and Bird Pests (OCLALAV--Organisation commune pour la lutte antiacridienne et lutte anti-aviaire);
- African Institute for Economic Development and Planning--Economic Commission for Africa (IDEP/CEA--Institut africain de développement économique et de planification/Commission économique pour l'Afrique); and
- Inter-State School of Veterinary Medicine and Science (EISMV-Ecole inter-états des sciences et médecine vétérinaire).

III. AGRICULTURAL RESEARCH INSTITUTES

A. Administrative and Political Structures

Prior to 1983, responsibility for agricultural research shifted periodically from one agency to another. Between 1966 and 1970, it was handled by the Bureau of Scientific and Technical Affairs, under the Office of the President of the Republic. In 1970, it was transferred to the Directorate of Scientific and Technical Affairs, under the State Planning Secretariat. The General Delegation for Scientific and Technical Research, under the Prime Minister's Service, assumed its responsibilities in 1973. From 1979 they were held by the State Secretariat for Scientific and Technical Research, first under the prime minister, and after 1981 under the Ministry of Higher Education.

Senegal in 1983 created a full-fledged Ministry of Scientific and Technical Research (MRST--Ministère de la recherche scientifique et technique). It is responsible for carrying out the government's scientific research policy in all social, economic and cultural sectors throughout the country. (See Figure 13.)

This policy is defined by the Inter-Ministry Council of Scientific and Technical Research, the top decision-making authority responsible to the President of the Republic. It meets once each year to study proposals made by the Ministry, especially regarding:

- Setting major national research orientations and priorities;
- Creating or closing research institutions; and
- Determining the annual budget.

The precise responsibilities of the Ministry are:

- The promotion of scientific and technical research which involves the government, independent researchers, financing sources, and the ultimate users of this research;
- The coordination and control of all research activities throughout the country; and
- Participation in development efforts through the improvement and distribution of acquisition.

To help it carry out its mission, the MRST has a great number of divisions, services, institutes, etc. There are four technical branches: Agricultural and Agro-Industrial Research, Technological Innovation and Progress, Medical and Pharmaceutical Research, and Social and Human Sciences Research and Coordination Research studies, projects and planning. There are also two administrative and planning services and two specialized technical services--the National Center for Scientific and Technical Documentation (CNDST--Centre national de documentation scientifique et technique) and the National Standard Institute (ISN--Institut sénégalais de normalisation).

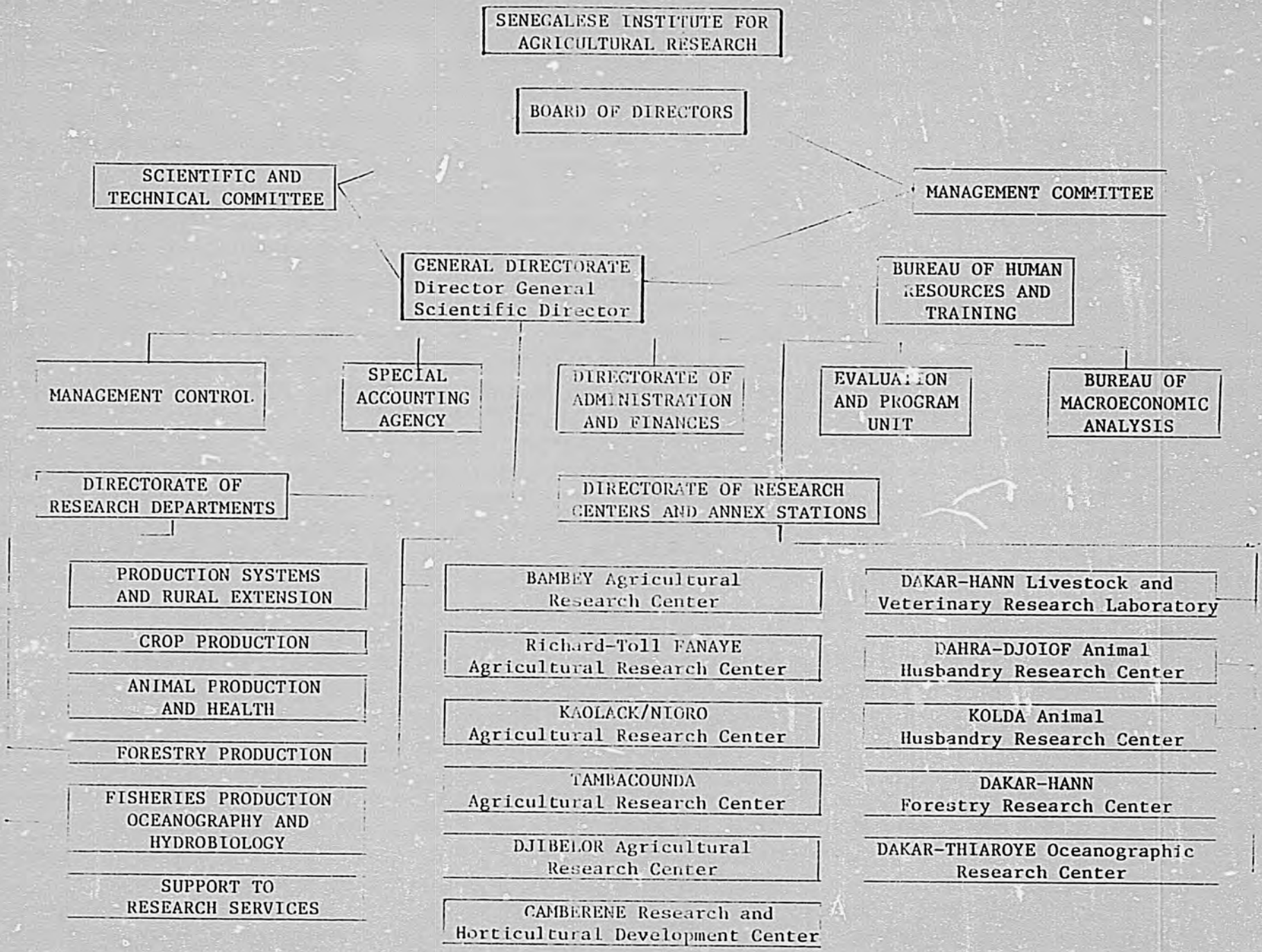


Figure 13: Organizational Chart for the Ministry of Scientific and Technical Research

The MRST directly sponsors the Senegalese Institute for Agricultural Research (ISRA--Institut sénégalais de recherches agricoles), the Institute of Food Technology (ITA--Institut de technologie alimentaire) and the Center for Studies and Research and Renewable Energy (CERER--Centre d'études et de recherches sur les energies renouvelables). The French Office of Overseas Scientific and Technical Research (ORSTOM-Office de recherche scientifique et technique outre-mer) in Senegal is also technically responsible to the MRST.

The Ministry also has six sectorial advisory commissions made up of scientists and representatives of research users which advise and make recommendations on the structures and progress of research activities. Technical committees are set up under these Commissions to study specific questions and submit reports on them. Special regional development committees, one for each of Senegal's eight administrative regions, deal regionally with the same research problems as the commissions handle at the national level.

B. Research Institutions

1. Senegalese Institute for Agricultural Research (ISRA)

a. Institutional authority and management

ISRA is a government organization of an industrial and commercial nature created November 19, 1974, by Decree 74-122. Its organization and operational by-laws were established by Decree 82-598 on August 2, 1982, amending the preceding order.

ISRA is administratively under the authority of the MRST, while financially accountable to the Ministry of Economics and Finance. ISRA is subject a posteriori to financial control regulations, except for those matters relating to personnel.

There are three decision-making bodies in ISRA. The Board of Directors considers and rules on all matters regarding ISRA management, particularly annual and multi-year research programs, training policies and planning, utilization of financial resources, and preparation of ISRA/third-party agreements. The Executive Committee ensures the technical and financial execution of research programs and production plans.

The Scientific and Technical Council, directed by the President of the Advisory Commission on Agricultural and Agro-Industrial Research, is comprised of people from the national and international scientific world (FAO, ICRISAT, IRRI, IITA, ILCA, GERDAT). Its major mandates are to assist the Board of Directors in:

- Evaluating ISRA scientific and technical performance;
- Defining general ISRA objectives and orienting its activities, with efficiency always in mind; and
- Planning and providing the necessary facilities for research activities.

b. Mission and objectives

Foundations for the present-day agricultural research program in Senegal were laid 50 years ago when an agronomic research agency network was set up in Bambey. Other research units for animals, fisheries, and forestry were set up in 1935, 1961, and 1965 respectively. In 1974, it was decided to incorporate these research facilities into ISRA.

The general mandate of ISRA is to undertake and develop research projects (on food crops, animal production, livestock forestry and fisheries) of importance for the economic and social development of Senegal; to do so it will:

- o Develop projects and programs to attain the objectives set by government;
- o Carry out programs ordered by the various technical bodies and adopted by the Inter-Ministry Research Council;
- o Collect, preserve, protect and generally ensure the rational management of the national scientific heritage in the agricultural sector;
- o Promote training of research personnel; and
- o Develop African and international scientific research cooperation.

Immediate and medium-term objectives were readjusted to conform with a point-by-point six year Research Plan, precisely formulated to fit within a Project for Restructuring Agricultural Research (PRA) that covers the 1981-1986 period. Its principal goals are:

- o Assistance in the control of desertification and the preservation of Senegal's arable soil;
- o Rational water resources management;
- o Development and diversification of the country's food crops and animal production;
- o Study and rational management of physical, biological and human environments;
- o Improvement of nutritional standards; and
- o Elevation of income levels for the rural population.

The new strategy adopted to achieve these objectives is based on:

- o Better knowledge of the rural farmers' problems that are specific to different regional ecological characteristics;
- o Better transmission of relevant research to rural producers;
- o Regionalization of research activities by support of the research centers in the country's principal ecological zones, some of these centers will have a multi-sectoral nature;
- o Integrated, multi-disciplinary approaches to each research program; and
- o Greater consideration by research programs of economic, social and cultural factors.

c. Organization

(1) General Directorate

The General Directorate of ISRA includes the Director General, the Scientific Director, the Office of Administrative and Financial Management, the Specific Accounting/Auditing Agency, the Technical Evaluation and Programming Unit, the Bureau of Macroeconomic Analyses, and the Bureau of Human Resources and Training.

(2) Research Departments

There are also research departments, each headed by a director, in food crop production, forestry production, fisheries production, animal production and health, production systems and rural technology and research services support. (See Tables 24-29.) The directors are responsible for the evaluation and selection of appropriate scientific approaches for attaining the objectives established by the Institute.

(3) Research centers and stations

ISRA has ten main research centers and an extensive network of substations and experimental farms. This network, which is divided on a north-south basis, includes the following:

Richard Toll Research Center at Fanaye: This center, established in 1949, and its substations at Guede, N'Diol and Saint-Louis conduct applied research on experimental crops (rice, in particular), animal production and principal production systems in the River Valley, with the objective of increasing agricultural production.

The total budget was FCFA 128 million in 1982 and FCFA 244 million in 1983. There are more than 80 employees, including 12 researchers, nine of whom are from the West African Rice Development Association, and one of whom is a trainee.

Physical plant includes three laboratories (soil, crop protection and physiology), one greenhouse, seven storerooms, two workshops, 23 offices, (including 16 at Richard-Toll), 16 dwellings (11 at Richard-Toll), and one reception center.

Table 24: ISRA - Research Programs for Crop Products

Title of Program	Research Operations	Site	Action Areas	Resources	
				Financial	Human
1. Multidisciplinary Program for Millet	1. Genetics and Selection 2. Physiology 3. Entomology 4. Phytopathology 5. Agronomy	Bambey	-Groundnut Basin -Casamance	PRA	6 Researchers 4 Technicians
2. Multidisciplinary Program for Sorghum	1. Genetics and Selection of irrigated sorghum 2. Genetics and Selection of rainfed sorghum 3. Phytopathology 4. Entomology	Kaolack (temporarily in Bambey)	-Groundnut Basin South -Senegal-Oriental -Upper and Middle Casamance	PRA	4 Researchers 4 Technicians
3. Multidisciplinary Program for Rainfed and Swamp Rice	1. Genetics and Selection 2. Agropedology 3. Entomology 4. Phytopathology 5. Weed Science 6. Hydraulics 7. Microbiology	Djibelor	-Casamance -Senegal-Oriental	PRA USAID/CILSS USAID	8 Researchers 7 Technicians
4. Multidisciplinary Program for Irrigated Rice	1. Genetics and Selection 2. Entomology 3. Weed Science 4. Agropedology 5. Water Resources	Richard-Toll	-Senegal River Valley	PRA WARDA	7 Researchers
5. Multidisciplinary Program for Maize	1. Genetics and Selection 2. Entomology 3. Phytopathology 4. Agronomy	Kaolack (temporarily in Bambey)	-Sine-Saloum South -Casamance -Senegal-Oriental	PRA	2.5 Researchers 2 Technicians

Table 24: ISRA - Research Programs for Crop Products (cont.)

Title of Program	Research Operations	Site	Action Areas	Resources	
				Financial	Human
6. Multidisciplinary Program for Cowpeas	1. Genetics and Selection 2. Entomology 3. Physiology 4. Rhizobiology 5. Pathology 6. Phytotechnics	Bambey	-Groundnut Basin	PRA University of California at Riverside	4 Researchers 4 Technicians
7. Multidisciplinary Program for Groundnuts	1. Genetics and Selection 2. Physiology 3. Technology 4. Rhizobiology 5. Entomology 6. Agronomy	Kaolack	-Sine-Saloum South -Senegal-Oriental -Upper Casamance	PRA	2 Researchers 2 Technicians
8. Multidisciplinary Program for Cotton	1. Genetics and Selection 2. Entomology 3. Agronomy 4. Transfers	Kaolack	-Sine-Saloum South -Senegal-Oriental -Upper Casamance	PRA	2 Researchers 2 Technicians
9. Multidisciplinary Program for Soybeans	1. Phytotechnics 2. Rhizobiology 3. Entomology 4. Weed Science 5. Phytopathology 6. Mechanization 7. Nutritional Improvement 8. Agronomy	Djibélor (temporarily in Bambey)	-Casamance	PRA	1 Researcher (full time) 5 Researchers (support)
10. Multidisciplinary Program for Market Garden Products	1. Genetics and Improvement 2. Entomology 3. Phytopathology 4. Phytotechnics & Irrigation	CDH/Dakar	-Coastal Zone -Casamance River Valley -Groundnut Basin	Senegal FAO	8 Researchers 6 Technicians
11. Multidisciplinary Program for Fruit Production	Formation in Progress	CDH/Dakar	-Casamance River Valley	To Be Researched	1 Researcher 2 Technicians
	1. Analysis of Residual Pesticide 2. Physical/Chemical Study of Pesticide Formulations 3. Treatment of Stored Crops	Bambey	-National	Senegal USAID	1 Researcher 1 Technician

Table 25: ISRA Research Programs for Animal Products

Title of Program	Research Operations	Site	Action Areas	Resources: Financial	Resources: Human
1. Range Management	1. Changes in Sahelian pastures 2. Changes in Sudano-Sahelian pastures 3. Layout of the Cap-Vert toposequences 4. Continuous monitoring of pastoral Sahelian eco-systems	LNERV/Dakar	Sahelian and Sudano-Sahelian zones	PRA FAO/UNDP SENEGAL	For operations (1, 2, 3): 4 Researchers For operation (4): 4 Researchers 4 Technicians
2. Study and Improvement of the Forage Production	1. Collection of forage plants 2. "Panicum" study 3. Rainfed leguminous forages 4. Phytotechnics of irrigated forages	LNERV CRZ/Dahra CRZ/Kolda Bambey	National	PRA	4 Researchers 4 Technicians
3. Upgrading of Natural Resources for Cattle Feeding	1. Cattle feeding 2. Intensification technique for animal products 3. Feeding improvement in extensive livestock systems 4. Cattle feeding in sylvo-pastural environment	LNERV/Dakar	National	PRA France	9 Researchers 11 Technicians
4. Improvement of Beef Production	1. Performance study of "Zebus" cows in research station 2. Performance study of "Ndama" cows in research station 3. Performance study of cattle in field	CRZ/Dahra CRZ/Kolda	North Zone South Zone	PRA	10 Researchers 13 Technicians

Table 25: ISRA - Research Programs for Animal Products (cont.)

Title of Program	Research Operations	Site	Action Area	Resources: Financial	Resources: Human
5. Improvement of Mutton and Goatmeat Production	1. "Touabire" and "Peul" sheep breeding for high meat quality 2. "Djalonke" sheep breeding for high meat quality 3. Pathology and productivity of small ruminants 4. Reproduction control for lambs 5. Industrial cross-breeding for "lacaune" and local lambs 6. Productivity of local goats 7. Performance of sheep in traditional environment	CRZ/Dahra CRZ/Kolda LNERV	National	PRA	8 Researchers 9 Technicians
6. Intensive and Semi-intensive Dairy Production --limited duration	1. Productivity study of the Montbeliarde stock in the Cap-Vert station 2. Productivity study of the Pakistani stock in the Cap-Vert station 3. Semi-intensive and intensive dairy production in the field (Cap-Vert) 4. Improvement of local breeds' dairy production	LNERV/Dakar	Coastal Zone	PRA	2 Researchers 5 Technicians
7. Microbial Pathology of Domestic Animals	1. Pathology of small ruminants 2. Salmonella carrier of domestic and feral species 3. Mycophanus and plague virus in respiratory systems 4. Botulism in Senegalese pork	LNERV	National	PRA	2 Researchers 5 Technicians

Table 23: ISRA - Research Programs for Animal Products (cont.)

Title of Program	Research Operations	Site	Action Areas	Resources	
				Financial	Human
8. Viral Pathology of Domestic Animals	1. Respiratory disease of viral origin in small ruminants 2. Small ruminant plague 3. Cattle plague and related diseases 4. African hog plague 5. Viral bird disease 6. Equine plague 7. Serologic diagnosis of rabies and vaccine improvement 8. Arbovirosis and ticks	LNERV	National	PRA	4 Researchers 7 Technicians
9. Parasite Pathology of Domestic Animals	1. Study of the tsetse fly and application of control measures 2. Comparative pathology and trypanotolerance 3. Diagnosis and chemotheraphy of trypanosomiasis in animals 4. Trypanosomiasis and reproduction 5. Rickettosis of domestic animals 6. Piroplamose and other parasitic protozoa of domestic animals 7. Breeding and dynamics of the tick population 8. Domestic animal parasitism by helminths and treatments 9. Malacology 10. Frequency and experimental cycles of trematode worms 11. Molluscoid plants 12. Onchocercosis as well as animal disease	LNERV	National	PRA	

Table 26: ISRA - Research Programs on Forestry Production

Program Title	Research Operations	Site	Action Areas	Resources	
				Financial	Human
1. Natural Forestry and Reforestation Studies for the Casamance	1. Natural forest and reforestation studies of the Lower Casamance 2. Ecosystem study and development of the Casamance "bolongs" mangroves	CNRF/Djibélor	Casamance	Senegal France USAID	4 Researchers 2 Technicians
2. Natural Forestry and Retimbering Studies for the Groundnut Basin	1. Improvement of natural and suburban forests in the Thiès region 2. Natural forest and reforestation studies of the Sine-Saloum 3. Introduction of exotic species 4. Feasibility study and salt terrain improvement	CNRF/Dakar	Groundnut Basin	France Senegal	1 Researcher 2 Technicians
3. Resources and Natural Population Study of the River Valley and the Sahelian Basin	1. Research on irrigated plantations and hydro-agricultural development of the delta and the river valley 2. Research on the production of Arabic gum and aerial forage	CNRF/Biddi and Nianga	Sahelian Zone	Senegal FAC CRDI FIS	3 Researchers 6 Technicians
4. Back-up Research for the Autonomous Reforestation Project of the Bandia Suburban Forest	1. Development of eucalyptus nursery techniques 2. Evaluation of forestry potentials 3. Soil development study in forestry population 4. Hydrous balance of forestry populations	CNRF/Bandia	Thiès/Diourbel	USAID	2 Researchers 3.5 Technicians

Table 26: ISRA - Research Programs on Forestry Production (cont.)

Program Title	Research Operations	Site	Action Areas	Resources: Financial	Resources: Human
5. Forestry Support Research	1. Selection and production of rhizobium and mycorhizum inoculums 2. In vitro and in situ crop multiplication techniques of forestry ecosystems	CNRF/Dakar	National	France FIS Senegal	3 Researchers 1 Technician
6. Genetic Improvement of Fast Growing Plants and of Certain Local Species	1. Improvement of the eucalyptus nursery and forestry techniques 2. Genetic improvement of the selected eucalyptus plants 3. Performance studies of recently introduced eucalyptus plants	CNRF	National	Senegal France	2 Researchers 1 Technician
7. Research on Species With Non-Ligneous Character	1. Phytotechnic studies on different latex plants and cracked seeds 2. Technical studies on different latex plants 3. Market study on natural resins of wax and gum	CNRF	Sahel	France Senegal	1 Researcher 1 Technician

Table 27: ISRA - Research Programs on Fishery Products

Program Title	Research Operations	Site	Action Areas	Resources: Financial	Resources: Human
1. Coastal Fishing	1. Biology of principal species 2. Evaluation of the biomass by echo integration 3. Fishing statistics on the Dakar sardine fishers 4. Statistics on large-scale foreign fishing 5. Rational exploitation of coastal fishing	CRODT	National	Senegal France USA Canada	3 Researchers 7 Technicians
2. Deep Sea Fishing	1. Biology and ecology of tropical east Atlantic tuna fish 2. Branding of tuna fish 3. Statistics on international tuna fishing in the port of Dakar 4. Rational exploitation of tuna fish stock	CRODT	National	France Canada Senegal	2 Researchers 2.5 Technicians
3. Demersal Fishing	1. Biology and dynamics of principal species 2. Ecology of the "demersal" population 3. Evaluation and management of deep-water resources 4. Collection and processing of trawling fishing statistics 5. Dynamics and rational management study of demersal stock in Senegalese territorial water	CRODT	National	Senegal Canada France	4 Researchers 5 Technicians
4. Small-Scale Fishing	1. Small-scale fishing analysis in the north of Cap-Vert, compared with industrial fishing 2. Improvement of machinery for small-scale fishing 3. Study of cephalapod fishing 4. Statistical data collection of the small-scale fishing along the Senegalese coast 5. Statistical data collection of the small-scale net fishing on the Senegalese coast	CRODT	National	Senegal EEC France	5.5 Researchers 8 Technicians

Table 27: ISRA - Research Programs on Fishery Products (cont.)

Program Title	Research Operations	Site	Action Areas	Resources: Financial	Resources: Human
5. Study on Ocean Environment	1. Hydroclimate of the coastal Senegalese ecosystem 2. Remote sensing 3. Environmental index of resource abundance 4. Upgrading of algal biomass	CRODT	National	Senegal France Canada EEC	5.5 Researchers 2 Technicians 5 Other Assistant Researchers
6. Sociology and Economy of Fishing In Senegal	1. Economic analysis of the small-scale fishing production 2. Economic analysis of the semi-industrial fishing 3. Study of storage and sale of fish 4. Follow-up and analysis of the unloading price and of the market for large fish in Dakar 5. History and sociology of fishing 6. Inland study on fish markets 7. Social transformation of small-scale fishing depending upon work and lifestyle 8. Study on fisher community of St. Louis	CRODT	National	France USA Senegal FAO	5 Researchers 10 Technicians

Table 28: ISRA - Research Programs on Production Systems and Transfer of Technology

Program Title	Research Operations	Site	Action Areas	Resources	
				Financial	Human
1. Diagnosis of Technical Constraints Limiting the Animal and Crop Production in the Northern Zone	1. Study of the harvest residue 2. Fertility diagnosis 3. Forage results and follow-up in animal science 4. Cropping technique: weeds science and agricultural mechanism 5. Inventory of culture diseases	Bambey	Groundnut basin	PRA	7 Researchers 3 Technicians
2. Agricultural Evaluation of Natural Resources for the Crop Production	1. Diffusion of methane converters 2. Biogas production for small-scale motorization 3. Upgrading of algal biomass 4. Residue evaluation of crops and agro-industrial by-products 5. Compost evaluation 6. Symbiotic and nitrogen assessment 7. Agricultural evaluation of calcium sources compared with acidity and salinity of soils 8. Utilization of natural phosphates 9. Evaluation of Niayes turf 10. Evaluation of fossil wood	Bambey	National	Senegal public private France public private WARDA FIS EEC	12 Researchers 4 Technicians
3. Post-Harvest Technologies	1. Experiment with decortication and maslin (millet, sorghum, maize) units in semi-urban environment 2. Development of grain threshing and decortication mechanism for maize seeds 3. Post-harvest technique identification 4. Experiment with post-harvest results	Bambey	National	PRA Canada	2 Researchers 7 Technicians
4. Agro-climatology	1. Knowledge of environment 2. Study of water economy	Bambey	National	PRA	7 Researchers 1 Technician

Table 28 : ISRA - Research Programs on Production Systems and Transfer of Technology (cont.)

Program Title	Research Operations	Site	Action Areas	Resources	
				Financial	Human
5. Additional Research: North Zone	1. Experiment in farming environment	Bambey	Groundnut basin	SAFGRAD USAID	1 Researcher 3 Technicians
6. Soil Fertility and Management of Territory in the South-Center Zone	1. Improvement of water availability for plants 2. Study and correction of acidity and mineral deficiencies 3. Cropping techniques 4. Agricultural mechanism and struggle against weeds 5. Identification of farmers' goals and production 6. Protection and restoration of soils	Kaolack	Groundnut basin	PRA	8 Researchers 11 Technicians
7. Production Systems in the Sine-Saloum	1. Preliminary surveys to establish program orientations 2. Verification of agricultural situations 3. Agronomic tests and animal science 4. Refining of socio-economic studies	Kaolack	Groundnut Basin South	PRA	4 Researchers 4 Technicians
8. Production Systems in the Lower Casamance	1. Diagnosis of production constraints 2. Agro-socio-economic course of agricultural exploitations 3. Study on land constraints 4. Study on non-agricultural activities and revenues 5. Migration study 6. Experiment in farming environment	Djibélor	Casamance	PRA	5 Researchers 2 Technicians

Table 23. ISRA - Research Programs on Production Systems and Transfer of Technology (cont.)

Program Title	Research Operations	Site	Action Areas	Resources: Financial	Resources: Human
9. Improvement of dam basins	1. Evaluation of effects dams can have on the environment 2. Water monitoring inside dam basins 3. Study and integrated monitoring of a site upstream from the dam 4. Focus on adapted production systems 5. Supervision of the mollusc fauna and the struggle against livestock parasites 6. Course of fish fauna and selection of adapted local species 7. Forestry population evolution				
10. Production Systems of the Delta and of the Middle Valley of the River Senegal	1. Exploratory studies and bibliographical review 2. Current systems study 3. Motorization study of small perimeters 4. Experiment in farming environment	Richard-Toll	River Valley	PRA	6 Researchers 6 Technicians
11. Agricultural Hydraulics in the River Valley	1. Hydrous and hydrodynamic soil characterization 2. Water needs estimation and definition of irrigation modules 3. Water management in rainy conditions (millet) 4. Agroclimatic course	Richard-Toll	River Valley	PRA	1 Researcher 1 Technician
12. Added Research in the North Zone	1. Experiment in farming environment	Richard-Toll	MATAM	Senegal France	6 Researchers 2 Technicians
13. Production Systems in the Niayes Zone	1. Exploratory study of a research program in the Niayes zone	CDH	Northern Coastal Zone	PRA	6 Researchers
14. Marketing of Fruits and Vegetables in the Niayes Zone	1. Statistics of local prices 2. Course of exports (price and tons) 3. Examination of significant markets	CDH	Northern Coastal Zone	PRA	1 Researcher 2 Technicians

Table 28: ISRA - Research Programs on Production Systems and Transfer of Technology (cont.)

Program Title	Research Operations	Site	Action Areas	Resources: Financial	Resources: Human
	4. Market structure study of horticultural products	CDH	Northern Coastal Zone	PRA	1 Researcher 1 Technician
15. Commercialization of Fruits, Vegetables and Cereals in the Casamance	1. Production and marketing of vegetables and fruits 2. Production, storage and commercialization of other cereals (millet, maize, sorghum)	Djibélor	Casamance	USAID	1 Researcher 1 Technician
16. Pre-Extension and Training in the Garden Product Production	1. Pre-extension and training in the Cap-Vert region 2. Pre-extension and training in the Thiès and Niayes regions 3. Pre-extension and training in the Sine-Saloum region 4. Pre-extension and training in the Casamance region	CDH	Niayes Groundnut basin Casamance	PRA FAO	6 Researchers 1 Technician
17. Sociology and Economics of Fisheries in Senegal	1. Research on fishery products	CRODT	National	PRA	
18. Population-Health-Development Project	1. Informal examinations of agro-socioeconomic problems and bibliographical review 2. Examination of the evaluation of the SODESP impact on the action zone of the project	DAHRA	Sylvo-pastoral Zone	INSAH PRA	3 Researchers 1 Technician

Table 29: ISRA - Research Programs on Support Services

Program Title	Research Operations	Site	Action Areas	Resources	
				Financial	Human
1. Statistical and Informational Procedure	1. Data analysis of the fishery, socioeconomic and environmental sections 2. Documents and program focus 3. Support for statistical programs	CRODT	All research centers	France USA Senegal Canada	5 Researchers 5 Technicians
2. Scientific and Technical Documentation and Information Processing		Bambey	All research centers	PRA	2 Researchers 6 Technicians

The four experimental stations have a total of more than 200 hectares, more than half of which are cultivated under irrigation (at Guédé with rice and wheat, at Fanaye with rice and sorghum, at NDiol with market garden crops, and at Sor with arboriculture). A rudimentary library and an IBM 5120 microcomputer complete the inventory. Generally speaking, facilities are old and worn, and an insufficient amount of supplies are being sent to the soil and entomology laboratories.

Animal Husbandry Center of Dahra: This center, established in 1930, is designed to do applied research on reproduction, nutrition and breed selection processes of cattle, sheep and horses. It also does research on predominantly animal production systems in the Sahelian Zone.

The total budget was FCFA 89 million in 1982 and FCFA 185 million in 1983. Personnel employed consists of 26 agents, seven of whom are researchers (two trainees) and 12 technicians.

The physical plant includes three offices, four dwellings, one reception center, two animal sheds (cattle and sheep pens) and one garage/workshop (with several storerooms). There are two generators to provide electricity and one well to provide water. Total land is 7,000 hectares, 6,000 used as pasture for 600 cattle and 200 small ruminants. Facilities and equipment here are also very old and the environment unfavorable.

Agricultural Research Center at Bambey: This center, established in 1921, and its substations at Louga, perform applied research on food crops (millet, cowpeas, groundnuts and market grain produce) and dominant animal species in the northern zone of the Groundnut Basin; principal production systems; and certain other specific matters.

The total budget was FCFA 509 million in 1982 and FCFA 707 million in 1983. The center has 450 employees, including 39 researchers (20 national) and 15 supervisory technicians.

Physical plant of the center includes four laboratories (soil, microbiology, crop protection) two greenhouses, one cold storage room, one stable, one workshop, one well-organized documentation center, 38 staff dwellings, and a reception center. There is also an IBM 5120 computer for data processing. The center has a total of 650 hectares of land for experimental farming, four of which have full irrigation systems. Once again, facilities and equipment are generally quite old, since there has been very little new construction, and maintenance facilities are limited. The center has an appreciable amount of laboratory and crop cultivation equipment, although this also is quite old. Electricity is provided from the public system, and water comes from the station's own well.

Forestry Research Center at Dakar/Hann: This center, established in 1965, its substations at Nianga, Mbiddi, Bandia, Keur-Mactar and Djibelor, and its test sites at Bambey, Soukorong, Maka, Fatick, Koutal, Bayottes, and Sefa perform studies on reforestation in all ecological zones and on equilibria in different ecosystems.

The total budget was FCFA 70 million in 1982 and FCFA 172 million in 1983. Personnel consists of almost 50 agents, including 15 researchers.

Physical plant is comprised of one analysis laboratory, one greenhouse for propagation of micro-cuttings, fourteen offices (seven in Dakar, three in Djibélor), two garage/workshops (at Bandia and MBiddi), one cold storage room (at Dakar), four storehouses, and one well-organized but poorly stocked library. There is no equipment valued at over FCFA 400,000 and no data processing equipment. Total area under cultivation at the five sub-stations is 700 hectares, 50 of them irrigated. This center has very limited resources and facilities. The physical plant is old, but generally in good condition, except at MBiddi.

Oceanographic Research Center at Dakar-Thiaroye and the Annex Station at Ziguinchor: This center, established in 1961, and its substation at Ziguinchor, study the nation's fishery potential and implement rational management procedures.

The total budget was FCFA 182 million in 1982 and FCFA 263 million in 1983. Personnel includes 89 agents, 17 of whom are researchers (two trainees), and 12 supervisory technicians.

Physical plant and equipment consists of one laboratory complex (physics, biology, ecology), one multi-science laboratory at Ziguinchor, one ocean research ship, one radioactive materials storage shelter, three storehouses, one carpentry workshop, and one well equipped and organized documentation center. There are also high-capacity data processing facilities (IBM 4331, HP 9845, and TI). Laboratory equipment at the Center is of good quality but incomplete.

Horticultural Development Center at Cambérène: This center, attached to ISRA in 1979, and its substation at km 15 study production systems to find ways to improve market gardening techniques and increase production.

The budget in 1983 was FCFA 286 million. Personnel consists of 100 agents, including 13 researchers (two trainees) and 12 technicians.

Physical plant and equipment includes four laboratories (pathology, entomology, genetics), one phytotron, one cold storage room, 25 offices, and a documentation center. Total land available is 40 hectares (33 of which are at the center itself) with irrigation systems in place. Basic facilities and equipment for marketing work are of excellent

quality, but material and financial resources for necessary operations are lacking. The production component of the center in almost devoid of human and financial resources.

National Livestock and Veterinary Research Laboratory: This laboratory, established in 1935, and its substation at Sangalkam, established in 1953, carry out applied research in virology, bacteriology, parasitology, physiology, and nutrition in cattle, sheep, and pigs; and also produce vaccines.

The total budget was FCFA 392 million in 1982 and FCFA 528 million in 1983. Personnel consists of 94 agents, including 25 researchers, four of whom are trainees, and 38 technicians.

Equipment and physical plant include one laboratory complex of 2,000 m^2 (microbiology, physiology, chemistry), three animal sheds, 20 rooms (offices, library, etc.) including two in Sangalkam one garage, two workshops and one well-equipped documentation center. Total land available for experimentation is 50 irrigated hectares. The laboratory also has appropriate data processing equipment (IBM 5120, programmable Olivetti, HP, TI). Facilities are in relatively good condition, but incomplete. The equipment is old and of variable quality. The center can be considered as moderately well equipped.

The Agricultural Research Center at Kaolack: This center, established in 1978, and its longer established substation at Nioro-du-Rip Sinthiou-Maleme, "Darou" have trial grounds at Missira, Velingara, Sonkorong, Boulel, Keur-Samba, Maka, and Koumbidia. This center is engaged in applied research on new agricultural (maize, sorghum, groundnuts) and animal types and prevailing production systems in the region.

The total budget was FCFA (35 million in 1982 and FCFA 313 million in 1983. Personnel consists of 100 agents, including eight researchers.

Equipment and physical plant includes three laboratories (soil, biochemistry, and crop protection), 27 offices, including 18 in Kaolack, two workshops, and several storerooms. There are very limited data processing facilities and a poorly organized documentation center. Land available for experimentation consists of 80 ha (including 60 in cultivation) at Nioro-du-Rip, 60 ha (including 55 in cultivation) at Sinthiou-Maleme, and 62 ha (including 37 in cultivation) at Darou. Lack of a structured basis, dispersed activities, poor equipment and lack of resources are problems faced by this center.

Animal Husbandry Research Center at Kolda: This center was established in 1972 to conduct applied research on reproduction, nutrition, and selection processes for cattle and sheep breeds, as well as on the principal production systems in the sudano-guinean zone.

The total budget was 60 million in 1982 and 71 million in 1983. Personnel consists of 30 agents, including five researchers (three of whom are trainees), and six technicians.

Equipment and physical plant includes one laboratory (artificial insemination), four offices, one garage-workshop, one cattle pen, and one sheep pen. There is data processing equipment, very limited laboratory equipment, and one poorly organized documentation center. Total land available is 2,000 ha (over 1,700 for pasture and 25 cultivated). Livestock on the pastureland consists of 400 cattle and 300 sheep. This center is under-equipped and has inadequate financial and human resources.

Djibélor Agricultural Research Center: This center, established in 1967, and its substation at Sefa (and trial grounds at Dianaba, Oussouye and Moupalago) are involved in applied research on agricultural production (emphasis on rice, soybeans, and sorghum) and on the principal production systems of the Casamance region (main target zone: lower and middle Casamance).

The total budget of the center was FCFA 182 million in 1982 and FCFA 255 million in 1983. Personnel number about 100 agents, including 17 researchers (four trainees) and seven senior technicians.

Equipment and physical plant comprises six laboratories (soils, crop protection, agronomy), two greenhouses, one seed-shed, one cold storage room, 34 offices (including three in Sefa), two stables, four workshops, one supply unit (in Sefa), and nine guest houses for researchers. The center has appropriate data processing facilities (IBM 5120, programmable calculators) and a well-equipped documentation center. Total land area available is 70 ha at Djibélor and 410 ha at Sefa. This center is relatively well equipped, but has limited financial resources.

d. Human resources and training

Upon independence, the Senegalese government endeavored to define a management policy for human resources as well as a continuous training policy for executive and implementation personnel. This policy resulted in 1982 in the creation within ISRA of human resources and training group directly linked to the General Directorate. The recruiting efforts (including overseas training) of ISRA, since its creation in 1974, have resulted in an increase in the number of researchers who are Senegalese nationals from 55 in 1979 to 126 in 1983. Under the "Senegalization" policy of the government, 75 percent of all researchers are to be Senegalese nationals by 1985. As of November 1983, total ISRA personnel amounted to 1,300 persons. This figure includes: 174 researchers (of whom 126 are nationals) with at least six years of training beyond the BAC level; senior technicians; and other implementation personnel.

Concerning training itself, a plan covering the short, medium and long terms is being finalized. This plan takes into account the implementation needs of the agricultural research project, the first stage of which will cover a six year period (1983-1988). The training plan integrates long-term training, refresher training and training during sabbatical years for scientific, administrative and accounting personnel. The implementation of this plan should allow ISRA to better fulfill its mission, namely to identify scientific bases useful in the promotion of economic and social development in Senegal.

e. Financial resources

1983 is an important year for ISRA as it corresponds to the initiation of this major agricultural research project. Two donors (the World Bank and France) and the Government of Senegal will provide 75 percent of the project's funding. The total expenses for 1983, including the salaries of expatriates and the corps of civil engineers are given in Table 30.

Salaries of expatriates and the corps of civil engineers documentation costs represent 28 and 27 percent respectively, while salaries for local personnel and research activities costs represents 22 and 24 percent respectively. The comparison with agricultural research resources in the 1982/83 fiscal year, excluding both salaries for expatriates and investments, is given in Table 31. In this comparative table it becomes evident that resources from abroad have increased, and there is a slight decrease in the Senegalese contribution. It should be noted that foreign funds deal only with research on crop production and production systems, while ISRA covers not only these two fields but also research on animal production, forestry, oceanography, and fishing. Forestry research, which has to date received only 6 percent of the financing allocated to ISRA in the Senegalese National Budget, is of special concern to ISRA officials. They are attempting to find appropriate funding for it, given the urgency of the problem of desertification and the protection of Senegalese forest resources.

f. Scientific and technical information resources

The document collection numbers approximately 60,000, of which more than half is informal. There are from 500 to 600 journal collections (most of which are incomplete or have expired), 2,000 to 3,000 original technical slides, and several hundred microfilms and microfiches. This inventory does not take into account the numerous documents being kept by the researchers in their offices.

This collection derives its richness from the technical value of the documents, as well as the long period of agronomical research it covers (since 1920 in the Bambey Center). It is certainly worth the effort required to develop it, to make it cost-efficient and to promote its use by local and foreign researchers.

Apart from a few exceptions, the following are the principal weak points in the way that the collection is organized:

Table 30: Financial Resources of Agricultural Research, 1983

Donors	Totals FCFA	Percent	Civil Engineering	Total Excluding Civil Engineering
France	1,462,492,000	24.13		1,462,492,000
IBRD	1,457,762,000	24.06	586,977,000	870,785,000
USAID	578,052,000	0.54	188,178,000	389,874,000
Senegal	1,497,594,000	24.72	166,962,000	1,330,632,000
Sinking Fund	116,118,689	1.91		116,118,689
Individual Agreements	557,067,000	9.19		557,067,000
Own Resources	391,444,453	6.45		391,444,453
TOTAL	6,060,530,142	100	942,117,000	5,118,413,142

Table 31: Comparison of Calendar 1983 and Fiscal Year 1982/83 Resources

Sources	1983 (1)		1982/83 (2)		Increase
	(000 FCFA)	(percent)	(000 FCFA)	(percent)	(1) / (2)
National Budget of Senegal	1,330,632	39.5	1,138,412	54.3	1.27
External Resources	1,648,593	48.9	532,073	24.4	3.81
France	249,867		144,970	6.9	1.72
IBRD	794,285		-		PM
USAID	251,374		387,103	18.5	1.56
Individual Agreements	353,067		387,103	18.5	1.56
Own Resources	391,444	11.6	424,914	20.3	0.92
Sinking Fund	166,149				
TOTAL	3,486,788	100	2,095,403	100	

- o Lack of a documentation network at the ISRA center: little or no inter-collection exchange, absence of pooling of resources, scarcity of document loaning between centers;

- o Due to a lack of reciprocal exchanges between archivists and researchers, the documentation is inadequate for needs of the researchers. Completely insufficient use of the documentation service is due, in part, to some documents not being made available to the users;

- o Lack of qualified implementation staff, lack of equipment and inadequate acquisition budgets. In some of the centers, archivists spend a great deal of time on duties unrelated to documentation such as administrative work, keeping the minutes of meetings, etc; and

- o Certain research findings have had a weak impact as result of a distribution system which left many users without access.

Within the framework of the new ISRA organization, a support services department has been created at the general directorate level, which will provide, among other things, a division dealing with documentation, publications and the diffusion of research findings. The existence of this new division clearly indicated the importance ISRA gives to the collection of scientific data, to adapting it in such a way as to be conveniently available to researchers, and to the proper diffusion of research findings. This division includes three subdivisions: documentation, publications, and diffusion of research findings.

(1) Documentation subdivision

This subdivision covers the whole range of issues related to ISRA. Given their breadth, in each research sector it will only keep reference works and basic and common bibliographies. Selection of subscriptions will be made in the same spirit. Specialized documentation should be acquired and kept by the research centers themselves. In order for the documentation sub-division to fulfill its role of centralization and diffusion of information, two collective work instruments should be created: a central file of the documents stored and published by ISRA (categorized according to related center), and a general catalogue of available periodicals. These two measures will improve efficiency in the system as a whole. In order to improve access to the information, the documents' contents should be analyzed and indexed, under the responsibility of the subdivision, with the cooperation of the researchers involved.

From a medium-term perspective, or from the perspective of participation in international networks (such as AGRIS or RESADOC), the indexing should preferably use AGROVOC or RESADOC keywords and be adapted to the specific needs of ISRA.

(2) Publications subdivision

This subdivision is in charge of centralizing all the documents published by ISRA, whose scientific quality will have been previously inspected by the appropriate authority. It is also in charge of standardizing their format and publishing them. The department managers should ensure that documents published are given to the publications subdivision.

(3) The Research findings distribution subdivision

This subdivision is charged with distributing lists of published documents, microfiches and slides to the research centers, and providing these centers with items requested from such lists. Each center for its part should maintain a collection of the documents published by ISRA in it's particular field.

2. Institute of Food Technology (ITA)

a. Legal and administrative framework

Law no. 63-11 (of February 5, 1963) provides for the creation of the Institute of Food Technology, a public sector institute of an industrial and commercial nature enjoying financial autonomy while having the character of a public agency. This institute, whose organization was set out by decree 64-485 of June 4, 1964, became a public entity of an administrative nature through Law no. 66-27 of May 8, 1966. This change in status was a result of the fact that FAO assistance to the institute was conditional on the establishment being a nonprofit entity. Following that, the ITA was reorganized by decree no. 67-105 of January 27, 1967. The principal organs within the institute are the Administrative Council, the Board of Directors, and the Administration. The entity is sponsored by both the Ministry of Economy and Finances and the Ministry of Scientific Research.

b. Objectives

The general objectives of the ITA are defined by the legal texts which established and reorganized the entity. The ITA has the mandate to:

- Conduct and coordinate research, studies and activities regarding the treatment, processing, consumption, and the storage of all foodstuffs and their by-products, and especially to undertake studies which should lead to the establishment of food industries using local raw materials from the sea, the farms, and the pastures;

- To develop new local food resources derived primarily from groundnuts, fish, meat, milk, fruits and vegetables;

- To develop and distribute on a large scale processed foods which are rich in protein, highly nutritional and adapted to the tastes and buying power of consumers; and

- To assist in quality control of food products during production, marketing, and importation and exportation.

The ITA must also provide assistance to state agencies and organizations in the food technology field.

The Institute also has a training mandate. The Interministerial Board recommended (on March 12, 1979) the creation of a training section within the ITA for further training of professionals in the nutritional and agri-business industries.

As for specific goals of programs (research, studies, training), they are established by the responsible ministry, and/or ad hoc interministerial council. These goals take into account the recommendations of the national advisory commissions on agri-business research, as well as the research needs identified by the structures of production and development. They were defined in the agri-business research plan for the period 1979-1984. Tables 32, 33 and 34 provide more detailed information on the research program of ITA.

The following principal results are expected from these different objectives:

- Increased income in rural areas following growth in agricultural productivity, itself due to better storage and marketing;
- Revaluation and increase in the income of professionals within the food sector, which will lead to the creation of numerous jobs, lessening unemployment;
- Improvement in the standard of living (and nutritional state) of the population, through more rational and more diverse utilization of local food resources. This must be effected in accordance with the needs of and the possibilities of consumers;
- Improvement in the trade balance of the country as a result of foreign currency savings after a reduction of foreign foodstuff imports; and
- Contribution to the advent of an improved socio-cultural identity for the country based on consumption of local products.

c. Institutional organization

The organization of ITA includes a Directorate, a Technical Directorate, an Administrative and Financial Directorate, an Internal Management Control Unit, Special Accounting Office, a supply department and a maintenance garage.

The research and study programs are implemented by the Technical Directorate, which includes four departments:

Table 32 : ITA - Research Programs on Plant Products

Title of Program	Research Operations	Site	Scope of Activity	Resources Financial / Human
1. Cereal programs	1. Production of instant couscous from millet.	ITA	National	USAID FRG Senegal IDRC
	2. Production of bread and various products from wheat and maize.			
	3. Use of millet or maize as substitute products for rice.			
	4. Study for using millet in bread.			
	5. Supplementation of millet and sorghum and production of stable mixed flours.			
	6. Preventative processing and treatment.			
	7. Standardization of hulled grains and of flour and quality control.			
	8. Nutritional and functional properties of millet and sorghum of West Africa.			
	1a. Consumption and nutritional balance studies.	ITA	National	Senegal
	2a. Extension of supplemented foodstuffs.			

Table 32: ITA - Research Programs on Plant Products (cont.)

Title of Program	Research Operations	Site	Scope of Activity	Resources Financial / Human
2. Programs on leguminous and oleaginous plants	1. Participation in the integrated control of Aflatoxin (CAA). 2. Preventive treatment and processing of groundnuts and cowpeas. 3. Production of enriched foods from groundnuts, from "oule" (Parkia Biglobosa) or from soybeans.	ITA	National	CAA Senegal
3. Programs on fruits and vegetables	1. Stabilization of "Ditakh" (Detarium Senegalensis) juice, of "made" (Landolfia Senegalensis), from corrossol and various fruit species. 2. Definition of optimal conditions for ripening, harvesting, and preservation of local fruits (mango, papaya, guava). 3. Standardization and quality control.	ITA	National	Senegal Italy

Table 32: ITA - Research Programs on Plant Products (cont.)

Title of Program	Research Operations	Site	Scope of Activity	Resources Financial / Human
3. Programs on fruits and vegetables (cont.)	4. Development of new products (juice, nectar, jam).			
	*5. Solar drying of vegetables.			
	6. Training of female rural instructors for domestic preserving.			

Table 33: ITA - Research Programs on Animal Products

Program Title	Research Operations	Site	Scope of Activity	Resources Financial / Human
1. Beef programs	1. Production of meat-base canned traditional dishes. 2. Development of utilization of offal. 3. Standardization and quality control.	ITA	National	Senegal
2. Dairy product programs	1. Production of proteins with yeast growing on lacto serum. 2. Standardization and quality control.	ITA	National	Senegal France Canada
3. Fish and fish product programs	1. Solar drying. 2. Adapting traditional methods of producing locally-dried products. 3. Improving traditional smoking methods.	ITA	National	Senegal USAID UNU NL FAO UNDP

Table 34: ITA - Studies and Extension Programs

Program Title	Research Operations	Site	Scope of Activity	Resources Financial / Human
1. Socioeconomic studies	Estimating availability of raw materials. Evaluating consumers' needs. Studies on acceptability of finished products. Profitability study. Marketing study.	ITA	National	Senegal IDRC USAID
2. Extension programs	Distribution of finished products and methods to agro-industries, rural and urban communities	ITA	National	Senegal IDRC USAID

- o The Crop Products Department, comprised of the Grains and Leguminous Plants Division and the Horticultural Products Division. Each of the divisions includes a processing section and storage and canning section;

- o The Animal Products Department includes the Milk and Dairy Products Division, the Fish and Fish Products Division, and the Meat and Meat Products Division;

- o The Laboratories Department include Chemistry, Microbiology and Taste Analysis laboratories as well as the Diet and Nutrition Division. The laboratories act principally in the areas of quality control and nutritive and organoleptic value of products, both those developed in the pilot workshops of the institute and those brought in from the outside; and

- o The Research Support Department includes the Maintenance, Socio-Economic, Refining and Packaging, and Standardization Divisions, as well as the documentation center.

d. Physical plant and equipment

The ITA currently occupies two buildings. The administrative building, which used to be the Packaging division, now houses mostly offices, specifically those of the technical directorate accounting and support services. There are also refrigerated rooms, a laundry room, and the maintenance division. The technical building, built in 1967-1968, includes the chemistry, microbiology, sensory analysis, prophylaxis and aflatoxin laboratories, as well as pilot workshops for cereals, meats, fruits and vegetables.

The technical building is no longer large enough for all existing sections to carry out their activities under satisfactory conditions. Several of the sections are not just settled in spaces that are not adapted to them, but are also forced to jointly occupy the area with another research unit. It should also be said that some essential areas of food research, such as fats, processed sugar products, fermentation products, etc., are not among the institutes's activities.

Consequently, the ITA expansion program, of which the first stage in to be completed by December 1983, seeks to remedy these space limitations. This stage is costing FCFA 210 million and includes the construction of premises intended for the nutrition, family technology, horticulture, and milk and dairy products divisions.

It should be noted that ITA, with a total area of about one hectare, does not yet have any regional branches. It is planned that these will take the form of pilot units in the production zones.

Machinery in the pilot workshops and the measuring devices in the laboratories were for the most part purchased during the course of the FAO assistance project with ITA from 1966 to 1974. Some of the machines and devices are already very worn. Others have broken down and cannot be repaired due to lack of replacement parts.

Consequently, this equipment needs to be repaired or replaced, while new equipment for the divisions now under construction needs to be purchased.

e. Human resources and training

(1) Staff

Senior staff, with degrees ranging from bachelors to doctorates, are responsible for the design of production protocols for the pilot workshops and for quality-control analyses in laboratories.

Senior technicians, with DUT, BTS or equivalent degrees, assist senior personnel and supervise the use of processing or storage procedures as well as conduct analyses.

Technicians, of a level equivalent to the baccalaureat or BT, are the implementation agents along with assistants who have BEI or CAP diplomas. The total number of employees at the Institute is almost one hundred. One difference between ITA and other research agencies in Senegal is that the employees are almost all of Senegalese nationality. There is only one expatriate, and his contract expires in November 1983.

It has been shown by management evaluation studies, that the institute suffers greatly from a lack of financial and administrative staff.

(2) Training for institute employees

The FAO assistance project for ITA included a component in which international experts trained their Senegalese counterparts. Moreover, institute personnel have been involved in many internships and study programs in foreign research or teaching institutions in the food technology and sciences sector. Many senior employees were thus trained, making ITA one of the African agencies with the greater number of national specialists in the sector.

(3) Other training at ITA

ITA accepts a number of trainees from several foreign and Senegalese schools and institutions for training at ITA.

(4) Training performed by ITA agents abroad

Besides on-site training, the institute has provided extension training in rural areas of grain preservation in barrels, supervision of storage agents (from what used to be ONCAD), processing of fruits and vegetables, uses of solar tents to dry fish, and in regional capitals of the country for training or for retraining of bakers. Some agents have also given courses or lectures at IUT, the school of medicine, EBAD, ENEA etc.

(5) Financial resources

Since 1974, when the FAO assistance project ended, ITA's financial support came largely from government subsidies. The amount of their support has been fairly constant, at about FCFA 185 million, since the time period 1979-1980. The constant level of government support, in the face of increasing personnel and materials costs, has seriously reduced the amount of funding available for institute activities in research, production, and analysis. Furthermore, due to the laws that govern administrative public establishments, ITA is not permitted to use revenues that come from the delivery of its services or promotional sales, and must return these revenues to the public treasury. Table 35 presents a summary of the ITA budget.

To compensate for its financial limitations, ITA, on the initiative of the Ministry of Scientific and Technical Research, made a strong commitment to attempt to raise funds from abroad, mostly in the form of bilateral or multilateral assistance. Preliminary results are quite encouraging and have led to a number of projects.

3. Office of Scientific and Technical Research Overseas (France) (ORSTOM)

a. Sponsorship

ORSTOM is sponsored by the French Ministry of Research and Industry, and the French Ministry of Cooperation and Development. The activities of ORSTOM in Senegal are under the technical authority of the Senegalese Ministry of Scientific and Technical Research.

b. Objectives

ORSTOM, a French institution of research for cooperative development, has the following objectives in France and elsewhere, according to article two of the decree which established it:

- To promote and implement scientific and technological research that may contribute to the cultural, social and economic progress of developing nations;
- To implement a scientific and technical information policy for the various cultures concerned;
- To contribute to the application and social and economic development of the production of its activities;
- To provide assistance in training for research, and in research itself, for French nationals and foreign citizens; and
- To foster cooperative action, of a formal, contractual nature, among organizations in ORSTOM's field.

Table 35: ITA Budget, 1977-1983
(FCFA)

Distribution	Fiscal Year					
	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
Staff	91,337,220	91,373,171	110,960,293	125,560,325	125,552,190	126,000,000
Equipment	63,662,700	73,626,839	74,039,707	59,439,675	59,447,810	59,000,000
Total	155,000,000	165,000,000	185,000,000	185,000,000	185,000,000	185,000,000

ORSTOM also monitors the international scientific climate and its evolution in order to assist in the formulation of related policies.

c. Institutional organization

The Interdisciplinary Research Departments each include several research units, defined by scientific objectives translated into program terms. (See Tables 36-40.) The structure is in charge of scientific and budgetary implementation of research programs.

Scientific commissions each correspond to one or a group of disciplines; this structure is in charge of directing, developing and evaluating the work of the institute its departments, its research units, researchers, engineers and technicians.

Under the authority of the Board of Directors and its Chairman, the Director General is responsible for the administrative and scientific policy of the institute. He presides over the Scientific Council, and is assisted by a management team. A Secretary General assists the chairman and the director general in the financial and administrative management of ORSTOM, which will be executed by a number of departments, such as finance, personnel, equipment, travel, and accounting. Three structures complete the Institute's organization: a Directorate of Joint Scientific and Technical Services, a Directorate of Training, Information and Development, and a Scientific Coordination and Support Department.

Finally, in the "field", both in France and abroad, the research units and the departments will operate in the framework of three kinds of structures: research centers specific to ORSTOM, and teams and laboratories associated with other French and foreign institutions.

d. Physical plant and equipment

The ORSTOM Center in Senegal is in the category of missions to foreign institutions. It is under the technical authority of the Ministry of Scientific and Technical Research of Senegal.

An agreement between ORSTOM/headquarters and the Ministry of Technical and Scientific Research establishes the requirements for activities of the Center in Senegal. An annual meeting for cooperation defines the content of ORSTOM activities in Senegal.

The ORSTOM facilities in Senegal include:

- The Dakar-Han Center, which houses the Directorate and ORSTOM's representatives in Senegal;
- The pedology, geology, hydrogeology, and geophysics divisions are housed in the center, which has about 1,000m of laboratories, six offices and the mission's major documentation center;

Table 36: ORSTOM - Earth Sciences

Program Title	Program Area	Site	Scope of Activity	Resources	
				Financial /	Human
Surface development of the earth's crust	Geochemistry of evaporating confined environments: study of continental saline rock and peat formation in the Sahelian zone. Geochemistry of Senegal and Gambia River basins: evaluation of alteration, erosion, transportation and sedimentation.	Dakar	Coastal area	France	Researchers (2) Technicians (2)
Water resources	Study of hydrological mechanisms on representative basins. Hydrological measures on important waterways in Senegal.	Dakar	National	France	Researchers (1) Technicians (2)
Earth resources	Characterization and evolution of the principal types of soils irrigated in the Senegal River Valley. Cartographic summary of the soils of the Casamance at 1/200,000. Study of salt-lands in Senegal. Summary of soils in Senegal at 1/500,000.	Dakar	National	France	Researchers (4) Technicians (1)

Table 37: ORSTOM - Agronomic Sciences

Program Title	Program Area	Site	Scope of Activity	Resources	
				Financial /	Human
Agrosystems: structure, operation and development	Ecology and physiology of forage grasses in Senegal. Multi-site studies of the behavior of Panicum maximum roots. Study of soil development where eucalyptus is planted.				Researchers (2) Technicians (0)
Interaction between plant and soil micro-organisms	Nitrogen fixation in flooded rice fields. Biological cycles of sulfur and iron in flooded rice fields. Symbiotic fixation of nitrogen by leguminous and non-leguminous plants. Ectomycorrhyzation of certain ligneous species. Biogas fermentation. Study of rodents in the Sahelian zones.				Researchers (9) Technicians (1)

Table 37: ORSTOM - Agronomic Sciences (cont.)

Program Title	Program Area	Site	Scope of Activity	Resources	
				Financial /	Human
Interaction between plant and soil microorganisms (cont.)	Eco-ethology of paleo-tropical birds, especially granivores.				
	Arboviroses.				
	Inventory of viral diseases of plants grown in Senegal.				
	Knowledge of bacterial diseases of plants grown in Senegal.				
	Ecology of nematode thread-worms (phytoparasites) in the Sahel.				
	Control of the pathogenic activity of nematode threadworms (phytoparasites).				

Table 38: ORSTOM - Human Sciences

Program Title	Program Area	Site	Scope of Activity	Resources	
				Financial /	Human
Economic and social development	Population and systems of production in the Senegal River region.				
	Living centers, prospects, social changes in the Casamance.				
	Pastoralism and wildlife protection.				
Baseline data and population transition	Demographic study of Sine-Saloum.				Researchers (6) Technicians ( )
	Urbanization and health in the Dakar-Pikine metropolitan area.				

Table 39: ORSTOM - Medical Sciences

Program Title	Program Area	Site	Scope of Activity	Resources	
				Financial /	Human
Research on human and animal nutrition	Study of protein-energy malnutrition. Study of nutritional anemias. Interrelationship: nutrition-infection-immunity. Study of food and nutritional conditions using large samples representative of West Africa.				Researchers (5) Technicians (3)

Table 40: ORSTOM - Oceanographic Sciences

Program Title	Program Area	Site	Scope of Activity	Resources	
				Financial /	Human
Structures and basic mechanisms of the sea environment	Systematic study of West African rays.				Researchers (1)
Physical oceanography	FOCAL.				Researchers (7) Technicians (6)

- o The Dakar/Bel-Air Center houses the microbiology, nematology, and physical oceanography divisions. There are 2,000m of engineering laboratories, specialized libraries, and a phytotron in this center;

- o The Mbour Geophysics Center, which essentially houses the seismography system, has 600m of laboratories and offices for researchers;

- o The Richard-Toll Station, which is highly specialized in ornithology research, has 300 m of laboratories and offices.

- o ORSTOM has an impressive equipment collection, particularly the microbiology laboratory. ORSTOM also has a complete routine soil analysis laboratory, but its equipment is outmoded.

ORSTOM does not have its own land for agricultural research, but instead uses that of Senegalese organizations.

e. Human resources and training

There are 227 employees at ORSTOM, divided as follows: two directors, 42 researchers, five students, eight research grantees (+VSN), 32 technicians, 68 laboratory technicians, and 60 other employees. The 42 researchers, which do not include the oceanography and nutrition researchers, represent 17 scientific disciplines.

f. Financial resources

Over the last three years, financial resources have amounted to an average of FCFA 375 million for operations and FCFA 27 million in investments. These figures do not reflect all resources used for ORSTOM in Senegal. Wages and some investment expenses (for equipment) incurred outside Senegal are excluded here.

The office manages and provides training in Senegal for a number of senior employees in the ORSTOM training course, with specialization in two years. An average of three foreign students are accepted for training each year in Senegal, and an average of five Senegalese nationals also take this course. On the average, three Senegalese researcher/trainees are included in ORSTOM's research teams for a period of two to four years. In addition, approximately 25 trainees from Senegal, the sub-region and Europe are trained each year by ORSTOM/Senegal researchers. The duration of the training periods varies greatly.

About ten of ORSTOM's researchers teach in post-university and university level training institutions.

g. Information resources

For all of the stations in Senegal, ORSTOM has about 5,000 works and purchases 100 each year. The number of scientific journals and reviews is estimated at 200. In-house production is estimated at 70 publications per year, led by the human sciences and soil biology. Improvement of storage, processing, and information systems is currently underway.

As part of its research programs, ORSTOM has established relationships with the national research institutes (ISRA and ITA), the University of Dakar (geology, zoology, and geography departments), the Institute of Environmental Sciences, development organizations (SAED, SOMIVAC, and SENPRIM), international agencies (OMVS, OMVG, CILSS, OCCGE, OCLALAV, Inter-State Schools and FAO), and various departments and agencies (Institut Pasteur, Directorate for Statistics, Ministry for the Protection of Nature, IFAN, BRGM, ASECNA, Ministry of Rural Development, and Directorate of National Parks).

4. Other research agencies

a. Organization for Research on Food and Nutrition in Africa (ORANA)

(1) Information

Founded in 1956, ORANA was merged in 1961 with the Organization for Coordination and Cooperation for the Control of the Great Endemic Diseases (OCGGE--Organization de coordination et de coopération pour la lutte contre les grandes endémnies) in Bobo-Dioulasso, Upper Volta. Its area of interest is nutrition in the member West African countries (Benin, Ivory Coast, Upper Volta, Mali, Mauritania, Niger, Senegal, and Togo). It operated using contributions from member countries, subsidies from associate members and from multilateral and bilateral assistance agencies.

(2) Personnel

The staff is comprised of 13 researchers, one senior technician, three technicians, and one team of temporary interviewers.

(3) Programs

ORANA is engaged in three principal types of programs. One type of program is field surveys, concerning food consumption, on the one hand, and the nutritional condition of the people, on the other. ORANA also undertakes research on analysis of food composition and on human biology (such as protein-energy malnutrition, interrelationships between nutrition-infection and immunity, nutritional anemias, and goitrous endemic diseases). Lastly, ORANA's programs include teaching in the Medicine and Pharmacy Department at Dakar and at various specialized centers (such as CESSI, and the school of social workers).

(4) Cooperation

In Senegal, ORANA has relationships with several organizations in the field that are under the authority of the Ministry of Public Health, and with the Institut Pasteur, ISRA, ITA, Senegal Food and Nutrition Service (SANAS).

ORANA also cooperates with various international and foreign organizations, such as ORSTOM, IDRC--the International Development Research Center, and the Ministry of the Plan and Cooperation.

b. Senegal Food and Applied Nutrition Service (SANAS)

SANAS (Service pour l'alimentation et la nutrition appliqué au Sénégal) is a division of the Ministry of Public Health. It is more or less the Senegalese counterpart of ORANA; its activities and programs are largely the same, particularly in the area of field surveyor of nutrition and consumption.

SANAS also cooperates with various national organizations, such as ITA, ISRA, and the Training Centers, and with international organizations such as ORANA, USAID, etc.

C. Critical Analysis of the Sector

1. Synopsis of the sector

The agricultural research policy is essentially established at three levels, each of which involves specific aspects and components:

On the national level, an Interministerial Council, (CIM-Conseil interministérial) dedicated to technical and scientific research or its specialized branches, is responsible for advising the government on policy in the sector (including goals and priorities in economic and social issues) as well as on the distribution of required resources. Sectorial advisory commissions, comprised of directors and specialists in research and agricultural development, are responsible for providing technical assistance in decisions made by the CIM or by the MRST.

On the ministerial level, policy is presently involved with problems of major interest for the agricultural community, in determining the objectives, standards, and resources of each of the sectors.

On the institutional level (ISRA, ITA, ORSTOM) the policy is to monitor the way the above mentioned objectives are fulfilled, maintaining high scientific standards.

The system's handicaps are essentially at the level of operation of the advisory agencies, and in communication among the various levels.

The advisory commissions are highly inefficient in that they meet very infrequently, have no continuity in the representation of the departments involved, and have no feedback or debate. The result

is the lack of an objective mechanism for measuring the productivity, relevance, and quality of research activities.

The commissions provide no technical support to the Interministerial Council, which generally only ratifies positions and proposals suggested at the ministerial level. There are inadequacies in the personnel and procedures for making policy at the ministry level, such as identification of development potentials and needs and striking a balance among the different kinds of research. There are also shortcomings in evaluation and promotion of research results.

Another problem is that of the legal statutes governing research establishments, neither those of an industrial nature nor those of an administrative nature are appropriate to the specific objectives of such establishments. The heterogeneous nature and the inadaptation of the institutional framework generate imbalances and internal distortions in the way they operate.

2. List of problems that affect the institutions' capabilities

a. Finances

Agricultural research is faced with a number of financial problems:

- o Insufficiency of operating and investment credits; this is true particularly for ITA and ISRA;
- o Irregularities in their implementation (ISRA/ITA) and resulting financing problems. Funds for research are subject to rather sudden changes in the financing laws,
- o Distortion in the structures of financial resources: financing from abroad is predominant, and often structures depend too heavily on it; there is a genuine public effort, but it is insufficient and irregular; there is almost no effort on the part of the parastatals and private sectors; and only limited resources of institutions themselves;
- o The lack of financial objectives, planning and programming on the medium and long terms for resources, to take into consideration how to replace foreign financing; and
- o Lack of control of the financing mechanisms in some institutes, such as ISRA and ORSTOM.

b. Material

The material means of the institutions are largely linked to the financial situations. They are particularly inadequate at ITA. ITA's problems in this area are related to the tiny premises that are not adapted to the role they play, a lack of regional branches, and equipment that, for the most part, has not been replaced in over two decades.

c. Human resources and training

There is no articulated policy for overall training of personnel that establishes the objectives and types of training, the courses of study and their duration, methodologies, priority areas, and pace of training.

There are also financial constraints for placement of persons sent for training (lack of planning and programming). Further, an education and training structure by and for research and structured research, specific training, continuous training, and methodological training is needed.

Lastly an appropriate legal status, common to all research staff, including researchers and technicians, is lacking.

d. Scientific and technical information

Lack of information and lack of communication have been identified as major obstacles to acquiring and utilizing techniques that would satisfy the needs of the country. Aware of the problem, Senegal has established a body for defining and implementing policy in the area of technical and scientific information: The National Center for Technical and Scientific Documentation (CNDST--Centre national de documentation scientifique et technique). Unfortunately, the agency does not operate with the expected effectiveness. This is mainly a result of the lack of a number of institutional links, an incomplete inventory of all target groups interested in information and a limited knowledge of the needs of the target groups, the lack of financial, material and human resources, and the lack of a genuine policy of information that involves promotion and development of the information circuit.

This agency will function properly only if the functions of production, data processing (both domestic and foreign), and distribution of data become operational.

3. Summary of the research staff's opinions on the sector's major problems

"According to the research staff's opinions, what are the most serious problems that have an effect on the ability to attain the objectives." The preceding is the wording of the questionnaire, addressed to a rather large range of staff, including the director, researchers, administrators, technicians, lower level staff, and to a wide range of institutions, such as ISRA, ITAM, ORSTOM. The questionnaire is ambiguous, and has other limitations as well. Given the mass of available information, we have used categories to attempt to arrive at an average group opinion.

a. Financial resources

These are invariably a source of major difficulties. The dominant characteristics are the insufficiency and irregularity, and the weak national participation of both public and private sectors.

The small amount of (or total lack of) investment in ISRA and ITA is inhibiting the growth of these organizations; operational budgets are largely used up in staff-related expenses. Financial problems at ISRA often inhibit the operation of ongoing programs and activities in the research centers.

b. Material resources

In general, physical plant and equipment are very old and poorly maintained, e.g. at Dahra, Richard-Toll and Bambey stations. Offices are inadequate at Dahra, Bambey, Kaolack, and Richard-Toll; laboratories and annexes are inadequate and not functional at Bambey, ORSTOM/Hann, ITA.

Cambérène, Dakar-Thiaroye and ORSTOM/Bel-Air are specifically mentioned as having adequate structures.

Laboratory equipment is outdated and poorly adapted at Bambey, ORSTOM/Hann, Dahra, and Kolda, and partly so at the National Livestock and Veterinary Research Laboratory. The same holds for field experimentation equipment at Dakar/Hann, Dakar-Thiaroye and Djibélor.

c. Human resources and training

In general, design personnel have a proper level of training, even if the range of their education/training backgrounds is broad. There is not enough design personnel at ISRA, particularly in forestry research, and they don't have sufficient refresher training programs (there are no policies or plans for this).

Senior technicians and senior-level administrators also have an adequate level of training, but usually lack practical experience and know-how. They would like to set up continuous academic training, and define what the needs and opportunities of this training would be. Special emphasis must be placed on administrative and financial management, maintenance and high technology.

The positions and opinions of the technicians and lower-level staff are more difficult to determine. The levels of qualification are rather varied, yet all of them would like to have continuous training. A rather sizeable portion of the implementation staff has no basic level training, and has only experienced on-the-job training.

Maintenance capabilities for equipment and infrastructures are in the worst shape of all.

d. Scientific information and communication resources

The communications problem is noticeable at every level, although the acuity of it obviously varies. What is particularly worthy of mention is the irregularity of contacts of one institution with another between staff members of the same category. This type of communication is most often established on the basis of personal contacts, as is the case for researchers.

Access to technical and scientific information poses no special problems.

e. Structural and other problems

The status of staff and their career perspectives are the subject of major concern. This is particularly true at the level of senior technicians and researchers. The personnel classification and benefits system that has been proposed to them is based on those of teachers at the University. It proposes real material benefits, but the opportunities for advancement for field researchers under this system will be limited.

The legal status of research institutes is felt to be inappropriate. The desire is to set up a regulation for the establishments of a scientific and technical nature that would emphasize the research function.

The social environment is also a subject of concern for staff at the excessively remote research stations of Dahra, Richard-Toll and Kolda. The problems of access to housing, to social services such as schools and hospitals, and to cultural institutions are among the more serious problems in this realm.

D. Analysis of Problems by Sub-Sector

1. Analysis of production

a. Plant production

Over fifty years of research efforts have (despite their somewhat unequal distribution) helped to give the rural sector the elements necessary for rapid development, notwithstanding the diversity and fluctuation of economic and climatic conditions.

Due to the lack of appropriate structures and an overall and coherent policy, the steps taken have not considered all of the existing problems in the production structures.

Until the present time, Bambey has actually been the national agricultural research institute. Research performed at Fanaye and Djibélor has been largely limited to rice growing, although some research has been performed on other crops in Fanaye. Past crop research activities suffered from a number of significant shortcomings:

- They were concentrated at the Bambey station, which is in a region where there was not much potential for increasing production;

- o Contacts with the extension services were few, and extension studies were based on phytogenetic selection, rather than on the farmers' problems;

- o Disciplines were too segmented, preventing rational coordination and programming of research; and

- o Studies were largely done in the stations. Few were done in farmers' fields.

As a result of these problems, the following steps are being taken as part of the sub-sectoral restructuring currently underway:

- o Decentralization of research activities to help the regional centers in Richard-Toll, Kaolack and Djibélor; and

- o Replacement of the fragmented unidisciplinary approach with a coordinated approach, using a multidisciplinary team that studies all of the problems of each crop.

Implementation of these decisions has begun as part of the Agricultural Research Project. Teams for millet, rice and cowpeas are now being set up. The groundnut, soybean and cotton teams are in the process of being organized properly. Others still suffer from a lack of human and financial resources. The sorghum and corn teams are at this point the most destitute.

Agronomists/phytotechnicians to develop and apply the research results obtained are lacking in all of these programs. In addition, the following are also lacking (in descending order of priority): geneticists-selectors; agropedologists, and specialists in areas of current importance, such as microbiology and physiology.

On top of the above-mentioned handicaps is a lack of experience. The research teams are quite young, and the coordinators that are appointed most often are inexperienced. Experienced researchers, able to provide genuine scientific leadership, as well as training for junior researchers, must be hired for all of the teams.

From the results obtained, the following directions and objectives have been established for the various programs.

Plant production, particularly groundnuts, has profited from the earliest attention, which today makes it possible, despite soil-related obstacles, to offer appropriate plant equipment and high-performance production techniques. In the future, the main work for groundnuts will continue to be opening up the genetic base to increase the qualities of resistance to drought, insects and disease, as well as the industrial and organoleptic qualities. Of course, aflatoxin will continue to be the focus of the concerns.

As for the traditional cereals, the main thrust of the effort will be on millet. The goal is to identify varieties that are productive, resistant to environmental adversity, and of sufficient quality.

The results obtained on sorghum are very encouraging. While strengthening the selection activities to increase genetic variability, emphasis must also be placed on the technology and application aspects.

The basic objectives are identical for all other cereals. Corn is certainly the cereal of the future for the entire Gambian belt. Its potential rests in development of non-hybrid synthetic strains that are adapted for this environment and for the shortening growing cycle. The whole post-harvest phase will need more research and greater coordination between agricultural, agro-business, and nutritional research activities.

The existence of two rice-producing areas that differ in their ecology and their production systems necessitates consideration, beyond the general framework of selection objectives, of several area-specific constraints. In the North Subsaharan area, the temperature factor is important. In the South area, particular obstacles are functions of the soil, diseases, weeds, and especially the lack of regularity in water. For that region, improvement of ideotypes 144 B9 (rain-fed), IR8 (shallow immersion), and Roer 5 (deep immersion), and development of effective and economical weed control techniques will make it possible for rice production to increase beyond present levels.

It is interesting to note that the area of development of the two secondary leguminous crops, cowpeas and soybeans, largely coincides with the development of millet and corn, respectively. This analogy of status will lead to some complementarity in the objectives and research activities. Emphasis needs to be placed on high-performance (productive and resistant) strains both in single and multiple-crop systems. Microbiology and food and industrial technology must play a very important role, regardless of the objective.

Establishing a new balance of research efforts in the area of horticulture would make it possible for the fruit sub-sector to overcome its current inactivity. As for produce, solving the seed problem, and development of research on varietal improvement of local vegetables (such as gumbo and pimentos), and on methods for preservation and development of all products, must be the major concerns.

b. Animal production

As in the case of the agronomic sector, research on animal production (which has existed for over 40 years), suffered from important structural imbalances prior to the establishment of ISRA. These imbalances were partly responsible for the slow growth of the sub-sector:

- The dominant research emphasis was placed on animal health, such as virology, bacteriology, helminthology, entomology and protozoology;
- Most of the resources and research were concentrated at the National Livestock and Veterinary Research Laboratory and its substation located in Sangalkam;

- o Production of vaccines was a major activity of the laboratory;
- o The research programs located in the Dakar and Kolda centers were oriented to problems of a zootechnical nature; and
- o Not enough attention was paid to the production obstacles faced by livestock herders and agro-livestock herders.

As part of restructuring and strengthening agricultural research through the Agricultural Research Project, the following decisions have been made:

- o To establish multidisciplinary teams concerned with bovine and ovine meat, milk, food and nutrition; and
- o To strengthen the capabilities and increase the field of competency of the other zootechnical programs in Dahra and Kolda.

First and foremost, there must be a critical mass of trained personnel in these various centers to cover all required disciplines. As is the case for plant production, the major handicap on this level will continue to be the lack of experience of the researchers. The physical plant and equipment, especially at Dahra, will have to be entirely rehabilitated and strengthened. If these conditions are met and if a production system team is set up, the platform of orientations for research, determined from the critical and orienting evaluation below, can be developed.

The major constraint in bovine production, in meat, or milk, or in labor, is feed. To improve the feed, the agrostology, fodder production and nutrition departments have set up continuous follow-up programs and programs for improving pasture lands. These programs also seek to diversify fodder crops and determine the food value of fodder and residues, in order to develop feed tables for tropical African animals. Pasture lands in the sylvopastoral zone in Senegal have been mapped, and the development of these lands is studied each year as a function of rainfall. Methods to improve them, such as analyzing the forest/pasture relationship, are studied jointly with the Water and Forestry Department. Monitoring pasture lands now uses remote sensing by satellite and systematic airplane reconnaissance flights, which make it possible to categorize the pasture areas and count the herds. Using a combination of these methods it is possible to set up the feed requirements for animals as early as October for the dry season and to take the appropriate steps.

Improving pasture lands by planting fodder plants has been tried in several areas in Senegal, with uneven results. Species studied are mainly Andropogon gayus, stylosanthes gracilis, S. humilis, Brachiaria mutica and corn and fodder sorghums.

The study of the food value of fodder progresses rapidly, but the means are lacking to strengthen the study that involves estimating

the theoretical needs of tropical ruminants. Hay and straw that are available in Senegal generally have a good energy value, but their content in nitrogenous matter that is digestible is quite insufficient, which calls for additional nitrogen input. Experiments attempting to develop rough feeds by chopping and processing them with sodium, ammonia or cellulose have not yet brought about any significant results.

As for pathology, the most notable obstacles are undulant fever and trypanosomiasis. Despite many years of research, proposed solutions have only been applied on a very limited basis.

Animal husbandry research has made it possible to obtain significant results at the stations, but they are not easily transferred into the traditional setting. The selection of the Gobra zebu has made it possible to produce males that weigh 115 kg at six months and 750 kg at four years of age. The selection of the Ndama bull is also making progress. The trypanotolerance of the Ndama does not seem to be correlated with any given type of coat. The draught bovines integrated into production operation are an important experiment and may lead to greater productivity.

As for marketing and branches of processing, the present system is quite cumbersome and is greatly debated. There are too many intermediaties, and the breeders and consumers are paying for them. Despite fruitful attempts at processing made by ITA, the results have not been adopted by industry.

Bovine milk production is dependent upon the same animal husbandry activities as those involving meat, especially those of disease control and feed improvement. One major obstacle arises from genetics, in which research on local animals is not very advanced. It would be useful to try to find male animals to use as reproducers that have high-producing genes from traditional herds. The most pressing problem in the area of dairy production continues to be feeding. The animals simply are not getting what they need.

Research is ongoing on local breeds: Peulh sheep from the Sahel, Touabire and Djallonké sheep. The factors that influence production are health and premature death. Small ruminant plague has not yet been controlled. At this time, industry crossings of Peulh sheep with an imported breed (Lacaune) are being tried and the results look promising. The profitability of ovine experimentation has not yet been demonstrated despite good results obtained in fattening. The only way to make the animal fattening operation profitable is marketing carcasses at fair prices.

Pork production is not very significant in Senegal. Traditional village pork production is not highly developed and little research has been done on this activity, besides the small-scale crossing efforts made on the Large White pork.

Similarly, little research has been done on poultry and poultry productivity, other than the study of diseases that affect them. However, direct introduction of "racing" roosters in village breeding

has resulted in a satisfactory outcome, with an increase in sizes and reproductive rates. Village poultry raising is not well managed as far as health and nutrition are concerned. It could nevertheless be competitive with the highly technological, intensive, modern poultry sector in terms of organoleptic qualities of the animals.

The horse production program is also attempting to improve horse breeds in Senegal through continuous crossing with high performance foreign breeds. The process of artificial insemination is used successfully at the Dahra research center.

In both North and South, the now dominant livestock systems are subsistance systems. This is due to the many environmental obstacles, as well as to constraints of a socioeconomic nature. To obtain profitable livestock, modifications are necessary, both in customary practices and attitudes.

The great nomads of yesteryear have given way to transhumants that travel only within well-defined zones. The extensive transhumant system has its limits. Rational management of grazing land by the herders themselves is an absolute necessity.

Models that have been established, such as intensive or semi-intensive modes of milk production, industrial feeding, industrial crossings to produce beef or mutton, as long as research defines the practical methods and demonstrates resultant and timely profitability, will be adopted by group or individual producers. The probability of success is seriously limited for such models if they are used solely in state-owned or partially state-owned organizations with large amounts of investment and labor intensity.

Present research on improving the milieu and feeding of animals is attempting to intensify animal production in the not too distant future, with possibilities for implementation throughout the country.

c. Forest production

Forestry research began in Senegal in 1968 and is still developing. The research first involved the groundnut basin regions, such as Thiès, Diourbel, and Sine-Saloum, as well as the woodlands and pastoral areas. In 1976, it was extended to include Casamance, and shortly thereafter, to Eastern Senegal.

In general, the major goal of forestry research in Sahelian and Sudanese regions is to locate and establish a new balance with the environment which is disturbed by several factors, including the drought cycle, brush fires, overgrazing, and man's activities. These factors brought about a serious decrease in the biomass: 30 percent of the forestry biomass in the Sahel. In a country such as Senegal, where the climate depends on both the Sahelian and the Sudanese domains, and which has a window on the ocean and a large river toward the North, overall forestry problems are presented in terms of desert encroachment and energy.

The result is that the major national policy directions for forest production are as follows: control of desert encroachment and energy needs for the people. Given these policy directions, priorities have been set and are summarized under lateral and vertical priorities listed below.

Lateral priorities that concern all regions of the nation are:

- Definition of forestry techniques, the cost of which is consistent with the Government's financial means and which can be implemented without interruption;
- Selection of tree varieties that are resistant to drought;
- Study of the water requirements for certain varieties, and extrapolation for artificial or natural plantations;
- Inventory of the various types of soil and identification of tree varieties adapted to them;
- Study of symbionts that could improve resistance to drought, increase production and conserve soil fertility;
- Quantitative and qualitative evaluation of the Sahelian and Sudanese ecosystems and study of their development;
- Promotion of forestry products, other than those that are ligneous; and
- Socioeconomic studies that make it possible to better understand the impact of the forest on environmental equilibrium.

Vertical priorities which include regional actions to be taken are:

- Conservation, improvement and enrichment of natural multi-purpose forests, for gum tree production, wood for heating, service, building and craftsmanship, hunting reserves, air forage, conservation and protection of soil;
- Reintroduce trees into the agrarian countryside in order to build windbreakers and quickset hedges, set up village or family woods, forage orchards as part of the implementation of the agriculture-forestry association;
- Meet the needs of the urban populations for heating and service wood using intensive planting of varieties that grow quickly;
- Adaptation and improvement of carbonization, gasification and combustion techniques; and
- Development of techniques that provide better use, better processing and better conservation of local types of wood.

As part of the implementation strategy to restructure its research activities developed in 1983, the priorities mentioned above have been translated into programs, operations and research activities.

Still, it must be recognized that the place of the sub-sector in the web of agricultural research remains limited, even marginal. The major problems that affect the development of forestry research are:

- o Lack of financial means allocated annually (about 6 percent of the total amount of resources allocated to research by the Government);
- o Difficulties of implementing the special research agreements signed by the sub-sector to improve its resources, such as CRDI, FAC, USAID. The administrative procedures are very cumbersome;
- o Lack of human resources, both research and implementation staff, as well as equipment;
- o Inexperience of national researchers;
- o Irregularity and insecurity of financial resources, (indicating unawareness of the essential role of forestry research in protecting nature) which often interrupts planting activities; and
- o Lack of participants at the grass-roots level, and of a relay structure to effectively utilize the research results.

d. Fish production

As the primary source of protein in the country, fish play an important role in meeting nutritional requirements, and also make a large contribution to improving the trade balance. The rate of growth was 13 percent for fishing over the last 2 decades, the highest rate in the primary sector. Expansion in this sub-sector is due to several factors:

- o Waters rich in nutritive salts are conducive to fish production;
- o A more favorable natural environment which is only partially dependent upon climatic variations allows greater technical progress; and
- o The establishment of a coherent fishing policy based on the rational use of national water potential, as regards the ocean and the rivers.

However, it must be mentioned that efforts made in the area of continental fishing have been insufficient due to structural and environmental problems. Sea fishing, on the other hand, which relates

to both the industrial and traditional branches, has developed dramatically since 1960. Catches have gone from 78,000 tons in 1960 to over 200,000 tons in 1980.

(1) Constraints

Although it is difficult to quantify, the share of research in general, and oceanographic research in particular, in the extraordinary development of catches continues to be significant despite the many obstacles it has encountered since the establishment of the Dakar-Thiaroye Oceanographic Research Center (CRODT--Centre de recherches océanographiques de Dakar-Thiaroye) in 1959 and the takeover by ISRA in 1974.

Among the most serious obstacles, the lack of financial resources has been noted in all sectors and manifests itself in the following ways:

- Weak and often irregular participation of the national economic operators in both the private and public sectors in financing research activities. The ratio of the share of fishing in the GDP to the financial resources allocated to fishing is quite small;

- The insecurity of financing from abroad, which is significant at this point in time. Some of this financing is linked to fishing or special agreements of a limited duration;

- Unlike the forestry sub-sector, the lack of relay "grass-roots" structures to effectively transfer the innovations, such as supervisory structures like the Regional Organization for Development of Plant and Animal Production/Société régionale de développement des secteurs productions végétales ou animales. The CAPAS example should however be emphasized;

- The lack of real exploration and rational follow-up tools and equipment for the sea environment and all of the stocks, for the special case of the deep-sea fringe, such as an appropriate research boat; and

- For this specific sector, the lack of national structures for training senior design staff for research.

Other problems of this sub-sector have already been listed under other sectors such as training, legal framework, statute of research personnel and social environment.

Though significant, these problems do not obstruct future growth. In fact, present results illustrate that Senegalese resources are used nearly to the maximum of their potential. An extensive review of the relative importance of the different types of fishing that make use of the major kinds of fish, of their area of activity and of the equipment used, shows, however, that increases in production are feasible as long as certain activities, such as research, are

emphasized. Its present and future action will be concentrated in the following areas:

- o Studies of the main migrating species, in cooperation with the laboratories in the sub-region, in order to determine migration patterns. Recourse to the use of magnetic signals will certainly provide some solutions. Furthermore, echointegration equipment, soon to be purchased, will help to refine data on the available biomass cartography; and

- o Improvement of fishing boats, as well as conditions for conserving fish on small-scale fishing boats.

Moreover, to supplement knowledge of how environmental factors influence the biological cycle of species, studies on coastal ecosystems are continuing; they should make it possible to determine the effect of environment on the survival and growth of larva, and the survival of young fish of the major species sought in the coastal areas. This multidisciplinary operation will include: sedimentology, hydrology, phytoplankton, zooplankton, and will also study pollution.

For the major species, these investigations will make it possible to determine the numeric development of cohorts (a population born in one laying) since they entered the coastal area and until they leave the area, which is actually the time they enter the fishery.

Presently, resource use, and choice of which sector to develop, small-scale or industrial, will be conditioned by socioeconomic considerations. In order to make an economic observation available to the authorities which would operate as a data base and means for assessing projects, decisions, fishing agreements, and regulations, various socioeconomic studies must be undertaken:

- o Small-scale fishing;

- o Study of the domestic market;

- o Industrial-scale fishing; and

- o Fishing industries.

In the unfortunate case of the continental fishing component, research on fish breeding has been in a state of total lethargy for over a decade.

The total catch for this type of fishing has increased from approximately 30,000 tons in 1967 to nearly a third of that amount in 1980. Many factors, including drought, environmental conditions, social and economic problems, are blamed. However, objective elements for evaluation are not provided.

Among the reasons for this shortcoming, those related to research are as follows:

- o The marginal status of this component, i.e., a lack of interest;
- o The lack of research on continental fishing and aquaculture, i.e., a structural flaw in ISRA;
- o The total lack of financial resources to set up and maintain necessary structures;
- o The scarcity of qualified human resources; and
- o The lack of a policy and national structures responsible for the promotion, coordination, development and follow-up of these activities.

(2) Objectives

Once critical resources, such as financial, material, human and institutional, are in place, continental fishing research can be carried out in Casamance, in the Senegal Valley and in Upper Gambia. Then it will be necessary to estimate production from models that include rainfall, morphology, and soil conditions of basins that flow into the various portions of a river.

As for environmental study, emphasis will be placed on establishing an experimentation system that will establish aquatic environment quality standards so that the environment is not abused.

One of the aquaculture-related problems is the need to improve local species. The species selected must be at the low end of the food chain. In the Sudanese and Sub-Guinean area, emphasis will be placed on those species that have a high commercial value. The numerous species that are preadapted to breeding conditions will be the subject of fundamental biological studies.

e. Production systems

Production systems research designed to limit or eliminate obstacles faced by the Senegalese breeders has been identified in the field, and then assessed to confirm its validity. It is still in the early stages. The exception is the experience of the experimental units in Sine-Saloum designed and and set up along the same lines, but with another methodology.

In the approach now being used, each systems research program is composed of three elements:

- o Identification and quantitative evaluation of social, economic and technical obstacles through studying existing production systems;
- o The search for a solution to obstacles in the operations themselves and at the station; and
- o Attempts at using these solutions in the operations.

Identification consists of continuous study of the obstacles as opposed to the introduction of new techniques. Each research team works from obstacles already identified and quantitative evaluations of the various regions. The base composition of each team will be an agronomist as a generalist, a breeding specialist, an agricultural economist, a rural sociologist and an agronomist who specializes in agricultural extension. Other specialists will be added, if need be, to analyze more precise obstacles. To resolve some special problems, during short periods, the teams will have recourse to assistance provided by members of the product research group, from specialist responsible for support research, and from highly specialized foreign consultants.

Four plant production teams and two animal production teams will settle in different ecological zones as indicated by ISRA's Transfer and Production Systems Department. Some of the teams are already in place. This is the case for the following:

- The River Valley System Team. This team's activities are concerned with irrigated agriculture based on the cultivation of rice. Rice growing, combined with other crops and animal raising will thus be made a first priority. Even though irrigated agriculture is the main thrust, traditional systems will continue to be maintained until they are absorbed. Some team members are already in place, such as the agronomist and the economist, and are involved in rough preliminary operations;

- The Sine-Saloum System Team. The production systems research team is trying to introduce innovations into the Sine-Saloum region based on the experience of the experimental units. The team is still incomplete, with only an agronomist and an economic sociologist, and is not very active. The important components of this program should be animal and plant protection, animal feeds, regeneration of soil fertility and is not very active. The important components of this program should be animal and plant protection, animal feeds, regeneration of soil fertility and rational soil development, and agricultural mechanization, with everything centered around producers' concerns; and

- The Lower Casamance System Team. The production systems research team based in Djibélor will concentrate its effort on rice-based agriculture. This region provides a great contrast to the Senegal River Valley and thus must have its own team to research operation systems. Rice growing problems in the swampy mangroves, in both irrigated paddies and plateau crops, require a cooperative research effort. Results obtained by teams responsible for operation systems based in Nioro du Rip and in Kolda should be applicable to the production areas of the plateaus of Middle Casamance. Thus, the team involved in agricultural operation systems in Djibélor should concern itself mainly with rice and small diversified agriculture in which raising of certain cows, sheep, and trypanotolerant caprines, as well as pork and

poultry, is especially important. The entire team (in place) is comprised of two agronomists, 2 economists and one sociologist, supported by the "rice program," and by forestry and hydraulics specialists.

At this point, this team is not very active. Among its responsibilities is to develop a methodology which is better adapted to Senegal.

A vegetable production team for production systems is planned for the Eastern Senegal region. Both teams mainly responsible for breeding will settle in Dahra for the forestry-grazing zone and in Kolda for the Upper Casamance area.

Given the newness of this sub-sector, the problems are limited to conceptual and strategic aspects:

- o There is no standard research methodology for production systems that can be adapted to research on animal or plant production systems in Senegal. The methodology must be developed on site. The major handicap is that the available short-term expertise consists of teams which are "young" and organized by researchers that do not have enough experience;

- o Lack of logistical and budgetary means, as well as the capacity to automatically process the data on site. This situation gives rise to more progressive programming of team settlement;

- o One real difficulty is to put an integrated approach into practice, regardless of the scale involved; and

- o The critical mass of basic information on agriculture.

The lack of well-trained and experienced managers at the national level is a subject for macro-economic studies. However, it must be explained that the teams for these aspects has just been set up.

f. Nutrition and food technologies

Problem analysis in this sub-sector will be concentrated at the national level through ITA. Its mission, objectives, activities and results have already been described.

At the national level, the most important problem of the sub-sector is the difficulty of coordinating activities among the various organizations, such as ITA, ORANA, and SANAS. The causes of this problem are the different legal frameworks (status and trusteeship) under which they operate and their relatively distinct yet complimentary missions.

ITA's major problems are of a legal, financial, administrative, and technical nature. Other problems concern training the institute's agents, and the lack of application of research results.

(1) Legal problems of ITA

The legal framework of the research establishment is not ideal for managing a program or research project. This establishment is not ideal for managing a program or research project. This establishment is, in most cases, either "administrative," or "industrial and commercial" in nature. Their budgetary control systems are often not consistent with the requirements of scientific and technical research.

This framework does not encourage the passage of laws to improve personnel status.

(a) Personnel

The staff is regulated by:

- An order that relates to all of the senior managers (bachelor's degree and a specialty, plus a doctorate) as well as all senior technicians (DUT and BTS diplomas). It plans for no advancement and has a number of gaps. It makes no provisions for those who have masters degrees, DEA diplomas or DESS diplomas, nor for those who have diplomas form institutions that are not part of the French system. Furthermore, the order does not give any explanation of the type of doctorate, even though there are several types and several very different levels of doctorates;

- A collective trade agreement that involves the technicians and other senior agents which is enforced in a highly confused manner, particularly when it comes to promotions; and

- The shortcomings of these regulatory provisions have caused a number of resignations in all professional levels within the establishment.

(b) Protection

It should also be emphasized that the present statute of the Institute does not lend itself to promoting its effort to make the delivery of its services profitable.

Furthermore, the numerous results of the Institute are not protected by patents or licenses, despite the fact that their use by industry or private citizens does not include any sort of compensation for the Institute. Finally, it should be mentioned that no legal framework defines ITA's relationships with future pilot plants that may use the results of its work. In such a situation, it is difficult to motivate staff.

(2) Financial problems

The lack of operating and equipment credits at the Institute hinders the execution of tasks which will help it to reach its objectives. Delays in procuring credits hinders the work of laboratories and pilot workshops.

(3) Administrative problems

The most serious administrative problems are lack of an adequate administrative structure and the lack of an inside regulatory policy, which creates a number of flaws in personnel management and in the Institute's financial and material management.

Financial management (management by objectives) of the research programs and projects must be administered by a center of responsibility in a decentralized manner. Thus, it requires strict planning, based upon objectives set and carried out by those who are responsible for the projects or programs.

Yet, often the researchers have little knowledge of financial and accounting management, which significantly hinders the operation of central responsibility management system.

(4) Various problems

Problems other than operational ones linked to the lack of material, financial and human means and frequent stoppages caused by equipment in poor condition are mentioned here. The equipment, usually purchased through an international call to tender, have rather diverse origins.

Furthermore, the international isolation of the institute is deplorable. It has no joint programs with other agencies for research in the food sector. Exchange programs with foreign countries must be established to keep pace with science and technology.

The lack of an appropriate structure for training high-level managers in the fields of food technology and nutrition in Senegal forces the country to turn abroad for training and specialization of its agents. The agents are usually trained in training centers.

Moreover, the diversity of the foreign training centers produces a variety of diplomas which causes serious problems for uniformity.

With the exception of a few attempts, such as Pamiblé, the use of ITA's results in developing national resources to meet local nutritional and food needs is still insignificant.

This overall situation is due largely to a shortage of raw materials and the lack of a national network for collecting and distributing foodstuffs.

2. Description of solutions and possibilities for action

The analysis of the sectorial obstacles listed on the preceding pages, when placed within an overall logic, calls for the following remarks and conclusions:

- o The ability of the agencies and research teams to respond to thematic objectives and goals in their fields of activity is very unequal;
- o Despite the diverse nature of the fields of activity and abilities, the major problems identified are common to all. For the most part, they are linked to questions of a legal nature, such as structural, financial and human obstacles; and
- o The evaluation of obstacles must be done within the overall context of the rural sector, considering its realities and limits.

That is why in the effort to identify solutions to link structures, to improve and rationalize their activities, and to coordinate their actions, a clear distinction is to be made between the institutional and structural aspects and the technical aspects.

a. General recommendations

(1) Directly related to research

The following recommendations are in order:

- o Alteration of the present legal framework of research institutes to public scientific and technological establishments;
- o Establishment of a structure to promote and transfer innovations responsible for developing the research results on both the small-scale and industrial level;
- o Improvement of the means of evaluation and formulation of technical and scientific policy in the agricultural and agro-business sectors;
- o Establishment of a statute that motivates the research staff, by considering the specific nature of research carried out in the agricultural or agro-industrial institutes;
- o Growth and security of credit for operating and investment, which must be considered in light of the pressing problems of the national treasury, particularly with respect to recurrent

costs. Finance should ideally represent between 3 and 5 percent of GDP;

- o Strengthening and coordinating equipment specifications;
- o Improvement of administrative and financial management capabilities through recruitment and training at high levels;
- o Preparation of a national training policy for research personnel to include the objectives, type of training, subject matter and duration, methodology, priority areas and pace of training. In particular, the training capabilities of the research institutes must be improved;
- o Strengthening of scientific and technical cooperation, on both the national and international levels, through framework agreements among research institutes;
- o Improvement of the senior management recruiting policy for researchers and technicians, to attain a threshold of 75 percent nationals for overall staff;
- o Promotion and development of a national information circuit, done by reorganizing and strengthening the documentation centers; and
- o Improvement of the social and cultural environment of researchers and technicians.

(2) Indirectly related to research

The following recommendations are in order:

- o Promotion of communication and cooperation among basic or applied research institutes, agencies for supervising rural populations, professional associations and users of technology. Toward this end, it is necessary to establish legal, administrative and institutional means as needed. In particular, the following are needed: establishment of a permanent cooperative group at all levels among research, education and agricultural extension, and establishment of an exchange program for institute managers;
- o Expand the role of research in training rural development agents. Special emphasis must be placed on improving the management of goods, service and maintenance;
- o Improvement of the rural communities' abilities to make money by setting up a coherent national policy for agrarian reform to include: a price policy for producers that provides incentives; a reorganization of marketing circuits; a decrease in certain production-related burdens; a policy to diversify and develop sources of energy for the agricultural sector,

such as solar, wind and biomass energy; a reorganization of producers' groups, based on giving greater responsibility to the members; and

- Fostering the establishment of small and medium-sized enterprises to process local production.

b. Scientific and technical recommendations

The following recommendations attempt to integrate various agricultural dimensions (socioeconomic, processing, nutrition);

- Study and development of environment;
- Inventory and study of the development of the principal ecosystems (phase II of the Pilot Project for the continuous Monitoring and Inventory of Pastoral Ecosystems in the Sahel: Regional Level Extension and Other Ecosystems;
- Continuation of studies on climatic evolution and predictions of drought cycles on a regional and world level;
- Use of high technologies, e.g., satellites and radiometry, to take an inventory and become aware of mineral resources and living resources such as fish supplies and forests on a regional level;
- Establishment of a coherent policy for the development of irrigated crops. Rational use of water resources considering the special characteristics of the soil, climate and crop. This involves improving irrigation techniques used in the river's perimeters, such as reduction of losses in the network, improvement of the water tower, experimenting with integrated development techniques, small outpouring basins and small valleys in Sine-Saloum, Eastern Senegal and Casamance for anti-salt dams, hillside dams, anti-erosion protection of slopes, and to intensively pursue research on agricultural development of semi-arid and arid areas;
- Promotion of a policy for water pumping and conservation intended to supply villages, using equipment and management of works, fluoride treatments;
- In particular, it is necessary to: study the possibilities for producing pumping equipment locally as well as prefabricated wide-diameter, simple, piping equipment appropriate to local conditions;
- Study the means for rational use of water holes in forest-grazing areas;
- Establish a national soil department, with qualified staff and equipment for a laboratory for analyzing and mapping soil. In the long run, this involves complete coverage

of the country on appropriate scales in order to provide forestry, pastoral and agricultural development and planning;

- o Special attention must be paid to improving and safeguarding the environment by concern for the problems of erosion and soil restoration; and

- o Continuation of studies on the regeneration and maintenance of soil fertility, with special attention paid to rainy areas. The use of local mineral or organic additives that are efficient and inexpensive must be a permanent goal for research.

(1) Plant production

(a) Overall recommendations

Increase efforts to set up the following on the national level:

- o A regional bank;

- o A regional pesticide control laboratory;

- o A plant quarantine facility; and

- o A national commission for the preparation of an official catalogue.

These steps must be combined with strict regulation of plant material introduction (strengthen the services of the health policy) and seed production.

A center for production of fodder seeds should also be established along with a network of warning stations for plant protection which emphasizes integrated control to reduce operating costs, intensify study of the possibility of local production of tools and machinery and to contribute to the training of local craftsmen for maintaining agricultural equipment, especially in the case of animal traction.

(b) Food crops

Continue efforts to select varieties adapted to various ecological conditions, that resist diseases and insects with good grain organoleptic quality; the research effort should make it possible to develop a varietal map by crop.

Develop work on the fonio, angola pea and casava. Strengthen the financial and material means of research to enable it to meet the needs of "foundation seeds," and arrive at a better understanding of ecology and the dynamics of the main dangers. Intensify research activities that involve integrated control in order to reduce operating costs. Continue work on techniques for food crop processing both on the level of the farmer and industry. Set up tables of recipes

that can be used by the farmer for his own consumption needs. Continue studies linked with the socioeconomic aspects of food crop production. The studies must in the final analysis improve distribution circuits for cereal production through better organization of collection and transportation.

(c) Industrial crops

Direct varietal improvement of the groundnut to obtain the following characteristics:

- o Resistance to foliar diseases: rust and cercosporiosis;
- o Resistance to soil-borne diseases: pythium, rhizoctonia, sclerotium, macrophomina, and aspergillus;
- o Resistance to the penetration of Aspergillus flavu and to the development of aflatoxin;
- o Tolerance to drought; and
- o Potential of nitrogen fixation by rhizobium.

Begin a program on the entomology of the groundnut in order to:

- o Protect the plant both during growth and after harvesting;
- o Evaluate the economic importance of pests on groundnut supplies;
- o Evaluate the real effect of the use of pesticides on the increase of yields and the reduction of losses in supplies; and
- o Promote a reasoned use of pesticides to provide effective protection without danger and at a low cost.

(d) Horticultural crops

Balance research efforts to favor legumes of local origin, emphasize the processing and conservation aspects, and recharge fruit research organizations by providing them with the financial, material, and human resources they require.

(2) Forest production

Special priority should be given to research on local varieties, with emphasis on the technology problem, and also to research on by-products, the role of which cannot be questioned in the socio-economic balance. Begin work on improving forest fruit varieties as part of soil development, study the bio-ecological consequences of large works, such as dams and mines, on the forest, and study wild fauna to protect it, without dismissing the possibility of introducing species and hunting development.

(3) Animal production

(a) Animal products

Continue selection work on cow and sheep local breeds, and the search for better methods to spread genetic progress, and strengthen research on modern artificial insemination technologies, such as extension of the bovine and ovine industrial crossing experiment. Perform research on low-cost conservation of meat products.

Undertake crossing tests, followed by research, on local pigs with the Large White and Landrace breeds, and genetically improve the Senegalese pork breed. Continue research on birds and also milk production studies using imported high-performance and local cows.

(b) Animal feed and health

Continue and strengthen research on the evaluation, development and management potential of natural pasture lands. Emphasize the haymaking technique. Continue and intensify research on fodder culture to integrate it into farming. Test research on physiology and behavior of domestic animals in large ecological areas of the country, in particular, to solve the problem of the food crisis during the month of July. Continue research on the most economic fattening rations and study the causes of success or failure of peasant feeding of animals on small herds. Continue research on aviary pathology. Intensify research on diseases linked to trematodes and mollusks.

(4) Fish production

Continue studying major migratory species in cooperation with sub-regional laboratories. Multidisciplinary studies on the coastal ecosystem and the use of the biomass of hydrophytes should also continue. New studies should be undertaken of the stratification of marine sediments (for rational usage of available alcoves) and the biology and feeding of species in their natural habitat. Socioeconomic studies on industrial fishing, fishing industries and the domestic market should also be valuable but small-scale fishing investigations must not be abandoned.

For aquaculture, set up functional, efficient research and development structures for fresh brackish and salt water fish. This would be especially valuable at the sub-regional level.

Follow the movements of fauna at the sub-regional level to estimate species' availability and edemicity in different parts of the river.

Improve fishing boats and fish storage conditions on board small-scale fishing boats. Set up relay and transfer structures, such as pilot use centers, to assess economic and technical standards.

Develop several production systems, taking into account the position of the fish in the food chain, and compatability with other activities.

IV. TRAINING INSTITUTIONS

Several ministerial departments in Senegal are involved in agricultural training. Each of the departments has professional training establishments with its own specialties and distinct goals:

- The Ministry of Higher Education trains upper and middle-level personnel through specialized schools and institutes under its supervision;

- The Department of Education is controlled by the Ministry of National Education and is generally responsible for training entry-level personnel. The technical ministries that use the trained personnel cooperate in the training. These ministries are: the Ministry of Rural Development, for technical personnel in the areas of animal husbandry and agriculture; the Ministry for Environmental Protection, for technical personnel in the areas of water and forests; the Department of Maritime Fishing, for personnel in the areas of oceanography and maritime fishing; the Ministry of Technical and Scientific Research, for personnel in all sub-sectors; and

- The Ministry of Social Development provides professional training for people in rural areas. The training is intended to help them improve their living conditions.

A summary of the structure and operation of these various establishments appears below:

A. Training Establishments and Designers

1. Training establishments for upper-level personnel (outside the university)

a. The Interstate School of Science and Medicine (EISMV--L'Ecole inter-états de science et médicines vétérinaires)

This school was founded by the Etats de l'organisation comune africaine et mauricienne (OCAM), and is operated by a Board of Directors, comprised of all African member states, whether they belong to OCAM or not. These states assist in financing the school.

The following candidates may register for the preparatory year of Veterinary Studies: students who have received their baccalauréat in secondary level education (series C or D), or who have an equivalency that allows them to register for studies. Education for the preparatory year is organized by the Science departments of the University of Dakar and by the EISMV.

The following candidates may register for the first year of veterinary studies:

- Those who have received the Preparatory Certificate for Veterinary Studies (CPEV--Certificat préparatoire aux études vétérinaires)

- Those who have received the university diploma in scientific studies (DUES--Diplôme universitaire d'études scientifiques chemistry-biology); and

- Those who have passed the competitive entrance examination for the French National Veterinary Schools.

Following the baccalauréat, training at EISMV lasts six years and includes:

- One preparatory year;

- Four years of veterinary studies; and

- One year of thesis writing, after which the thesis is defended and candidates receive the Doctorate of Veterinary Medicine.

The school is involved in both teaching and research. It provides higher education, which is comprised of basic veterinary knowledge i.e., all aspects of production, conservation and uses of animals, with particular emphasis on Animal Husbandry, Hygiene, Medicine, Surgery and Pharmacy for domestic animals, as well as the control and use of animal products, including fishing products.

The training emphasizes important aspects of the students' future activities: animal production, processing and marketing of animal-related commodities, but also its role in public health.

b. The National Institute of Rural Development (INDR--L'Institut national de développement rural)

The INDR is an administrative and public agency with its own legal characteristics and financial autonomy. Its objective is to train rural development engineers in scientific research in the fields of agriculture, animal husbandry and water and forests.

Training at INDR is provided under the supervision, control and follow-up of a Board of Directors and a Teaching Committee, which is comprised primarily of representatives of governmental agencies that hire future INDR engineers.

There are five different teaching departments at INDR:

- Vegetable sciences and technology;

- Animal sciences and technology;

- Earth sciences;

- o Social and economic sciences; and
- o Rural engineering and agro-food industries.

There are two cycles:

- o The cycle for preparation of the competitive entrance examination; and
- o The training cycle recognized by the Rural Development Engineer Diploma.

Preparatory cycle studies last one year and are currently provided by the Sciences departments of the University of Dakar (Faculté des Sciences de l'Université de Dakar). Candidates who have a baccalauréat of secondary level education (series C and D), and who have passed the entrance tests, may register for the preparatory year.

The training cycle is open to:

- o Those candidates in the preparatory cycle who have been admitted to the direct competitive examination; and
- o Those agricultural, rural, animal husbandry, water and forestry engineers, and those cooperation and rural expansion inspectors, who have at least five years of professional experience and who have been admitted to the professional competitive examination.

Training cycle studies last four years. The first year of studies is in core subjects, making it possible for the students to acquire a knowledge of the basic sciences and agronomic techniques.

The second and third years of study include required and optional subjects that are intended to prepare the engineering students for a subsequent specialty.

The fourth year of studies is devoted to the student's chosen specialty.

There are 200 places available; 10 percent of them are reserved for foreign students, or:

- o 60 first year places;
- o 40 places for the following years; and
- o 20 places for foreign students.

INDR accepted its first nine students on January 5, 1983. The term is from January to November, which makes it possible to study growing activities during the rainy season.

By 1984 the teaching structure should be in place. A program for the training of trainers now exists to provide technical assistance over the next three years.

2. Training establishments for mid-level personnel

There are three training institutions for mid-level personnel:

- The National School of Rural Training at Bambey (ENCR--l'Ecole nationale des cadres ruraux de Bambey);
- The National School of Applied Economics (ENEA--l'Ecole nationale d'économie appliquée); and
- The National University College of Technology (ENSUT--l'Ecole nationale supérieure universitaire de technologie).

a. Non-university institutions

(1) The National School of Rural Training at Bambey

ENCR was founded in 1960 to meet the training needs in rural areas. ENCR's role is to train engineers in the fields of agriculture, animal husbandry, water and forestry, and hunting.

During the initial stages of its development, ENCR recruited students holding the first cycle elementary diploma to study for four years.

Since academic year 1971-72, recruiting has been at the baccalauréat level, and the program was reduced to two years of study. As of October 1976, the training was increased to three years for the same recruiting level. Studies were extended owing to qualitative changes in the educational program.

Since its inception, ENCR has graduated 19 classes, or 666 engineers, distributed as follows:

- 372 agricultural engineers;
- 143 animal husbandry engineers;
- 123 water and forestry engineers;
- 18 rural engineers: and
- Ten fishing engineers (the section was transferred to the fishery center at Thiaroye in 1971).

Studies have shown that nearly 90 percent of the sectors and 10 percent of regional inspector positions in the fields of agriculture, animal husbandry and water and forestry are filled by ENCR graduates who also have been made division officers for training, assistance

and research services, such as the SODEVA, the SOMIVAC, the SODAGRI, the SODEFITEX, the SODESP, and in particular, the ISRA.

(2) National School of Applied Economics

Founded in 1963, ENCR is a higher-level short-term teaching establishment. Its role is to train personnel responsible for the operation of training structures in rural areas, such as management, training, cooperation and land development on various levels, such as rural communities, districts, counties regions, and the nation.

The school helps promote government agents by providing supplemental training for persons with some professional experience who have passed the school's competitive entrance examination. This first task was in fact completed when the school was founded. However, since the reform of 1971, ENEA recruits the vast majority of its students from among those who have the baccalauréat and the Diplôme de fin d'études moyennes (DEFM).

ENEA has six academic departments: Land Development, Management, Cooperation, Mid-level Practical Teaching, Planning and Statistics. Training varied from two to four years between the first and seventh graduating classes. The new system consists of three years training for teaching auditors inspectors, engineers and monitors, and two years for the technical agents.

When they arrive, the students from every department receive general training in the core subjects, as well as an initiation to new subjects and approaches.

True vocational training actually begins with the second year, while the third year is devoted to specialized training.

From the eight graduating classes, 189 ENEA students have received diplomas as follows:

- 32 technical cooperation agents;
- 103 managers; and
- 54 statisticians.

The ninth graduating class will include 194 students. ENEA is accepting more and more foreign students, mostly Africans.

There is a capacity of approximately 30 per graduating class per department.

Two-thirds of the permanent teaching staff, as well as the freelancers, are Senegalese.

ENEA receives assistance from USAID which has made it possible to:

- o Establish three training centers;
- o Build new facilities (for internships, a library, an amphitheater, etc.; and
- o Establish a project to train trainers.

b. The National University College of Training (previously Institut universitaire de technologie--IUT).

The primary role of this establishment is to train mid-level personnel in tertiary and industrial production centers, in applied research, and in services. ENSUT thus has a two year program leading to a university diploma in technology. This program is original, on the one hand, in that the technical training was designed with professional goals in mind, and on the other hand, in the composition of the teaching staff which includes professionals, company executives and upper-level personnel from both the private and public sectors along with teachers from upper-level and secondary education; and finally, in that the flexibility of its structures makes it possible to offer many and varied program options. Such a policy requires close and permanent contacts between the management of ENSUT and user services, such as ministerial departments, private organizations and businesses. These contacts also assist ENSUT graduates in seeking employment.

Steps taken in Senegal to promote technical education both on the secondary level and on the upper level, and the possibility for DUT graduates to return after two years of professional life to work toward an engineering diploma, have ensured the program's success. For ten years, ENSUT has trained 1,600 graduates, 1,300 of whom are upper-level technicians, and 300 of whom are technological engineers.

The Senegalese government bases it argument to give public status and facilities to ENSUT on the above-listed unique conditions.

Besides traditional programs, for the last four years, technical secondary school teachers have been trained at ENSUT.

The capacity is 15 students for the engineering diploma and 12 students for the University Diploma in Technology.

ENSUT plays a role in training qualified agricultural personnel, mostly in the following areas:

- o Laboratory technicians for agro-food industries;
- o Service technicians for the defense of plants;
- o Hydraulic and rural engineering technicians; and
- o Meteorological technicians.

3. Training establishments for entry-level personnel

a. The School for Agricultural Technicians (EATA--L'Ecole des agents techniques de l'agriculture de Ziguinchor) (Casamance)

Founded in 1963, the School for Agricultural Technicians recruits students who have the Diplôme de fin d'études moyennes (DFEM) for a three-year period. Foreign students who can meet the requirements are accepted pending their government's approval.

The studies result in the Technical Agent Diploma, which leads to work as extension agents. Twenty-five students per graduating class are accepted.

The school has the following assets:

- A farm of 120 ha where the major crops produced are groundnuts, grains and cotton, with about 80 ha of fallow fields;
- A herd of 25 cattle and 100 heads of poultry;
- A horticultural farm with 3.3 ha of fruit trees and 0.6 ha of truck farm produce; and
- A forestry area of ten ha.

The school also has a practical training area, comprised of three villages used for extension training programs.

The teaching staff is comprised mainly of agronomic engineers, 90 percent of whom are Senegalese.

In 1982, the school had 64 students, 21 of whom had graduated.

b. The School for Animal Husbandry Technicians at Saint-Louis (L'Ecole des agents techniques de l'élevage de Saint-Louis)

Founded in 1962, the School for Animal Husbandry Technicians at Saint-Louis recruits students that have the DFEM diploma into a three year program. The capacity of the school is 30 students. Foreign students are accepted if they are sponsored by their government and if they fulfill the same conditions. The studies result in the Technical Agent Diploma, and graduates serve in the Ministry of Rural Development and in development companies.

The school possesses:

- A veterinary clinic;
- A natural sciences laboratory;
- A bee-keeping room;

- o A teaching farm of 12 ha, six of which are for forage;
- o A herd of 45 heads of cattle;
- o A herd of 36 heads of sheep; and
- o Five hives for bee-keeping.

Sixty percent of the teaching staff is Senegalese.

In 1982, there were 61 students, 20 of whom had diplomas.

c. The School for Water and Forestry Technicians at Djibélor (L'Ecole des agents techniques des eaux et forêts de Djibélor-Ziguinchor-Casamance)

Founded in 1963, the School for Technicians at Djibélor recruits students with the DFEM diploma for its three year program. Foreign students are accepted if their government allows them to attend and if they fulfill the same conditions. The studies result in the Technical Agent Diploma, and graduates serve as the extension agents in the Water and Forestry Department or as agents detached to forestry projects or to the service of agriculture.

The school has:

- o A laboratory especially for fish breeding;
- o A teaching farm of 150 ha; and
- o A practical training area for extension courses.

d. The National School of Horticulture at Cambérène (ENHC--L'Ecole nationale d'horticulture de Cambérène)

The role of this school, founded in 1975, is to train public and private sector technicians in the field of horticulture.

Presently the school provides three types of training:

- o Certificat d'aptitude professionnelle horticole (CAP);
- o Brevet professionel horticole (BPH); and
- o Brevet de technicien horticole (BTH).

The teaching structure is different from the others; there is no separate structure for social promotion training (CAP-BPH) and training technicians (BTH). Also, the Director and Professors serve in both sections.

ENH has a training farm of four ha which may be expanded to ten ha.

The CAP-BPH social promotion section is built on alternating cycles between training at the School and working with an employer. Students in their fifth year of secondary school or former students of horticultural initiation centers (described later) may enter this section. The entrance examination assumes that the student has had professional experience. The program lasts three years. The number of students that can be admitted annually is from 43 to 45 for the CAP as well as for the BPH.

The BTH section leads to much higher levels of general knowledge and agricultural capability. Students are admitted to this section after they obtain the final diploma of mid-level secondary studies (DFEM). The program lasts three years. In each new class 35 students can be admitted to this section. The curriculum includes two years of required courses and a third year of specialization with two options:

- o Ornamental horticulture, gardens and green areas; and
- o Truck farming and fruit growing.

France is now helping to restructure the school.

4. Training centers and agricultural initiation centers which are part of the Ministry of Rural Development

The government of Senegal is activating the process of social and economic development by educating the masses to play a role in improving their own living conditions. To this end, it solicited and obtained assistance from the United Nations Special Fund to prepare an action program for rural vocational training.

The International Labor Organization is responsible for the implementation of this program.

From the structural standpoint, Rural Vocational Training (RVT) is presented as a training activity that is both diversified and integrated to the extent that it is addressed to men, women, children and adults in all sectors of activity in rural life.

The activity also involves training of trainers on two levels:

- o Training of trainers (teaching instructors in rural practices); and
- o Training peasants, such as rural pilot projects for livestock farmers, fishermen and craftsmen.

Horizontally, this activity is arranged differently, but the methodology is quite similar:

- o Training centers system;
- o Horticulture initiation centers system; and
- o Follow-up and post-training system.

Vertically, the activity also involves training, but does so on different complementary levels:

- o Training of instructors according to the needs of the pilots; and
- o Training of pilots, reduction agents.

The system includes:

- o A team at the central level; and
- o 21 training centers and advanced training centers, plus eight follow-up teams and five individual follow-up units in the region.

The centers are distributed as follows:

- o There are five agricultural centers, the objective of which is to train women in economic, social and technical practices that are adapted to their needs, in their three-fold roles as spouses, mothers, and producers;
- o An advanced training center for truck farming, the objective of which is to provide advanced training for pilot truck farmers and couples in the medium term;
- o A national training center for irrigated agriculture of Nianga;
- o Fishing centers to improve working conditions for fishermen and their sons;
- o Craftsmanship centers which are to provide craftsmen with advanced training in their area of expertise--metal, wood, or buildings; and
- o The national training and advanced training centers, the objective of which is to provide training for instructors oriented to advanced training of service craftsmen in the rural sector and to simultaneously provide advanced training for craftsmen to enable assistants to find practical applications for their work.

5. Special cases of training institutions for fishing

The vocational and professional training institutions for fishing in Senegal include the centers described in Table 41.

A brief review of available resources reveals that there is no major problem in obtaining qualified personnel.

Table 41: Training Institutions for Various Fishing Occupations

Ministry in Charge (1) SEET	Centers	Type of Training
SEPM	National Maritime Training Institute (Dakar)	Sailing personnel (from sailors to fishing captains and 1st class mechanics officers)
SEPM & SEET	School for Oceanographic Technicians and Maritime Fishing (Thiaroye)	Training, research and extension personnel for maritime fishing (mid and entry level)
MPN-SEET	School for Water Resources and Forest Management Technicians (Djibélor)	Water and forestry technicians
MES	National School for Rural Managers (Bambey)	Water and Forestry Engineers-after 9 months, continental fishing option in Bouaké (Ivory Coast)
MDS	Training Institute for Professional Maritime Fishing (Joal)	Small-scale traditional and modern fishermen
MDS	Training Institute for Continental Fishing Extension (Goudomp/Casamance)	Continental fishermen
MDS	Training Institute for Continental Fishing Extension (MBour/River)	Continental fisherman

- o Sea-based personnel: The existence of the National Maritime Training School has contributed to providing nearly complete training for industrial fishing. However, although training for personnel skilled in freezing techniques, for electricians, and for radio officers is essential to the activity of fishing in the deep sea and beyond, such training is not provided at the present time;

- o Technical personnel: The training of EATOPM students has progressed quickly enough to make it possible to cover personnel needs up to this point. However, it must be recalled that the recruitment of upper level technicians (DUT level) would make it possible to free researchers now involved in routine tasks; and

- o Upper-level personnel: Nationals are trained in different laboratories for maritime sciences abroad. In our country it is essential that we set up an institute to satisfy our own needs. Along these lines, it is noteworthy that Institute of Fisheries Sciences in Nouadhibou will open soon.

B. Human Resources and Service Requirements

The major problems, dealt with in an integrated manner in this section, are identified for teaching personnel in the institutions.

1. Training establishments for advanced personnel

The two establishments that provide this type of training, EISMV and INDR, are quite different, considering their statutes and experience.

The number of teaching personnel at EISMV is sufficient and has been Africanized to 65 percent for the permanent positions and to about 25 percent for the temporary positions. The teaching statute is advantageous and insures employment stability and quality in recruiting. It should be noted that some professors do not have tenure.

There is an excessive number of students. The fact that 10 percent of the students are female causes problems on the premises. The capacity is 40 students per year; and the graduating classes at this time are about 80 students, There is a need to strengthen the studies of management, economics and planning.

At INDR, the complete structure is not yet in place. The lack of qualified teaching personnel and stable financial means have slowed the implementation of teaching. The Senegalese personnel is insufficient, although the amenities and legal statute of the Institute are good. The major difficulty at this time is that there is no training center for teachers.

2. Training establishments for mid-level personnel

a. ENCR

At ENCR, the major problems relate to:

- The lack and obsolescence of the infrastructure and existing equipment;
- The lack of programs to train teachers; and
- The lack of outlets for practical application of training.

It should be noted that the nationals make up one third of the permanent teaching staff and occupy all of the additional positions. The conditions of service have, up to this point, been mediocre and thus have limited this establishment's expansion.

b. ENEA

At ENEA, the problems relate to:

- The lack of a policy for training teachers, despite the fact that the majority of the teachers are Senegalese;
- The lack of coordination in teaching and the problems in defining programs due to imprecise requests from users; and
- The insufficient subsidies given.

The obsolescence of the infrastructure and the laws governing teachers have created mediocre service conditions.

c. ENSUT

At ENSUT, the teaching staff, which is 30 percent Senegalese, profits from a law that rewards motivation of teaching personnel. Conditions of employment are good, but there are still some problems related to:

- Inability to replace outdated teaching materials;
- Lack of training of national personnel in technical disciplines; and
- Obtaining scholarships for training nationals.

3. Training establishments for entry-level personnel

Schools for technical agents: agriculture, animal husbandry and water and forestry all are under the same administrative trusteeship and the same legal statute. They have had very serious operational difficulties for a long time related to the lack of qualified human

and financial resources. Their situation has improved considerably due to Swiss assistance which supplies the operational resources and provides the investments required, as well as training of teachers (this outlook is due to technical assistance in the next four or five years).

However, there remain some problems, particularly regarding:

- o The increase in supervisory personnel (the specific case for water and forestry) and for training in these fields;
- o The statutes governing national trainers who do not receive the benefits granted to secondary level teaching personnel. This situation causes loss of motivation in some cases, for example, in agriculture; and
- o A lack of service personnel (45 percent for all of agriculture).

As for the special case of the Cambérène National Horticultural School, the problems relate to:

- o The outdated premises and the poor quality of the equipment;
- o The lack of technical training for supervisory personnel; and
- o The need for almost all technical teaching programs to have access to technical assistance which is always in touch with socio-cultural and socioeconomic realities of Senegalese horticulture.

4. Advanced training and initiation centers for agriculture

These centers will simply be mentioned in order to illustrate the lower segment of the agricultural training program in Senegal. The effectiveness of these centers is especially limited due to the availability of human and financial resources given the ambitious but justifiable goals.

The policy and approach adopted for continuing public education and information programs must be reviewed and better adapted to the national educational system and its development strategy based on the rural sector. Implementation of training and advanced training of "base-level" personnel must be improved to provide these people with better technical and environmental knowledge.

C. Status of the Relations Between Training/Research and Training/Extension

Following are some facts and figures taken from an FAO report on agricultural personnel in Senegal to introduce this section.

- o Senegal has approximately one qualified agricultural agent per approximately every 168,000 inhabitants, every 1,124 rural workers and approximately every 628 ha;

- o The Ministry of Rural Development employs 56.4 percent of these persons, 39.6 percent of which is for development companies;

- o The Ministry for Environmental Protection, along with the Department of Water and Forestry employs 18.7 percent;

- o The Ministry of Social Development, with the rural expansion centers, employs 14.4 percent; and

- o The Ministry of Technical and Scientific Research, with ISRA, employs 11.3 percent.

The public sector, which is involved in rural development through the four above-mentioned ministries and the Ministry of Hydraulics, employs almost all of the qualified agricultural personnel. This prevents the existence of a private sector supported by qualified national personnel. One fourth of the personnel works for SODEVA. Employment is structured in categories as follows: Besides the marginal sector represented by the Ministry of Economics and Finances and the private sectors, the Ministries of Hydraulics and Scientific and Technical Research employ the largest number of high level personnel (classification A) with 44.4 percent and 37.8 percent respectively.

The Ministry of Rural Development uses less than 8 percent of Category A personnel, which implies that a huge effort must be undertaken to raise the technical level of supervision, and in so doing raise its effectiveness. As concerns mid-level personnel (classification B), these two ministries do not provide basic extensions. The Ministry of Hydraulics and Scientific Research are the largest users, with 55.6 percent and 28.6 percent respecively.

As for lower level personnel (classification C), the ministries which have recourse to extension services are those who employ the largest numbers, i.e., the Ministry of Rural Development (79.4 percent), and the Ministry of Social Development. All of this corroborates the findings of distortion that exist in the system and in the training section, and explains the following relationships between the sections.

1. Training/research

The relationships that exists are generally weak for the following reasons:

- o The training structures for research personnel are limited and very recent;

- o The majority of research personnel has been and continues to be abroad because the local structures are

inappropriate, except for animal husbandry which until recently was in the same category;

- o Research personnel is not highly sought for teaching purposes, although ORSTOM and ITA are exceptions to this rule;

- o Research structures are not widely used as teaching supports. This includes all levels and sub-sectors; and

- o Incentives for researchers to play a role in education are not very great. There is no institutional bridge that would make it possible for researchers at a given level to move into research from teaching and vice-versa.

These weak links that exist materialize as follows.

- o For ISRA there is very limited activity in the area of admitting and training interns of personnel training establishments at the A and B levels; and some participation in teaching councils of certain educational establishments;

- o ITA has normal activity in the area of admitting and training interns of personnel training establishments at the A and B levels, participation in teaching in some structures, and organization and implementation of training sessions of a highly technical nature, on a national and sub-regional level. ITA also participates in advanced training councils of some teaching establishments; and

- o ORSTOM participates in normal teaching at the university and some affiliated institutes and trains interns in the ORSTOM training section in second year specializations, and interns in upper level education outside the ORSTOM section (Senegalese and foreign).

It is imperative that there is greater participation of research personnel in training and in the necessary reorientation of the training policy and greater and more regular usage of the research infrastructure and equipment for training needs.

2. Training/development

More organic relationships do exist between these two areas. This is more marked for personnel of levels B and C. The reasons are that the Ministries of the Rural Development Sector, i.e., Agriculture, Protection of Nature, Social Development, are the largest users of personnel "produced" on site and until recently, the majority of national trainers were employed by or dependent upon ministries. The relationships were reflected in:

- o The acceptance and the training of students for their practical training internship;

- The participation in education provided in the form of various benefits, e.g., vacations; and

- The highly active participation in organizations that manage the establishments, such as Teaching Councils and Orientation Councils.

D. Recommendations for Improving the Training Institutions

To improve the productivity of agricultural training establishments, the following actions are proposed.

- The abilities of the agencies must be emphasized, strengthened and mobilized. These are higher education for the university and affiliated institutes, and research for ISRA, ITA, and ORSTOM, for training high level and implementation agents;

- A complete critical analysis of training must be made so that all aspects of the section are dealt with, so that the profile of the trained agent is compatible with users' needs. For research, training in the following sectors must be developed as a priority:

  -- Plant production: priorities are millet, sorghum, rice, corn, legumes, groundnuts, forests, forage and pastures--priority disciplines are genetics, agronomy, pdedology, agricultural mechanization, developmental forestry;

  -- Animal production: priorities are meat, milk, and fish--priority disciplines are animal husbandry, birdkeeping specialist, pork production, and small ruminant pathology;

- Increase and secure financial resources for training structures. It will also be necessary to create work conditions that encourage teachers and students, and to promote laws that create incentives and provide security for the trainers. (See Figure 14.);

- Foster the emergence of regional training centers by promoting existing training capabilities through training of research policy officers and research managers and the development of training in high technology fields whenever possible and necessary (biotechnologies, remote sensing, data processing);

- Set up a rational programming and planning system with the goal of monitoring the employment/training relationship and monitoring agents to be trained or retrained; and

- Encourage the exchange of teachers and students among countries of the sub-region.

Table 42: Training Requirements - Research Personnel

Plant Production	Short Term 3-4 Years	Medium Term 5-7 Years	Long Term 8-15 Years
Genetics/Selection	3	3	7
Plant Protection			
Pathology	1	4	5
Entomology	2	3	5
Weed Sciences	2	2	5
Technology and Storage	1	3	3
Physiology	1	3	5
Agronomy/Phytology	3	4	7
Mechanization	2	3	6
Bioclimatology	-	2	2
Pedology	4	2	3
Chemistry and Fertilization	1	2	4
Microbiology			
Soil	1	2	5
Nutrients	2	3	7
Fruit Tree Growing	4	4	2
Production Systems			
Agronomy	4	5	10
Agro-economy (broadly defined)	1	3	5
Anthropology (broadly defined)	2	3	7
Management (broadly defined)	3	4	7
Forests			
Forestry (broadly defined)	3	3	10
Protection	2	4	4
Management and Development	1	2	4
Animal Husbandry			
Zoology	2	3	6
Bacteriology	1	1	1
Virology	1	2	2
Forages and Agrostology	2	2	5
Range Management	3	3	5
Parasitology	1	1	1
Fishing			
Biology	2	4	7
Physics	2	2	2
Environment	2	3	5

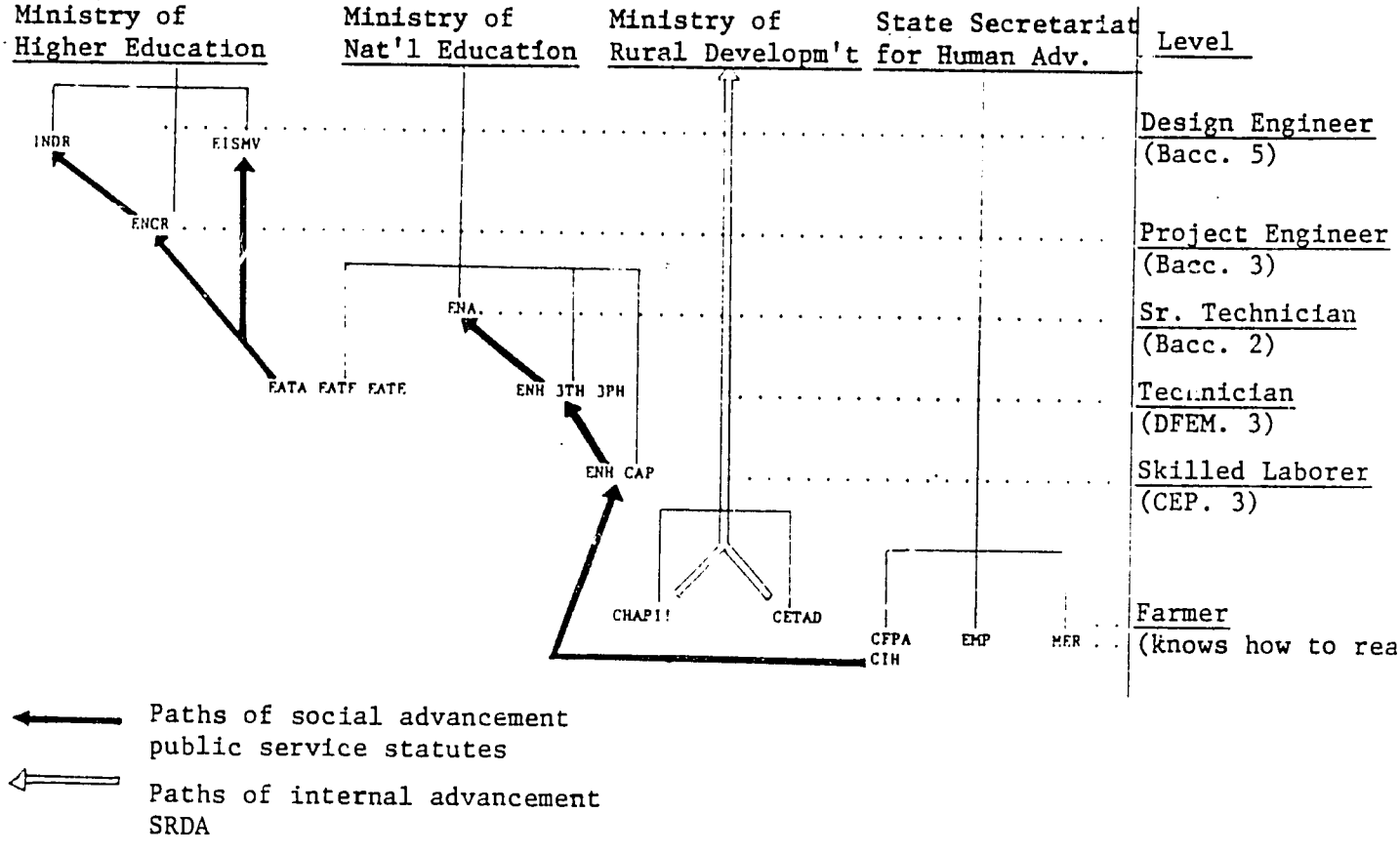


Figure 14: Various Paths of Social Advancement

Source: Techno-Forest Report - January 1981

V. EXTENSION INSTITUTIONS

As in the majority of Sahelian countries, agriculture is still the motor of the Senegalese economy since it employs 70 percent of the population and accounts for 34 percent of the Gross Domestic Product (GDP). Since 1968, the level of national production for agriculture, animal husbandry and forestry has been subject to fluctuations due to a series of years of drought. This explains the relatively slow growth of the GDP, with an average annual growth rate of 2.2 percent in constant prices or 6.4 percent in current prices.

In the following pages we will limit ourselves to the primary sector, i.e., agriculture, animal husbandry, forestry, and fishing. where we will investigate and analyze the areas of activity, technical potential, results, and limitations.

A. Agriculture

Senegalese agricultural policy is defined by the Interministerial Council of Agricultural Production, and is implemented by the MDR. It is built around the national economic recovery and breathes new life into the overall agricultural production system in order that the rural masses may know a better life. The directions of this policy, defined in the Fifth and Sixth Economic and Social Development Plans (the latter is still in effect), have been recalled in these pages.

To help execute the agricultural policy of rural development reform initiated in 1982, the MDR, as well as the Cabinet and the various related departments, relies upon the following institutions:

- Rural development inspection: This efficient monitoring unit is responsible for supplementing and completing the actions of the general state inspection agency;
- Six national directorates:
  - Agricultural directorate, responsible for the implementation of agricultural development policy, the evaluation of results and the restructuring, if need be, of programs set up by rural development societies and agencies;
  - Agricultural studies directorate, responsible for defining the ways and means to implement agricultural policy, to ensure that agricultural projects results are studied in cooperation with the rural development societies and agencies;
  - The Directorate for plant protection, responsible for protecting the health of plants and their products, for the phytosanitary monitoring of plants and various plant products as they enter or exit the country;

-- Directorate of animal husbandry, which is described more completely bolow;

-- Directorate of cooperatives, whose objective is to look into all problems related to supervising the rural population, and to organize and maintain cooperatives;

-- The food security commission, responsible for implementation of the national policy concerning storage and for management of the national reserve for food security. It also promotes, manages and distributes food assistance. It prepares the national food plan and ensures that it is followed with the assistance of the ministerial departments and agencies concerned;

o A national firm for supply (SONAR--Société d'approvisionnement du monde rural) has also been established. This company, with an industrial and commercial background, is publicly owned. It was founded pursuant to the ONCAD reform (law #80-42, August 25, 1980). In close cooperation with the Directorate of Agriculture, the regional rural development societies and the Directorate for Cooperation, it is responsible for making seeds, fertilizers and other necessary inputs for agricultural production available to the farmers. It acts in all rural communities throughout every region of Senegal.

The selected groundnut seeds are collected or purchased from stores. They are chosen in what are called reproduction areas, collected and put through all required phytosanitary treatments for preservation.

From 1960 to 1982, agricultural machinery, and particularly the equipment for animal traction, which is essential for implementing intensified agriculture and for productivity, was given to the peasants as part of the Agricultural Program. Financing for the program in the early years was provided through gifts and loans from the FED, the FAC, the CCE, and the IBRD.

Continuing financing for the agricultural program has until the present time been provided by the National Bank for Rural Development, by the national budget (through the Mutual Fund for Rural Development and by the Office of Adjustment and Stabilization of Prices. The possibility of setting up a more operational and effective agricultural credit system is now under study.

SONAR provides transportation and implementation of the various agricultural inputs. To do so, it uses its own heavy-vehicle fleet, which numbers a total of 80 vehicles, as well as private vehicles. The operation takes place from plants and refrigerated stores for seeds, and goes to the agricultural program dispersal centers. In order to accomplish the task it has been assigned, SONAR employs 630 permanent agents and 1,060 seasonal agents and rural action societies.

There are also six regional rural development and rural action societies organizations (SODEVA, SONIVAC, SODEFITEX, SAED, SODAGRI and STN) which are explained in detail below.

1. The Agricultural Extension and Development Organization (SODEVA--La Société de développement et de vulgarisation agricole)

Founded in 1968 because of the nationalization of training activities, for which SATEC has been responsible since 1964, the major objective of SODEVA is to organize the agricultural development of the groundnut basin by training rural populations and by distributing technological packages that have been suggested by research. These are essential for promoting tree, animal and plant production. It is active in four regions: Thiès, Diourbel, Sine-Saloum and Louga. These regions cover 54 percent of the land or 64 percent of the arable land. There are 200,000 farmers in these regions. Between 1968 and 1973, SODEVA, limited by lack of human and financial resources, had to concentrate its activities in consolidating acquisitions from SATEC, especially its distribution activities, which dealt with relatively insignificant matters, such as cattle traction and strong manure. From 1973 to 1979, using projects it designed and implemented, SODEVA built up its intensification plan and increased the number of employees. This period was characterized by a policy of integrating agriculture and animal husbandry, and as a result necessitated recourse to audio-visual materials as extension distribution tools.

a. Supervisory and training policy

Using the SATEC experience, SODEVA prepared a new action strategy for integrated development with the following thrusts:

- Contributing to the accomplishment of food self-sufficiency by increasing the amount of millet, corn and sorghum grown, and by increasing yields and areas planted;
- Promoting livestock fattening and diversification crops, such as cowpeas and vegetables;
- Securing revenue through diversified production and by seeking to obtain full employment, by promoting off-season activities (such as livestock fattening, truck farm production and craftsmanship) and by setting prices that are high enough to make the activity worthwhile;
- Progressively restoring the groundnut basin ecosystem through reforestation;
- Restoring confidence in rural populations by restructuring the cooperatives; it involved giving the peasants more responsibility and giving them the tools needed so that they could carry out their responsibilities more fully; and
- Contributing to improving the trade balance by attempting to effect a recovery in groundnut production, largely by

increasing yields through selected seeds and appropriate growing techniques.

Implementing these guidelines requires taking the additional steps--streamlining and redeploying the supervision/extension component, as well as raising the level of personnel, implementing a decentralized management system by giving additional responsibilities to the regional delegations and farmers, strengthening its leadership in the groundnut basin, and implementing a mass extension strategy.

It is interesting to note that since the 1981-82 season, the Government and SODEVA have signed a contract every year in the form of a "Letter of Objectives," detailing the commitments of each party.

b. Human and financial resources

(1) Human resources

At the present time, SODEVA has 1,361 agents that are distributed as follows:

- 42 upper-level extension agents (20 agronomists, one rural engineer, four animal husbandry specialists, one veterinarian, three horticultural engineers and 13 economists;
- Nine administrative agents;
- 343 upper-level and mid-level technicians; and
- 967 action agents at the BEPC level or at less than BEPC level.

It is noteworthy that given certain financial difficulties, due to a tendency for financing sources to break their commitments, SODEVA is having to lay off some employees. As for training, one female agent is now in training (BAC level + two years). The training needs for the next ten years, as expressed by the officers of the Organization, may be summarized as follows:

- 66 agents at a level of BAC plus five years, 48 of whom are in Senegal, ten elsewhere in Africa and eight in developed countries;
- Four agents at a level of BAC plus five years, trained elsewhere in Africa;
- Eight agents at a level of BAC plus two years, six in Senegal and two elsewhere in Africa; and
- Ten agents at a level of BEPC plus two years, trained in Senegal.

(2) Financial resources

As part of the Sixth Social and Economic Development Plan now in progress, SODEVA must pursue its objective as assigned to it in three major projects:

- Integrated development project in the Louga region and the MBour department. Financing is provided by FIDA and BIV: FCFA 4,289,000,000 for four years;
- USAID project in Thiès-Diourbel, Phase II: FCFA 2,753,000,000 for four years; and
- Continuation of the Sine-Saloum project redirected to the departments of Kaolack and Foundiougne, financed by IBRD and CCCE: FCFA 1,602,000,000 for four years.

For the 1983-84 fiscal year, the financial resources of the Organization are broken down as shown in Table 43.

c. Extension results

As previously stated, SODEVA was able to profit from significant gains in the agricultural extension operation directed by SATEC from 1964 to 1968, despite the fact that the operation did not reach the goal it set because the goal was obviously too ambitious. The goal sought an increase of 25 percent groundnut and millet production in the groundnut basin. It can be stated that the groundnut basin has a long tradition of supervision and that the farmers, although they may not always use them, are at least aware of simple technical themes called thèmes légeres, which in fact are the most important for the vast majority of the farmers. The following should be mentioned here: use of selected groundnut seeds; seedbeds of proper density, depth, and in line; processing of seeds; recourse to mineral manure, in small doses; weeding with a harnessed hoe, done at the proper time; harvesting groundnuts when they are fully ripe, using a groundnut harvester and ensuring that none are left in the earth.

From 1968 to 1972, SODEVA attempted to popularize these themes throughout the entire groundnut basin through mass extension. In addition to this priority task, it also sought farmers who had assimilited the "light themes" so that they could go to the next step, known as "heavy themes." These are:

- Cattle traction;
- Plowing;
- Improving the land by tree stumping and deep phosphating (400 kg per ha of tricalcic phosphate);
- Strong mineral manure (8-18-27);
- Rotation four times a year, for fallow fields, groundnuts-millet-groundnuts; and
- Reforestation.

Table 43 : Financial Resources of SODEVA, 1983-84

Source	Investment	Operation		Totals
		Personnel	Extension	
National Equipment Budget & BNDS	100,000,000	450,000,000	72,000,000	622,000,000
FIDA & BID	1,201,000,000	100,000,000	100,000,000	1,401,000,000
USAID	-	210,000,000	120,000,000	330,000,000
IBRD & CCCE	-	310,000,000	60,000,000	370,000,000
Totals	1,301,000,000	1,070,000,000	352,000,000	2,623,000,000

Beginning in 1972, a classification system for the three different types of farms was created. The three levels correspond to the levels of intensity. LT farms for light themes, CT farms for cattle traction, and farms for cattle traction and intensive fertilizer. This typology was for years the frame of reference for SODEVA. From 1972 to 1975, it continued its supervisory and intensification activities in various projects, such as phases I and II of the Sine-Saloum Pilot Project, Sahel Phase I and II, etc. The common denominator is the emphasis placed on cattle traction and plowing with a tendency to concentrate efforts on farms that at first glance demonstrated the best potential. The quantitative results obtained during this period did not meet the high expectations, since the extension themes adopted for small target zones are not generalizable. Tables 44 and 45, which related to the major accomplishemnts of the Sine-Saloum pilot project (phases I and II), can be presented without further comment:

Tables 44 and 45 illustrate the following:

- The percentages of technical goals accomplished are in general quite satisfactory. Most of the themes had excellent results, with the exception of plowing;
- The land that was intensified, although significant, was only a minute portion of surfaces planted in the area; and
- The increase in production as a result of the projects was on the order of 55,000 tons (average of estimates) at the end of the project.

As for evaluating all of SODEVA's activities, it can be said that the economic results, compared to significant technical changes, are somewhat disappointing. This is due to several problems, two of which are worthy of mention--insufficiency and delays of supplies of inputs, and lack of organized marketing of grains.

Given demographic pressures, the groundnut basin must be intensified.

The development of cattle traction and equipment (seeders, Sine-hoes, groundnut harvesters, wheelbarrows), tree stumping, deep phosphating, and corn growing, as part of the diversification process, are the most remarkable successes that SODEVA has achieved.

As for the potential, SODEVA's activities have diversified considerably, under the new directions of the "Letter of Objectives."

d. Relationships between the SODEVA extension program and agronomic research

In the area of relationships between research and development, SODEVA has without a doubt the oldest, most entrenched relationships. This is due to pre-extension research performed in "Experimental Units," and initiated beginning in 1968.

Table 44 : Accomplishments of the Sine-Saloum Pilot Project, Phase I, 1972-1975

Criteria	Goals	Accomplishments	Percent of Goals
Number of Farms "C.T.-D.M." (x 1,000)	2	0.6	30
Number of Farms "C.T." (x 1,000)	3.3	4.2	127
Number of Farms "L.T." (x 1,000)	5.6	6.3	113
Stumping-phosphating (1,000 ha)	6.3	10.4	165
Plowing (1,000 ha)	2.2	0.7	32

Table 45 : Accomplishments of the Sine-Saloum Pilot Project, Phase II. 1975-1980

Criteria	1975/76	1976/77	1977/78	1978/79	1979/80
Number of Farms					
CTDM (in thousands)	2.3	3.3	5.1	6.2	8.9
Percent of Goal	68	62	70	67	80
CT (in thousands)	9.7	13.5	10.8	12.5	14.0
Percent of Goal	87	152	117	128	89
LT (in thousands)	13.8	17.2	17.2	14.8	17.0
Number of Farms Supervised	72.3	73.7	78.5	79.7	92.4
Percent of Total Number of Farms	35	46	42	44	43
Number of Farms Supervised		72	83	65	57
Tree Stumping-Phosphating (1,000 ha)	15.4	20.6	22.9	39.5	58.7
Percent of Goal			75	99	110
Plowing (1,000 ha)	2.1	4.1	2.7	4.4	
Percent of Goal	60	67	29	38	
Intensified Surfaces					
Groundnut (1,000 ha)	5.2	7.4	8.8	13.4	14.1
Maize	0.5	1.3	1.2	1.8	0.8
Sorghum	0.5	0.7	0.9	0.5	0.4
Millet	3.2	4.3	6.2	10.3	11.9
Cotton	0.1	0.1	0.2	0.2	0.2
Total	9.5	14.5	17.4	26.2	27.4
Increase in Production as a result of the project (1,000 T)					
Groundnut		4.4	13.5	19.0	23.3
Millet		1.2	3.9	5.5	6.7
Sorghum		1.0	2.7	4.9	7.7
Maize		1.7	4.3	7.7	11.8
Cotton		0.1	0.3	0.5	0.8

This operation, originally inspired by the concern of agronomic research to propose its technical themes and plans for rainfed agriculture in a true rural milieu, has had a considerable effect on the extension activities of SODEVA. In fact, the technological packages (light themes, cattle traction, cattle traction and intensive fertilizer, tree stump removal-deep phosphating, plowing) which have been used for extension by SODEVA were first refined and proven in the "experimental units" of Khoubidia and Thyssé-Kaymor.

In 1975, as part of the implementation of the medium-term Sahel Thiés-Dieourbel Project, a liaison office was set up between SODEVA and ISRA. The office is still operational and is a permanent cooperative and diagnostic structure for farm survey, research and follow-up in three departments in Thiés and Diourbel.

As part of building the research-development relationship, and with the arrival of the step-system, ISRA is now negotiating with SODEVA in the hope of signing a framework agreement which would define their relationship.

e. Problems identified by personnel

According to the opinion of a SODEVA officer and his assistants, the most serious problems affecting the extension and supervision goals of the organization are:

- Problems faced in implementing an accepted budget; these problems, related to the treasury, are caused on the one hand by the slow mobilization of credit from the national budget, and on the other hand, by the progressive cancellation of financial commitments from outside sources;

- Lack and delays in supply of inputs, especially for agricultural equipment. Since the agricultural program has been placed under tight control, replacing agricultural equipment has become more and more difficult. However, the attempt to set up a functional structure for agricultural credit, now being studied, should make it possible to solve this problem;

- Lack of an incentive pricing system and of an organized marketing system for grains; and

- The system's inadaptability to agricultural development, and to making farmers responsible for managing their affairs.

2. The Fiber and Textile Development Organization (SODEFITEX --Société pour le développement des fibres textiles)

SODEFITEX was established in 1974 to take over the role of CFDT. Its original objective was the development of cotton growing. The goal was progressively extended to other areas of activity. Thus, SODEFITEX is growing closer to its legal purpose, that of a "regional development organization."

In a letter of objectives, the government established its relationship with SODEFITEX in 1981, which is discussed in a contract program that covers threee growing seasons: 1981-82, 1982-83, and 1983-84.

a. Area of activity

The area of activity has two parts:

- o Sine-Saloum, solely for cotton (for the southestern part only; and
- o Eastern Senegal and Upper Casamance (Vélingra and Kolda departments) for developing cotton, cereals (rice and corn) and groundnuts, (edible groundnuts, reproduction of selected groundnut seeds for oil), and for livestock development.

In Eastern Senegal and the Upper Casamance only, SODEFITEX has the statute of a regional development organization. In Sine-Saloum, Tambacounda, Vélingara, Kolda and Kédougou. Each SODEFITEX region has a directing officer and is subdivided into management sectors.

Each sector is manaaged by a sector chief.

Each regional officer, as sector chief, is responsible for local problems in his area, such as extension, training, leadership extension and supervision of lower level managers. They have assistants who are responsible for administrative and managerial duties.

b. Extension and supervisory functions

The following functions are provided by SODEFITEX:

- o Extension of the following technical themes for farmers: intensive production, harvesting and processing of products such as cotton, corn, groundnut seeds, edible groundnuts, rainfed rice, lowland rice or irrigated rice; rational practice of animal traction; and seed reproduction in cooperation with seed agencies;
- o Structuring rural populations through assistance to help set up groups of producers, called "Basic Producer Associations" or BPAs. As of the present time, their activity is largely directed toward management of credit and marketing;
- o Supplying peasants with inputs, such as seeds and fertilizer, and with equipment for animal traction;
- o Distribution of credit;
- o Marketing and if need be, processing of products collected;

-- for cotton, SODEFITEX purchases and processes cottonseed, and arranges for disposing of the fiber, either locally or through exporting it. This is done as part of an agreement signed with the Caisse de Péréquation et de Stabilisation des Prix (Bank for Price Equalization and Stabilization);

-- for rice, a similar procedue is used; and

-- for corn and sorghum, SODEFITEX only plays the role of a middleman.

o Development of irrigated perimeters on the valleys of the Sandougou and the Gambia; and

o Participation in the development of animal husbandry.

c. Human and financial resources

(1) Human resources

At this point in time there are 680 permanent agents in SODEFITEX which are distributed as follows:

o 90 agronomists (10 percent) and agricultural engineers (90 percent);

o 30 administrative agents, accountants and industrial agents;

o 300 supervisors (agricultural agents, agricultural monitors); and

o 280 implementation agents.

Managerial structure is in typical pyramid form, corresponding to the organizational divisions such as regions, sectors, areas and centers. An on-site training program has been implemented in order to improve the technical management level and it is led by "regional" trainers (a total of three), supervised by a national trainer.

A long-term training plan for upper-level managers is now in formation.

(2) Financial resources

As of now the various SODEFITEX operations are financed by FED, FAC and the Senegalese national budget. Table 46 gives the amount, the period covered and the objectives for each type of financing.

The integrated development project of Eastern Senegal and Upper Casamance, evaluated at FCFA 16 billion, to be financed by FAC, CCCE, and IBRD, is worthy of mention. This project has an associated research component. The research is to be done by ISRA.

Table 46: Financial Resources of SODEFITEX

Source of Financing	Period	Amount in FCFA	Project Title	Goals
EDF	1980-1982	437,000,000	Development of the cotton zone (4th FED)	Development of small heavily-irrigated areas for grain production
	1982-1985	1,400,000,000	Intensive grain production in Senegal-Oriental	Achievement of a development program in Kédougou (rice production/maize, rural water supply, cattle traction, literacy)
FAC	1980-1981	100,000,000	Increase of grain production in Senegal-Oriental	Training
				Establishment of infrastructures (hangars, etc.)
FAC	1982-1984	200,000,000	"	Production of seeds, provision of fertilizer
				Functional literacy
				Improvement of traditional maize growing
				Training of blacksmiths
				Village associations
				Animal traction; primary health
National Budget	1983-1984	200,000,000	Counterpart	Wages of national staff

d. Accomplishments

Supervisory and extension activities of SODIFITEX have greatly contributed to cotton production in Senegal. The area used for growing cotton has gone from 1,000 ha in 1967-68 to 36,000 ha in 1982-83.

As for cereals, despite supply problems for seeds, corn growing in the supervised areas has experienced great development, and was at nearly 10,000 ha in 1982-83. Thanks to resources allocated to it in various projects, SODEFITEX will, on the one hand, have contributed to establishing better farming organizations, thanks to promotion of the "Basic Producer Associations", of which there are now over 1,300, and on the other hand, to insuring regularity in supplying fertilizer and equipment to the farmers. Finally, "operation blacksmith", which trains local blacksmiths in ironwork and woodwork to maintain the cattle traction equipment, seems to be highly successful.

e. Research-extension relationships

ISRA, in cooperation with SODEFITEX, has directed a research component for the last six years as part of developing cotton production. This component deals with varietal experimentation with cotton in many localities, phytosanitary protection of the cotton, trying different insecticides and herbicides, and phospho-potassic manure.

Beginning in 1983, a network of varietal trial parcels in peasant milieus was jointly produced. Among other experts, a research-development relationship specialist is planned with SODEFITEX as the host organization.

f. Summary of problems identified by the staff

Unlike other regional rural development organizations, SODEFITEX is not facing financing problems. According to the opinions of technical staff, the most important problems confronting the organization in its supervisory activities are problems related to seed supply for rainfed rice and corn, the degeneration of major phytosanitary products currently recommended, making it necessary to keep active materials up to date, diversification of cereal production, and maintenance of animal traction equipment.

3. Organization for the Agricultural Development of Casamance (SOMIVAC--La société pour la mise en valeur agricole de la Casamance)

SOMIVAC, an industrial and commercial public enterprise, was founded in 1976. It is the newest of the regional development organizations.

a. Objectives

Its major duties, in the particular region for which it is responsible, are as follows:

- o Design and plan development of the rural sector;
- o Coordinate agricultural development activities; and
- o Monitor the implementation of development activities through regular evaluation.

Three rural development projects are directly controlled by SOMIVAC:

- o The rural development project in the Sédhiou department (PRS 1st and 2nd phases);
- o The integrated development project of Lower Casamance (PIDACO); and
- o The Chinese Agricultural Mission (MAC).

The major objective of these projects is the intensification of rainfed crops such as groundnuts for oil, millet, rice and corn. Moreover, SOMIVAC is developing anti-salt dams and recovery of salt lands on 30,000 to 35,000 ha over the long term. Its purpose is then to improve both rainfed and irrigated crops.

b. Area of activity

SOMIVAC supervises about 25 percent of the area used for growing crops in Casamance and about 30 percent of the entire region's production.

c. Supervisory and extension functions

SOMIVAC has set the following objectives to be accomplished through its three projects:

- o Produce a fast and regular increase in agricultural production through better control of water, such as in anti-salt dams, and through a rational use of the factors of production;
- o Increase food crop production, placing emphasis on rice and the promotion of corn;
- o Produce a balanced development between cash crops, such as groundnuts and cotton, and food crops such as rice, millet, corn and sorghum;
- o Develop diversification crops, such as fruits and garden produce; and
- o Develop livestock, fishery and forestry.

d. Human and financial resources

(1) Human resources

The total number of employees at SOMIVAC is now 611 permanent agents, distributed as follows:

- o 87 upper-level technical staff;
- o 16 upper-level administrative staff;
- o 34 upper-level technicians;
- o 324 supervisors; and
- o 150 extension agents.

A training plan for senior staff is now being prepared, just as is the case at SODEFITEX. Additional staffing requirements exist but have not yet been developed.

(2) Financial resources

The financial resources for fiscal year 1983-84 for SOMIVAC are described in Table 47.

e. Accomplishments

Although it has operated only since 1978, SOMIVAC has succeeded in accomplishing the following in-depth tasks:

- o In the field of integrating and coordinating agricultural development activities in Casamance, it is noteworthy that the integration of the PRS, PIDAC, MAC, and Guidel projects, as well as the small scale banana project in Upper Casamance, has already begun by setting up a brance of SOMIVAC in Kolda;
- o As for management, the preparation and implementation of a program to clean up and restructure the cooperatives has made it possible for SOMIVAC to clarify the situation and to reorganize almost all of the cooperatives in Middle Casamance;
- o As for animal production and health, SOMIVAC has undertaken several projects (saving calves, fertility of mothers, cattle fattening, hybrid rams, breeding male roosters, and the struggle against soil diseases), the overall results of which opened many possibilities for the coming years;
- o As for hydroagricultural developments and infrastructure, there has been a praiseworthy effort despite the slow and burdensome administrative procedures in the area of procurement;
- o 19 literacy centers for national languages have been established; and
- o Pre-project studies.

Table 47 : Financial Resources of SOMIVAC

(FCFA)

Project	Outside Financing	Senegalese Counterpart (BNE)	TOTALS
PRS II	(ended in 1981)	45,000,000	45,000,000
PIDAC	300,000,000	669,000,000	969,000,000
Guidel Development	-	60,000,000	60,000,000
Bignona Development	-	80,000,000	80,000,000
TOTALS	300,000,000	854,000,000	1,154,000,000

f. Research-extension relationship

The relationships between SOMIVAC and research have, until the last few years, been created through supplemental research and inter-office cooperation on leadership extension. Beginning in 1983, as part of the establishment of an ISRA multidisciplinary team in Casamance to study production systems, an agreement for cooperation was signed by the two parties. Pursuant to this agreement, joint meetings are held twice each year.

g. Summary of problems as seen by the staff

According to the opinions of the officer and technical staff at SOMIVAC, the problems impeding the realization of the goals are:

- o Delays in setting up allotted credits;
- o Slow and heavy administrative procedures for procurement, reflected in considerable delays in implementing programs;
- o Increasing breaking of commitments by donors, and in particular, by the IBRD;
- o Rural exodus of women and young girls, especially in Lower Casamance;
- o Problems relative to input supply; and
- o Supervision of certain management zones.

4. Organization for the Development and Operation of River Delta Lands and Valleys of the Senegal and Falémé Rivers (SAED--La société d'aménagement et d'exploitation des terres du delta du fleuve et des valées du fleuve Sénégal et de la Falémé)

Founded in 1964, the SAED statute changed from that of an industrial and commercial public enterprise to that of a national organization in 1981. This was done to give the organization the management flexibility that agricultural production requires.

a. Area of activity

SAED's area of activity was at first limited to the delta and the valley of the Senegal River. However, in 1980 it was extended to include the Falémé river valley, or about 250,000 ha of irrigable lands located in the Dagana, Podor, Matam and Bakel departments.

b. Goals and functions of management/extension

As prime contractor for developing alluvial land on the left bank of the Senegal River and its affluent, the Falémé, SAED has been assigned two roles: implementation of hydroagricultural development to control water, and a managerial and extension function. The various components of both of these functions have been refined over the years and detailed as of 1981 by a "Letter of Objective." The letter defined the reciprocal responsiblities and commitments of the Senegalase Government and the Organization over three years in contract form. In light of this "Letter of Objective", the responsibilities of SAED may be summarized as follows:

- o Plan, authorize and control all rural development activities undertaken anywhere within its area of responsibility;
- o Manage and maintain the equipment for general use located in the activity area;
- o Coordinate the development activities in the activity area;
- o Coordinate supply activities for the production factors;
- o Support and advise village organizations; and
- o Collect, process and market the yield/harvest.

To more readily accomplish its objective and to assume its responsiblities, SAED set up a recovery plan three years ago, including two parts: internal reorganization based on a redeployment of staff and particularly on decentralization of the decision-making power so that it is more in touch with real needs. This is a creation of departmental delegations, each of which is led by an agronomist; and a reformulation of technological choices and basic management to better prepare the farmers for their responsibilities. Thus, the initial basic management system is being progressively changed to an agricultural council system for technology and managment.

c. Human and financial resources

(1) Human resources

SAED has a total of 133 agents at this time, distributed as follows:

- o 98 senior technical staff members, or six agronomic engineers, six agronomists, six rural engineers, one animal husbandry specialist, 75 horticulturalists, and six economists/sociologists;
- o 40 senior administrative staff members;
- o 150 senior technicians and technicians;
- o 238 supervisors; and
- o 507 agents.

Four persons are now in training and an additional 25 agents are expected to be trained over the next ten years.

(2) Financial resources

The financial resources of SAED come from the national budget and foreign financing, the majority of which is supplied by IBRD, CCCE, FAC, and FED.

d. Accomplishments

Since it was established, SAED has accomplished the following:

- Extension of hydroagricultural development with water control; from 10,000 ha developed in controlled submersion in 1965, SAED has today approximately 20,000 ha of developments with water control;
- Promotion of village perimeters (4,500 ha) a praiseworthy experiment in small village hydraulics which may help to achieve nutritional self-sufficiency;
- Reorganization of large cooperatives into smaller groups of producers, with the support of the social organization that already existed;
- Increase in rice production on a regional level: 10,000 tons in 1965, compared to 35,000 tons in 1982;
- Introduction of diversification of crops, such as corn and market gardening produce;
- Functional literacy in national languages; and
- Implementation of a training center for managers in the region.

e. Research-extension relationships

Relationships between agricultural research and SAED, up to the past few years, have experienced a few ups and downs. These relationships were formed through various additional research agreements for development projects signed between the two parties, such as the Delta Agreement, the Dagana Agreement, the N'Dombo-Thiago Agreement, and the Matam Agreement. Improvement of relationships is generally a function of the good will of the officers of both parties.

Since 1982 there has been a need for donors to SAED and ISRA to strengthen the relationship between research and development in the river region. The need to recharge the relationship is even more necessary at this point. Despite major research accomplishments made in the region, the farmers do not take advantage of them to any great

extent. Furthermore, given the implementation of the ISRA agricultural research project, an attempt has begun to define the ways and means to set up a research-development relationship on the regional level that would be based on the trilogy "research-development-training". This step should enable the technical commission to arrive at a set of research activities using the major restrictions identified by SAED. A prototype cooperation agreement between ISRA and SAED has to be signed by January 1984 at the latest.

f. Summary of the problems identified by the staff

(1) Problems as seen by the Director

In his capacity as officer of SAED, the President and Director General was questioned and identified the following as the main problems facing the organization:

- o Treasury problems that are largely due to the fact that the contributions of the Senegalese Government, as defined in the contract that binds its organization to the Government, do not arrive on time;
- o Contradiction between the duty assigned to SAED as an extension agency that is supposed to be working toward phasing itself out, and making the farmers more responsible in their management of the farms; and
- o Adaptation of research results for usage, the distribution of which is generally done in a way that is not easily accessible to extension agents.

(2) Problems identified by senior technical staff and lower-level technical staff

According to the opinions of these staff members, SAED is faced with the following problems:

- o Until now, a constant inertia in the relationship between research and development, and especially difficulties the extension agents experience trying to apply research results; and
- o Piecemeal training of technical staff capable of providing management training.

(3) Administrative staff

The administrative staff members questioned were unanimous in their recognition that a policy for administrative and managerial training should be promoted at SAED.

5. Organization for Agricultural and Industrial Development (SODAGRI--La société pour le développement agricole et industriel)

SODAGRI, founded in 1974, plays a role in Upper Casamance in the Vélingara department. Its major goal is to develop rice production

but it also manages groundnuts, millet, sorghum and corn. As of now, SODAGRI has rainfed crops on 14,600 ha, but its development plan rests essentially on the development of 16,250 ha in the Anambé basin because of a dam to be built. Besides its managerial role in production, SODAGRI processes what it produces in the way of rice, and markets it in Vélingara, Kolda and Dakar.

a. Goals and supervisory functions/extension

The principal goals and purposes of SODAGRI are:

- To implement the hydroagricultural development project of the Anambé Basin in Upper Casamance;
- To produce 150,000 tons of cereals within 15 years;
- To supervise between three and four thousand farmers;
- To set up an agro-industrial unit, comprised of a rice farm and storage silos;
- To create 2,400 jobs; and
- To develop livestock feed from rice by-products.

While it waits for the Anambé/Kayanga, which is under construction, to be filled, SODAGRI, since its inception, has focused its activities on supervision and production of rice.

b. Human and financial resources

(1) Human resources:

The total number of SODAGRI employees at this time is 68 agents, distributed as follows:

- Ten senior staff, with six agronomists, one rural engineer, one engineer for plant protection, and two economists;
- Eight senior technicians; and
- 40 active technicians and agents.

Training needs do exist but have not yet been formally defined.

(2) Financial resources

Besides the implementation of various infrastructures, such as dams, hydroagricultural installations, rice farms, etc., for which financing is provided jointly by FSD, DOAD, OPEC, and Switzerland, the financial resources of the organization, for operational purposes,

are from the national budget and proceeds from the sale of rice. For the 1983/84 fiscal year, the overall budget was FCFA 5,902,000,000, FCFA 485,000,000 of which come from the national budget and the organization's own proceeds, and FCFA 5,417,000,000 are from foreign sources.

c. Accomplishments

Besides the dam which is now under construction, SODAGRI has accomplished the following:

- o Supervision of producers on 14,600 ha of rainfed crops; this supervision may be considered as loose (15 supervisors can only extend light themes);
- o Rice production under state supervision on 200 ha; and
- o Seed production activities.

The extension activities of SODAGRI will develop efficiently only when the dam is completed and the lands of the Anambé valley are developed.

d. Research-extension relationships

The relationships between SODAGRI and agricultural research are not as developed as those between ISRA and SOMIVAC, or those between ISRA and SODEFITEX. The major explanation for this is that SODAGRI, although it was founded in 1974, is not yet actually established, since most of its activities are conditional upon the development of the Anambé Basin. It should, however, be mentioned that ISRA has set up a station in Vélingara to apply the results of thematic research on rainfed conditions for rice, corn, sorghum, cotton and groundnuts, and that SODEFITEX benefits the most from it. The ISRA Center in Djibélor, which is constantly concerned with extending its research activities into upper Casamance, has been testing rice for nearly three years on the SODAGRI pilot perimeter in the Anambé Basin near Vélingara. The studies are performed with the close cooperation of the SODAGRI supervisors.

It should be noted that the potential for improving relations between SODAGRI and ISRA appear to be good, because in the Anambé-Kayanga project, there are plans to establish a research station for which ISRA would be responsible. ISRA will work in close cooperation with the extension service and the evaluation and planning group that is part of SODAGRI. The research performed at this station will be mostly directed to:

- o Developing the use of animal traction and small motorized equipment;
- o Studying intensive irrigated growing on the development of newly cleared lands; as part of this, a fully equipped analysis laboratory will be set up in the station; and

- Studies in close cooperation with the Djibélor Center, on varieties of rice, corn and sorghum, rotation cropping, irrigation techniques, integrated control of weeds and insects.

e. Summary of problems as seen by the staff

A coordination committee, comprised of ISRA officers and the project administrator, will meet regularly to discuss problems, revise research activities, and to make recommendations.

According to the opinion of the officer and the SODAGRI staff, the major problems impeding accomplishment of its objectives are:

- Lack of staff, both senior and junior (particularly managers);
- Shortfall between the operational costs and the Senegalese counterpart budget allotted each year;
- Foreign financing is reserved solely for infrastructure, such as dams and land development in the Anambé Valley;
- Lack of supplementary research that would allow management to perform its work rationally;
- The supervised area becomes an enclave making it difficult to get the agricultural products out; and
- Excessive centralization of decision-making power at Dakar.

The solution to all of these problems resides partially in supplying water to the Anambé dam, in redeploying the staff, and also in increasing the contribution of the national budget for operating the organization. A recruitment and staff training policy should also be organized.

6. The Organization for New Lands (STN--La société des terres neuves)

The Organization for New Lands was set up in 1971. Until 1980 its major goal was to organize migration and settlement of families of farmers who came from the groundnut basin and to set up the necessary infrastructure. In May 1980, STN also was given the task of managing the market gardening and fruit farming sector throughout the country.

a. Management area

From 1972 to 1981, STN implemented two new lands colonization projects:

- STN I: the MAKA pilot project, 1972 - 1975, 250 km^2;
- STN II: the Koumpentoum project, 1976 - 1981, 450 km^2.

Beginning in 1982, and as part of the preparation of a master plan for colonizing national land, SAED identified four projects concerning the Eastern Senegal and Casamance regions.

As for fruit and vegetable growing, BAPA prepared a development plan for CCCE financing which includes two phases: a diagnostic phase to study the situation of the sector and another identification phase for projects to be set up in the Niayes area, which goes from Dakar to Saint-Louis.

This is how the following projects were identified:

- A test project to assist several vegetable growers in the Niayes region to improve onion, potato and tomato production;
- Vegetable growing development project in Gandiolais (130 km^2); and
- Self-sufficiency project in Senegal for onion and potato production. 25,000 ha managed in the Louga, Cap-Vert, Thiès and Fleuve regions.

b. Human and financial resources

(1) Human resources

STN now has 304 agents, distributed as follows:

- Ten senior engineers;
- 34 senior technicians and technicians;
- 195 supervisors;
- 37 administrative agents; and
- 28 agents.

Although a plan for staff recruitment for various projects has been formulated, there is no training program as yet.

(2) Financial resources

The Organization's budget fiscal year 1984 is distributed as shown in table 48.

c. Accomplishments

The implementation of projects I and II (New Lands) has had the following impact:

- Alteration of demographic, economic and social data in the areas of colonization, even though demographic developments

Table 48 : Financial Resources of the STN
(FCFA)

Source	Investment (x 1000)	Operations (x 1000)	TOTAL (x 1000)
National Budget	68,800	153,075	221,875
Donors	373,680	142,759	516,439
Totals	442,480	295,834	738,214

have not been controlled (spontaneous and uncontrolled migrations);

- o Improvement, to some extent, of agricultural practices, which is reflected in an increase and diversification of income; and

- o Disenclosure of the area through the building of trails, roads, classrooms, village warehouses and drilling wells. It should be noted that all of this infrastructure must now be maintained.

As for fruit and vegetable components, STN is only beginning to exercise supervision, but appreciable results have already been recorded, both for decreasing imports and for increasing onion and potat production in Gandiolais. As for extension, radio and television programs have been designed, as well as training sessions, for fruit and vegetable growing.

d. Research-extension relationships

Although there is not actually a relationship between research and STN, close links were long ago established, in 1973, between researchers an STN extension agents. Therefore, for vegetable growing, an agreement between CDH and STN has been in effect for nearly two years. The agreement deals with the following subjects:

- o Technical assistance for CDH to STN in supervisory activities;

- o Training of extension agents;

- o Supply of technical data and basic seeds, for onions, potatoes and local vegetables; and

- o Establishment of demonstration parcels in the milieu.

e. Summary of problems as seen by the staff

According to the opinion of the officer and staff of the Organization, the major problems confronted by STN in accomplishing its goal are:

- o The delay in setting up allocated credits from the national budget;

- o The lengthiness of administrative procedures concerning contracting;

- o The excessively low price of vegetable produce compared to the production costs, and organization and marketing; and

- o Unavailability of water due to the drought.

B. Animal Husbandry

The Health and Animal Production Directorate, under the trusteeship of the Ministry of Rural Development, is responsible for all matters involving animal production and protecting the health of the herds. As part of its role in this field, it provides technical trusteeship of development organizations and agencies involved in animal husbandry and is responsible for animal production, such as: the Organization for the Development of Animal Husbandry in the Forest-Pasture Region (SODESP--La Société de développemement de l'élevage dans la zone sylvo-pastorale) and the Project for the Development of Animal Husbandry in Eastern Senegal (PDESO--Le Projet de développement de l'élevage du Sénégal oriental).

1. The Organization for the Development of Animal Husbandry in the Sylvo-Pastoral Region (SODESP)

Founded in 1975, this organization was made responsible for developing and promoting animal husbandry in the forest-pasture region.

a. Area of activity

SODESP is active on 6,000 km^2 of two sub-regions where young animals are produced in the Ferlo region.

b. Goals

The goals assigned to SODESP consist of decreasing the load of pasture lands in the Ferlo region and transforming them into regions where young animals are produced. This is to be done by decreasing the number of sterile young males and females in regions where the amount of available feed makes it possible to produce feeder and feed lots for cattle. This is done in the River, Sine-Saloum and Cap-Vert regions.

The objectives of the organization are:

- Supervision of producers and their settlement;
- Improvement of animal feed; and
- Marketing the animals.

c. Human and financial resources

(1) Human resources

At this time, SODESP has 139 agents divided as follows:

- Ten senior technicians (one animal husbandry specialist, eight veterinarians, and one economist);

- 21 staff members and administrative agents; and
- 108 supervisors and other staff members.

Two veterinarians are now being trained. It should be noted that no training plan exists for the next ten years.

(2) Financial resources

In fiscal year 1982-83, the total budget for the Organization amounted to FCFA 2,350,000,000, divided as shown in Table 49.

d. Accomplishments

To accomplish its goals, SODESP has set up a system for supervising producers and for marketing animals and meat; in this manner, this insures professional technical management functions, assistance and social promotion, production and marketing credit. Opening the two regions of Labgar and Mbar Toubab has made it possible to manage 15,000 cattle at the young stage, 7,500 at feeding stage, and 2,400 during finishing. For the sixth plan, now in effect, the organization's objectives are:

- To establish three new supervisory and production areas;
- To supervise 57,000 reproductive cows and 63,000 sheep;
- To increase the number of young cattle being fed from 7,000 to 33,000 head; and
- To increase meat production and cattle and sheep offals from 800 to 4,600 tons.

e. Relationships between research and extension

Although not institutionalized, the relationships between research and SODESP are genuine because the Director General of ISRA is also chairman of SODESP'S board of directors and research programs in health and animal production in the forest-pasture region are implemented in cooperation with SODESP.

f. Summary of problems as seen by the staff

The most severe problems that SODESP has in accomplishing its objectives are:

- The lack of experienced technical staff and related recruitment problems;
- The dependency on outside financing sources;
- The gap between the market price and the production cost; and
- The non-functional nature of some wells in the action area.

Table 49 : Financial Resources of SODESP

Sources	Investment (× 1000 FCFA)	Operations (× 1000 FCFA)	Totals
National Budget	-	590,000	590,000
EDF	365,000	-	365,000
USAID	755,000	-	365,000
FAC	-	110,000	110,000
Self-generated Income	-	530,000	530,000
Totals	1, 120,000	1, 230,000	2,350,000

2. The Eastern Senegal Animal Husbandry Development Project (PDESO)

Founded in 1975, and operational as of 1977, PDESO is responsible for improving animal husbandry in Eastern Senegal by:

- o Closely supervising the animal breeders;
- o Protecting the circuit and animals;
- o Training animal breeders, (i.e., functional literacy);
- o Drilling wells;
- o Controlling brushfires; and
- o Marketing animals.

a. Action area

PDESO is active over an area that covers 13,000 km^2 in the northern portion of Eastern Senegal.

b. Human and financial resources

(1) Human resources

At this time PDESO has 64 agents on staff, divided as follows:

- o Five technical staff members: one agronomist, one rural engineer, three veterinarians;
- o Eight administrative agents;
- o Seven animal husbandry engineers;
- o 34 animal husbandry agents; and
- o Ten support agents.

Ten additional staff members are to be trained, including seven project evaluation specialists, one senior technician, and eight technical animal husbandry agents.

(2) Financial resources

For fiscal year 1982-83, the project budget amounted to FCFA 215,924,000, intended solely for operations and was divided as follows--75 percent from IBRD (IDA), and 25 percent from the National Budget.

c. Accomplishments

In the first phase of the project, which ended in 1982, PDESO accomplished the following:

- o Managed 90,000 head of cattle;
- o Drew up a circuit map with 53 pastoral units;
- o Drilled 100 wells for watering animals;
- o Made 2,000 animal breeders literate and trained 49 animal raisers in veterinary skills;
- o Produced special weekly radio shows devoted to the organization; and
- o Organized weekly meetings in the field attended by supervisors and animal raisers.

d. Relationships between research and extension

The relationship between research and PDESO were recently initiated by the National Animal Husbandry and Veterinary Research Laboratory as part of additional research on agrostology and epidemiology. An agreement between ISRA and PDESO is now under study with the goal of widening and consolidating the relationships.

e. Summary of problems identified by the staff

The PDESO's major obstacles in accomplishing its goals are financial ones since the vast majority of the resources come from outside and are decreasing. Other problems exist and are related to the high cost of groundnut feed cakes and concentrated products.

C. Water, Forests and Hunting

In this area, the Ministry for Environmental Protection is responsible for implementing and enforcing the Government's policy for environmental protection, management and development of natural plant resources and soil conservation as well as management and development of wild animal and fish resources. To accomplish this, the Ministry for Environmental Protection has at his disposal the Directorate of Water, Forests and Hunting, as well as other agencies.

1. The Directorate of Water, Forests and Hunting

a. Goals

The task assigned to the directorate may be summarized as follows:

- o Development of forests by enrichment, reforestation and planting;
- o Development of agro-forestry by integrating trees into the agrarian countryside;
- o Implementation of a national forestry master plan;
- o Administration of fauna and establishment of hunting legislation throughout the country;
- o Protection of the ecosystem and plants by controlling brushfires; and
- o Development of continental fishing and fish breeding while protecting fishery resources in domestic waters.

b. Action area

6,000,000 ha forests.

c. Human and financial resources

(1) Human resources

The total number of agents presently in the Directorate of Water, Forests and Hunting is 680:

- o 11 senior staff members, including ten Water, Forest and Hunting Engineers, and one economist;
- o 374 civil engineers or the equivalent;
- o One technical animal husbandry agent;
- o 11 horticultural technicians;
- o 34 administrative agents; and
- o 249 support agents.

According to the recruiting plan, staffing needs for the next ten years amount to 410 agents (23 engineers, 77 senior technicians, and 300 technical agents or the equivalent). It should be noted that 14 agents are now in training.

(2) Financial resources

Financial resources are shown in Table 49.

d. Accomplishments

The accomplishments of the Directorate of Waters, Forests and Hunting are numerous:

- o Forestry: establishment of various reforestation and planting projects has made it possible for the forestry sector to contribute an average of FCFA 9 billion to the gross domestic product, to provide the nation with 100,000 m^3 of construction wood and 4,000,000 m^3 of firewood per year. A master plan for national forestry was prepared in 1982;

- o Brushfire control: 4,260 km of fire lanes were developed in the sylvo-pastoral area and 2,620 people's committees for controlling brush fires were set up in the eight regions;

- o Hunting: a hunting code and a fauna protection code was written and is revised regularly; nine hunting areas and six national parks have been created; and

- o Continental fishing: supervision, training, and assistance to fishermen.

e. Relationship with research

Relationships between the Directorate of Waters, Forests and Hunting and ISRA, through its Forestry Research Center, have been well developed since 1971. These relationships have developed largely through several research support agreements involving former and present forestry projects (the PARFOB Project, the Mbiddi Gum Tree Production Project, the Irrigated Planting Project in the River Region, the Reforestation Project of the Center-East, the Ligneous Biomass Inventory Project in the sylvo-pastoral Area, etc.). Agreements signed between the two parties have been used to set up forestry research stations in Bandia, Keur Mactar and Mbiddi, among other things. Furthermore, the Directorate of Waters, Forests and Hunting has significantly contributed to increasing the scientific potential of the forestry research department of ISRA. This has been possible thanks to water and forestry engineers as well as civil engineers and technical agents which the Directorate has made available to ISRA.

As for scientific relationships, note that the director of Waters, Forests and Hunting is now a member of ISRA's scientific and technical committee, that ISRA's Department of Forestry Research is regularly consulted for feasibility studies relating to forestry projects, and that the director of the Department of Forestry Research is a member of the National Committee on Hunting Regulations.

f. Summary of problems as seen by the staff

In the director's opinion and that of his closest associates, the problems which impede the achievement of its goals are:

- o The climate (low rainfall);

- The insufficiency of human resources and lack of training of supervisory staff for various forestry projects;
- The problems in mobilizing financial resources (national budget);
- The rather indirect consideration given to the forestry component by extension organizations in their rural development projects; and
- The problems in sensitizing rural populations to the advantages of reforestation and control of desert encroachment.

D. Fishing Sector

As is traditional in French-speaking countries, extension in the area of maritime and continental fishing in Senegal is separated into two technocratic structures which are part of different ministerial departments:

- For continental fishing and fish culture in lakes, there is the Directorate of Waters, Forests and Hunting that is under the Ministry for Environmental Protection; and
- For maritime fishing, the salt-water fishing and sea aquaculture in general, the Directorate of Oceanography and Maritime Fishing, under the Secretary of State through the Ministry of Rural Development, is responsible for maritime fishing.

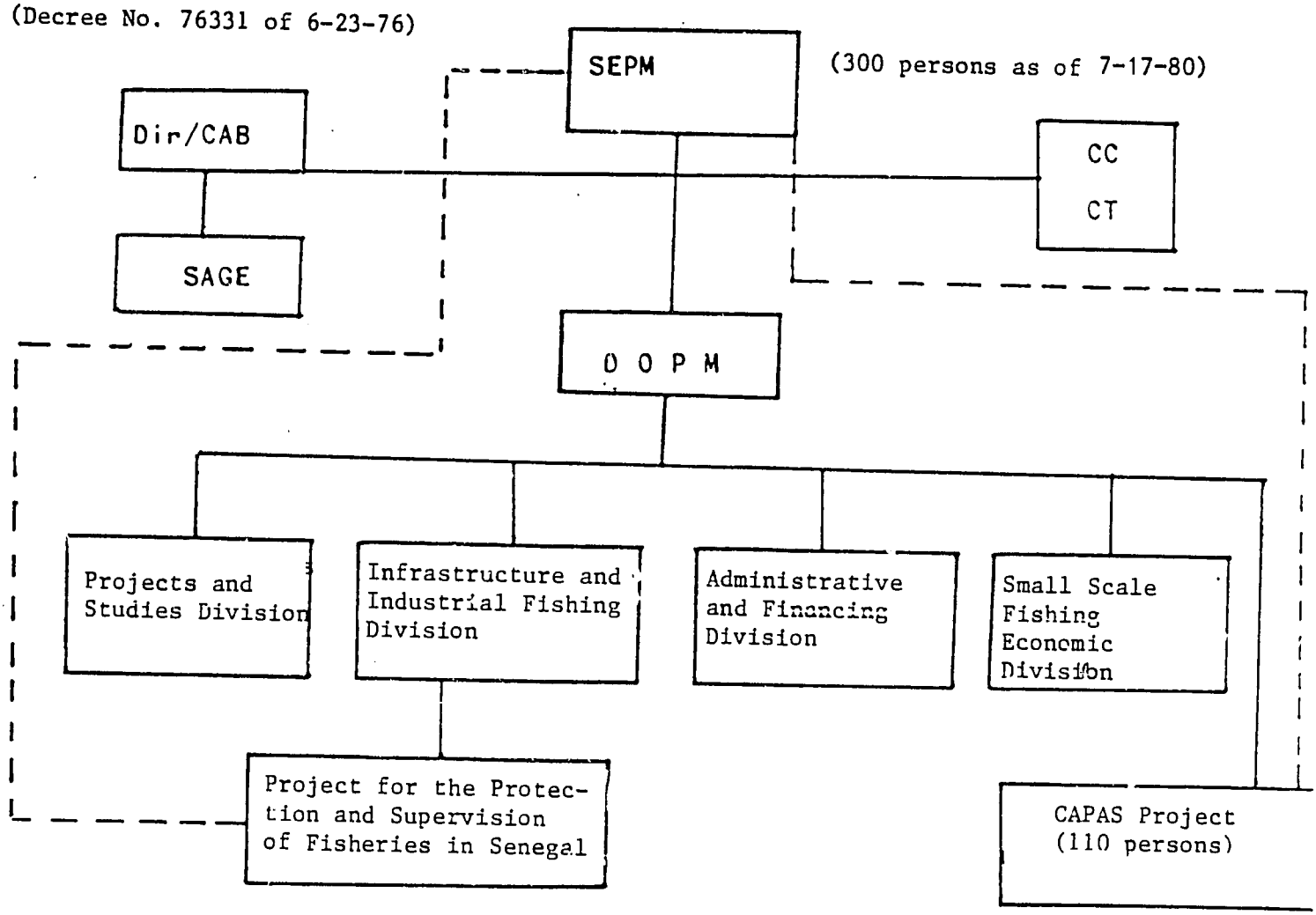
The Permanent Operational Study and Cooperative Group (GOPEC--Groupement opérationnel permanent d'études et de concertation) is responsible for: taking inventory of and coordinating all activities involving youth or undertaken for youth; assisting youth in the preparation and implementation of projects; in cooperation with the other agencies, seeking the ways and means to accomplish its task of socially and economically promoting youth; to foster implementation of a credit system of small and medium-size projects; identifying programs and actions to be undertaken for youth; reviewing and approving projects suggested by youth and submitted to the agency by youths; determining new activities to be financed, and to keep its own financial accounts.

GOPEC has a regional Committee in each regional capital. This committee includes 33 projects divided throughout Senegal. They cover various fields such as forages, drilling, animal husbandry, agriculture, fishing and vegetable growing projects. Maritime fishing extension is provided by the Secretary of State (see Figure 15) and small-scale fishing extension has been fostered by Canadian assistance, through CAPAS. CAPAS was formed from CAMP, the Center for Assistance in Motorizing Pirogues of which it is an extension.

1. CAPAS

a. Orientation

Effort is made here to provide economic and social



N.B.: 150 persons in the regional departments

Figure 15 : Organizational Chart for the State Secretariat for Maritime Fishing

promotion for small-scale fishermen and to improve the contribution of the small-scale fishing sub-sector to national production.

b. Objectives

The objectives for equipment are to provide fishermen with the means necessary for them to practice their profession with the lowest possible cost and to improve the range and quality of the means of production in conjunction with technological development, fishing techniques and conservation of fishing resources.

CAPA is also responsible for the rational distribution of fresh fish throughout the country, including the interior, in order to absorb the animal protein deficit.

This goes through the supervision of all operations in the marketing process, including supply, conditioning, storage and distribution, by minimizing the costs and by increasing profits in amounts that would provide adequate compensation for producers, and which would also meet the requirements of consumers. This could be done by decreasing the number of intermediaries, by setting of points of sale in the interior of the country.

c. Results of CAPAS

The results as of now, even if they are not close to the desired results, bode very well for the future.

d. Accomplishments

(1) Motorization of Pirogues

As of now, it is felt that all pirogues that can be motorized have already in fact been motorized (90 percent); it would be unprofitable to motorize the remaining 10 percent.

(2) Infrastructure

The administrative headquarters houses the central store, the repair workshop for outboard motors, and the experimental center for fishing equipment and techniques.

Seven satellites have been set up along the coastal region between Saint-Louis and Ziguinchor.

(3) Equipment for fishermen

Since the State Secretariat for Maritime Fishing was established:

- 3,600 outboard motors have been received and distributed to fishermen in the cooperatives;

- o FCFA 160 million have been invested in replacement parts to provide service after sale; and

- o Nearly FCFA 70 million have been used for maintenance and equipment of the machinery for infrastructure.

Japanese financing, which is the continuation of the Canadian project, has made it possible to purchase 1,300 outboard motors and to set up a stock of replacement parts. The total amount of financing comes to FCFA 152,659,000.

In the past, the supply agreement signed with Belgium for motors and spare parts made it possible to purchase 1,000 motors. The overall amount came to about FCFA 150 million. Therefore, the motorization component provided 5,900 outboard motors for the fishermen between 1971 and the present time.

(4) Training

The following personnel were trained:

- o 50 outboard motor mechanics; and

- o Ten stock keepers now working directly or indirectly on the project.

The experimentation component has designed and is now testing isothermic containers adapted to pirogues in order to conserve fish caught in the sea. In order to better promote the product and to analyze the socioeconomic impact of the innovation in the fishing environment, this action is being carried out in cooperation with the ISRA, CRODT and ITA research agencies.

(5) Marketing project

(a) Infrastructure

The administrative and technical headquarters includes:

- o Three fish trade centers with refrigerator units for processing the inventory, equipped with an ice producing plant, making ten to 20 tons per day and operational equipment; and

- o Six refrigerator trucks dispatched to the fish trade centers to distribute fish to the interior of the country.

Overall investments have amounted to approximately FCFA 737,500,000.

To this is added FCFA 15,000,000 given to the fish trade centers, which are the funds that allow them to set up their operations.

(b) Training

Four hundred ninety-six fishermen and employees of the fish trade centers have been sensitized, trained, and have received regular follow-up in the various activities of their respective areas.

e. Impacts

The project must be analyzed more completely as to its social impact despite the cost.

(1) The motorization project

About FCFA 353 million have been injected into rural populations as fishing equipment. The funds generated by this activity amount to FCFA 1,651,443,765.

(2) The marketing project

Unions of cooperatives have been able to mobilize 2,337.2 tons of fish in two years. More than 80 percent of the fish was distributed to areas in the interior of the country. The turnover amounts to FCFA 258,364,697.

(3) Impact on the fishing environment

Due to marketing activities, over FCFA 153 million have been provided to fishermen in the respective areas of fish trade centers that represent the prices paid to producers for purchase.

To this sum is added about FCFA seven million in profits that have been redistributed as rebates to cooperative members.

As for the economics, marketing has increased the income of the fishermen involved from FCFA 450,000 in 1981 to FCFA 550,000 in 1982, an increase of 22.22 percent.

The impact has been felt especially in the union of the north, at Fass Boye, and is confirmed by:

- Improvements in equipment, such as purchases of 12 new rotating draw nets at the outset of the season; and
- The rise in the standard of living (new permanent constructions, purchase of television sets).

(4) Processing

Processing, traditionally women's work, has evolved in the large Disembarkation Center. It involves braised fish (fresh sardine base, "tambadiang," "Guedji," "sali," "métorah"). Women in Mbour and Joal process about 50 percent of the fish produced.

Industrial processing of products caught by small-scale fishermen has followed another type of development. The plant in Djifer, activated in 1977, was shortly thereafter confronted with problems that caused it to close partially in 1980 and completely in 1982.

E. Summary of Responses Concerning Human Resources and Working Conditions

1. Human resources and working conditions

With the exception of SODAGRI, the Directorate of Waters, Forests and Hunting and SIN, the other extension institutions generally have qualified personnel, particularly for the supervisors and support agents. The lack of a long-term staff training plan was observed in most cases, except for SODEVA, SAED and SOMIVAC. As for working conditions, they are usually good, with the exception of the lack of logistical means, as generally noted by the field agents.

2. Relationship between research, extension and producers

In general terms, relationships between research and extension institutions are not as developed as they should be. With the exception of relationships which have existed for a long time, such as that between agronomic research and SODEVA (part of the distribution of technological packages in the groundnut basin), the majority of the research-extension relationships have remained at the stage of intentions and personal initiatives. The tendency up to now has been to institute relationships through support research agreements in development projects.

As part of the restructuring and decentralization of ISRA's activities, a strategy to make relationships more dynamic between research and rural development regional organizations is now in progress through:

- Progressively setting up multidisciplinary teams in the major research centers to study production systems and technology transfers which work in close cooperation with the regional development agencies; and

- Institutionalization of research-extension relationships through cooperative agreements with regional development organizations. One agreement has already been signed with SOMIVAC. As for the ministerial departments, the Ministry of Technical and Scientific Research has increased the number of cooperative meetings with the departments responsible for rural development, and plans to set up a directorate for application of research results.

3. Summary of problems identified by the staff

The survey results show that the major problems that the extension institutions have in performing their duties are as follows:

- Unpredictable production level owing to climate, such as low rainfall;

- o Gap between allocated financial resources needed to attain objectives;

- o High degree of dependency on financing form abroad, with donors withdrawing their commitments with increasing frequency;

- o Lack of qualified staff, especially in design and development project evaluation;

- o The supervisors are unable to perceive and understand technical matters; these problems are largely due to the highly scientific nature of distributing the research results;

- o Insufficiency and generally delayed receipt of production inputs, such as fertilizer, seeds, pesticides and agricultural equipment; and

- o High recurring costs related to development projects financed by foreign sources; the national budget is generally unable to bear these costs.

F. Recommendations for Improving Extension Systems Over the Next Ten Years

Because of various economic and climatic conditions, nearly 50 years of research in Senegal has given the rural sector a set of technological packages promoting rapid development. However, the observation is generally made that the development of the Senegalese countryside has not been satisfactory and that the objectives established for extension institutions to fully play their roles in developing the rural sector in Senegal, it is necessary to:

- o Establish a nationwide rational development plan in light of the drought. The new policy must be centered on attempts to achieve self-sufficiency in food;

- o Redefine the duties assigned to the regional rural development organizations and to the action organizations; these organizations must work toward phasing out their own organizations by slowly but surely making the producers more responsible for managing their own affairs;

- o Restructure the cooperative system by basing them on the rural village associations;

- o Spread the "letter of duties" system, ensuring that the Government respects its financial commitments;

- o Make the close supervision and integrated step strategies systematic in extension;

- o Connect research to the formulation, follow-up and evaluation of rural development projects;

- o Institutionalize research-development relationships both on the national and regional levels;

- o Ensure both timely and sufficient availability of agricultural inputs; and

- o Set up an agricultural credit system accessible to the producer for his agricultural equipment needs.

G. The Status of Interinstitutional Relations: A Critical Analysis

1. Goals and objectives of the research/development/training function

By simplifying as much as possible, this may be summarized in the following manner:

- o Analysis and definition of agricultural development strategies adapted to the realities of the country;

- o Programming research and training according to definite short and medium-term goals. The goals must be determined through the consensus of all partners on directions that can mobilize the country's agricultural research potential and provide decision-makers with sufficient choices and options; and

- o Application of research results through objective evaluation and analysis of their potential for contributing to the achievement of social, economic, legal, technical, and policy goals.

2. Existing structures fostering research/development/training relationships

The following organizations, committees, and programs currently foster research/development/training relationship:

- o Interministerial councils for research for vocational training, education, secondary and higher education and rural development. These are governmental advisory agencies which set sector policies and determine where resources will be used. These agencies generally lack the wide-ranging perspective they need for their operation. They most often simply endorse decisions made by ministerial departments due to a lack of in-depth dialogue on the subjects under consideration;

- o Regional units form relationships between ISRA and Rural Development projects and organizations such as SOMIVAC, SODEFITEX, SAED and SODEVA. The agencies are the most functional and efficient. However, they lack legal support and operating funds. They would also profit by opening up to all of the sub-sectors, such as forests, animal husbandry, fishing and education;

- o Technical committee meetings (major products, plant production, trials in many localities);

- o Seminars, brainstorming sessions and meetings organized by research or development;

- o Common action agencies (multi-site testing, experimental units);

- o The advanced teacher training councils of training establishments;

- o Lessons from researchers, particularly ITA and ORSTOM;

- o The national advisory commission of agricultural and agro-industrial research. This advisory agency is attached to the Government and the Ministry of Scientific and Technical Research on directions in research that concern the rural sector, such as identifying priority sectors (balances in research efforts, programming resources and goals, evaluation of results). This commission, comprised of technicians from MDR, MPN, MRST, and SEPM, has unfortunately not proven to be effective because of a discontinuity in representing the ministries that use research results; requirements for preparing the meetings; spacing them in time and short duration. The commission in no way directly supports the different Interministerial Councils;

- o The regional development committees (CRD--Comités régionaux de développement), dedicated to Rural Research or Development, are responsible for defining regional agricultural policy, for planning research needs, and for evaluating the performance of Research and Development Institutions. They have the same handicaps as on the regional level in that the representation is too diversified, there is a lack of real competence, problems in preparation of and participation in meetings;

- o The scientific and technical committees of research institutes. These are evaluation agencies which select annual and pluriannual programs as determined by research institutions for planning, programming, promotion and monitoring. The handicap here is the weak representation of the actual users of research results, and in particular, representatives of SEPM, MDIA and to certain extent, MDR; and

- o Boards of directors (and some management committees) of research, development and training institutions.

3. Reasons for obstacles in interministerial relationships

Very limited awareness of physical and biological milieu, of the environment, of climate, and of dynamic interrelations of organizations and the environment. Serious lack of considerations of action

themes in research, such as design, implementation and evaluation that are too often self-centered because of the rigid divisions of agricultural research, development and training agencies.

4. Prerequisites for improving the situation

a. At the human level

People must change their attitudes to develop mutual trust and a greater commitment to action, with a willingness to work together.

b. At the structural level

Establish agencies on the national, regional and local level. Give them legal legitimacy, clear, precise objectives, specific responsibilities, a trusteeship and a system of recourse to arbitration.

Extend the base of mutual cooperation by including all potential users of research results and actors in sectorial development, e.g., bankers, businessmen, academicians, and technicians from research offices.

c. At the level of ideas and actions

Establish an exhaustive diagnostic analysis of the status of research/development relationships (retrospective and prospective analysis of agencies for supervising and training rural populations). Analyze our system of information and communication. Consider an integrated research/development strategy that is both pluridisciplinary and regionalized in approach.

VI. CONSTRAINTS

A. Agriculture

Table 50 is a synthesis of results from surveys on obstacles to plant production, such as cereals, industrial crops and market produce. It emphasizes either the research proposals or action that can be taken to remove each of the major obstacles.

B. Livestock

Obstacles affecting the development of animal husbandry are many and varied. They overlap to the point where it becomes difficult to categorize them by products such as meat, milk, leathers and hides, honeys, and waxes. The list of the obstacles below is therefore presented in an overall manner by large sectors, such as food, health and socioeconomics.

1. Socioeconomics

At the farmers' level, there is a lack of activity in animal breeders' cooperatives, a lack of agricultural credit agencies, and a lack of training programs for farmers in the use of technical innovations or legal knowledge (for example, the law on the national domain).

At the management level, there is a lack of qualified staff in the field and the failure of the development organizations to distribute information on the socioeconomic obstacles which they have identified.

Overall, there is:

- No pricing policy for animal production in general, and for meat in particular, that would provide animal breeders with enough income to cover their own needs and production costs;
- A lack of references on technical and economic possibilities for improving and modernizing marketing circuits for meat; and
- The failure of regional development organizations to take a role in marketing animal products, and the failure to include this role in all animal husbandry development projects.

As for meat, these various obstacles have an effect on:

- The collection and grouping of animals;
- The transportation of large animals in particular;
- The monitoring of professionals or their assistance; and

Table 50: Major Constraints to Crop Production

Crop Production	Obstacles	Degree of Importance	Proposals Resulting From Research	Actions To Be Taken: Research	Actions To Be Taken: Institutional & Political
All plant production	Drought caused by insufficient rainfall	Very important	Recourse to varieties and species with a short cycle and rapid growth	Continue selecting appropriate varieties	Implementation of a vigorous policy for controlling water resources
	Marketing system	Very important	--	--	Establishment of an organized marketing system (similar to that used for groundnuts)
	Non-incentive producer prices	Very important	--	Macro-economic research	Implementation of an agricultural price policy
	Non-existant agricultural credit since 1980	Important	--	--	Accelerate the establishment of new agricultural credit by letting farmers' organizations play larger roles
	Land tenure system and excessive division of land	Important	--	--	Continue efforts to restructure land holdings
	Low literacy rate	Important	--	--	Intensify efforts to increase functional literacy
	Lack of and delayed implementation of production factors (basic seeds, fertilizers and pesticides)	Very important	--	--	Development of an operational system of supply and distribution by giving SONAR the necessary means

Table 50: Major Constraints to Crop Production (cont.)

Crop Production	Obstacles	Degree of Importance	Proposals Resulting From Research	Actions To Be Taken: Research	Actions To Be Taken: Institutional & Political
Millet	Varieties adapted to the different milicultural areas	Important	Other than the Souna III variety, three varieties that are of slightly higher performance and that are now in pre-extension stages (1.BV 8001, 1.BV 8004, and 3/4 BK) Yield: 2.5 T/ha	Selection of a variety with a 70-day cycle for northern areas with an average annual rainfall of 300 mm	--
	Attacks of mildew	Important	Selection of resistant varieties now underway (1.BV 8001 and 1.BV 8004 are promising)	--	--
	Anthrax, caterpillar and ergot attacks	Important	Insecticide treatment with Furadan, Metasystemax and Endsolfan bases	Directing research toward resistant varieties in cooperation with ICRISAT	--
	Damages caused by striga	Important depending on the years	Treatment with a mixture of atrazine and propazine	Regionalization of research by setting up an African Network of the Biosciences based in Dakar and under the sponsorship of UNDP and UNESCO	--

Table 50: Major Constraints to Crop Production (cont.)

Crop Production	Obstacles	Degree of Importance	Proposals Resulting From Research	Action To Be Taken: Research	Action To Be Taken: Institutional & Political
Millet (cont)	Post-harvest losses (during storage); separation of storage silos	Very important	Recommended molecule insecticides; diffusion of preservation silos	Directing research to develop simple storage techniques that are efficient and within the farmer's reach	--
	Damages due to attacks by birds	Very important on the sub-regional level	Recourse to explosives for destroying the nests	Sub-regional research program (OCLALAV)	--
Sorghums	Varieties adapted to the various ecological zones	Important	Varieties suggested for extension are CE90 for Center-North and Center-South areas, RT13 and RT50 for run-off cropping, yield: 1T/ha., 51-69 and 7410 kh (yield: 3T/ha) for the South Area, 73-13; 75-14 and 612 x 79-14 for the North (yield: 5T/ha)	Continuation of selection of short straw and non anthocyanic seed varieties for the North	Policy of introducing sorghum into the SAED areas
	Availability of seeds	Important	Supply of foundation seeds	--	Development of a framework of production
	Mildew attacks	Important for the southern area	Resistant varieties now in the pre-extension stage	Continue research on resistant varieties	--

Table 50: Major Constraints to Crop Production (cont.)

Crop Production	Obstacles	Degree of Importance	Proposals Resulting From Research	Actions To Be Taken: Research	Actions To Be Taken: Institutional & Political
Sorghums (cont.)	Impact of weeds	Less important	Treatment with atrazine	--	--
	Damages due to attacks by birds	Important in the northern area	Changing the sorghum cropping system	--	Control of birds by using explosives to destroy nests
Maize	Varieties adapted to different levels of intensification	Important	Depending on level of intensification, the following varieties are suggested: ZM10, synthetic 77, BDS III, HVBI, HVB II, Diarra composites. Yield: 5 t/ha	Research on yellow maize (rich in proteins and amino-acids) for weaning children and food for older persons	--
	Attacks by insects	Important	Treatment with Furadan	--	--
	Damages caused by catkins at picking	Important	Treatment with baited seeds (HCH); Lyndane)	--	--
	Impact of weeds on yields	Important in the southern zone	In the South, treatment with LASSOCE 48 or Gesaprim FW500	--	--

Table 50: Major Constraints to Crop Production (cont.)

Crop Production	Obstacles	Degree of Importance	Proposals Resulting From Research	Actions To Be Taken: Research	Actions To Be Taken: Institutional & Political
Maize (cont.)	Availability of seed	Important	Production of basic seeds for composites and synthetics; supply of parents for the hybrids (BDS III and HVBI II)	--	Implement an operation to produce hybrid seeds by the SRDR (SODEVA, SOMIVAC)
Strictly Rainfed Rice	Short cycle varieties and resistant to pyriculariosis	Important	144-B9 is currently recommended (yield: 2.0 T/ha)	Continue research on selection in cooperation with the station in Bouake	--
	Damages caused by insects (that bore holes in the stem in particular)	Important in the South	Furadan treatments	Directing research to phenehormones	--
	Impact of weeds on yields	Important in the South	Treatments with herbicide base: Taurruriz, perforan, CE 300, AMEX 280	Directing research to integrated control of weeds	Making the farmers aware of the herbicidal treatments
	Damages due to attacks by birds	Important sub-regionally	Guards; destruction of nests with explosives	Same as for millet and sorghum	--
	Decrease of soil fertility on the Casamance Plateau	Important	Nitrogen and phosphate fertilization with mineral and organic base fertilizers (8-18-27 urea)	Directing research to the development of natural resources e.g., phosphate, organic matter, leguminous plants	Take necessary steps for timely spreading of fertilizer in sufficient quantities

Table 50: Major Constraints to Crop Production (cont.)

Crop Production	Obstacles	Degree of Importance	Proposals Resulting From Research	Actions To Be Taken: Research	Actions To Be Taken: Institutional & Political
Submerged Rice	Varieties adapted to the various physiographic situations of the plains of Casamance	Quite important	Following varieties are recommended: IR8, DJ684D, IR1529, BR118-2 (yield: 4 to 5T/ha)	Continue selection and exploration of local material	Extension of materials recommended by research
	Damages due to pyriculariosis and cercosporiosis	Important, depending on the year	Resistant varieties above	Continue phyto-pathological research	--
	Damages caused by borers	Important in the southern zone	Same as strictly rainfed rice	Same as strictly rainfed rice	--
	Damages caused by attacks by birds	Important in the southern zone	Same as strictly rainfed rice	Same as strictly rainfed rice	--
	Impact of weeds on yields	Very important in the southern zone	Herbicidal treatments with rouster CE 250	Directing research towards integrated control	--
	Land problems	Important	--	--	Re-allocation of land
	Decrease in soil fertility	Important	Nitrogen and phosphate fertilization (8-18-27 and urea)	Development of natural resources	Same as for strictly rainfed rice
Mangrove Rice	Varieties adapted to different situations	Important in the southern zone	Variety ROK5 now in pre-extension. Yield: 3T/ha	Selection of varieties that resist salts and acidity	--

Table 50: Major Constraints to Crop Production (cont.)

Crop Production	Obstacles	Degree of Importance	Proposals Resulting From Research	Actions To Be Taken: Research	Actions To Be Taken: Institutional & Political
Mangrove Rice (cont.)	Salt and acidity content of soil	Very important	Lixiviation, drainage and soil recovery techniques; these techniques were the basis of the design of the dams-locks in Casamance	Directing research to problems of development of sulfate acid soils and especially development techniques	Extension of the program of building dams-locks
	Water control	Very important	--	Research on superficial and subterranean water sources control of the salt-water table	--
	Attacks by borers	Important	Same as for submerged rice	Same as for submerged rice	--
	Damages due to attacks by birds	Same as for submerged rice	Same as for submerged rice	Same as for submerged rice	Same as for submerged rice
	Impact of weeds on yields	Very important	Same as for submerged rice	Same as for submerged rice	--

Table 50: Major Constraints to Crop Production (cont.)

Crop	Constraints	Degree of Importance	Proposals Resulting from Research	Actions To Be Taken: Research	Actions To Be Taken: Institutional & Political
Irrigated Rice	Varieties adapted to the different growing seasons	Quite important	Varieties used in extension are wet-season rice: K.S.S., JAYA, IR8, I.K.P. (yield: 5t/ha); dry-season rice: I.K.P., KH998 (yield: 6t/ha)	--	--
	Water control	Important	Techniques for the development of the tertiary system	Directing research towards studying the efficiency of the irrigation network	Implementation by SAED of a policy to rehabilitate existing projects
	Damages caused by borers	Important	Same as for submerged rice	Same as for submerged rice	Same as for submerged rice
	Damages caused by attacks by birds	Important	Same as for submerged rice	Same as for submerged rice	--
	Impact of weeds on yields	Important	Treatment with the herbicides: Glyphosphate, Tamariz, Gramoxone	Same as for submerged rice	Systematization of herbicidal treatments
	Problems of fertilization	Quite important	Nitrogen and phosphate urea-based fertilization (250 kg/ha) and ammonia or supertriple phosphate	Same as for submerged rice	Timely application of fertilizers in sufficient quantities
	Availability of seeds	Quite important	Supply basic seeds	--	SAED sets up farms to produce seeds

Table 50: Major Constraints to Crop Production (cont.)

Crop	Constraints	Degree of Importance	Proposals Resulting from Research	Actions To Be Taken	
				Research	Institutional & Political
Groundnuts	Short-cycle varieties that resist the main foliar diseases	Quite important	Varieties used in extension are northern and central northern zone: 55-437 (2.5t/ha); South: 28-206 (2t/ha); edible groundnuts: UF 72-405 and UF 72-414 (2t/ha)	Continuing selection in close cooperation with the University of Georgia (US)	--
	Attacks by inferior cryptogams and depredators (catkins)	Quite important	Baits of H.C.H. base and Lyndane	--	--
	Attacks caused by Aspergillus Niger and rust	Important	Selection of resistant varieties in the form of lines now being observed (100 lines at this time for resistance to rust)	Directing research on rust and dissemination of Aspergillus Niger spores with establishment of a subregional program in cooperation with the Ivory Coast and The National Museum of Natural History (France)	--
	Aflatoxin problems with groundnut feedcakes	Very important	Chemical-based diamentazol detoxification technique	Research on Mycotoxins with the University of Texas	Systematization of detoxification of feedcakes using oil
	Impact of weeds	Quite important	Chemical weeding with Treflan	--	--
	Nematode attacks	Quite important for the groundnut basin	Extension of a nematicide applied during cattle traction	Research on residues of nematicides	--

Table 50: Major Constraints to Crop Production (cont.)

Crop	Constraints	Degree of Importance	Proposals Resulting from Research	Actions To Be Taken: Research	Actions To Be Taken: Institutional & Political
Cotton	Varieties adapted to the different ecological zones	Quite important	BJA and I.299 are now developed for extension (yield: 2-3t/ha)	Continuing selection in cooperation with IRCT	--
	Attacks by insects	Important	Various active substances with pyrethrenoid bases are recommended	Research on updating recommended active substances	Systematization of insecticide treatments
	Problems of potassium fertilization	Important	Potassium fertilizer formulas have been recommended	--	--
	Pathological problems	Quite important	BJA variety seems to resist bacteriosis	Research on varieties that resist bacteriosis	--
Soybeans	Varieties adapted to the different ecological zones	Quite important	Two varieties are currently in extension at the SEIB level (yield: 3t/ha)	--	--
	Problems of farming techniques	Important	Development of inoculation technique as well as production of inoculum (Rhizobium)	--	--
Cowpeas	Varieties adapted to the different ecological zones	Important	Recommended varieties are North: 53-57, 58-75 and Ndiambour (2t/ha); Central: 59-29 BAOL, Mougne, 58-185 (2t/ha)	Directing research to updating recommended varieties and associated millet-cowpea cropping	--
	Damages caused by insects	Important	Treatment with Endosulfan and furadan	Continuation of research on entomology & knowledge of entomofauna	--
	Pathological problems	Apparently important	--	Research begun	--

Table 50: Major Constraints to Crop Production (cont.)

Crop	Constraints	Degree of Importance	Proposals Resulting from Research	Actions To Be Taken: Research	Actions To Be Taken: Institutional & Political
High-consumption Vegetables (European Type)	Adapted varieties and spreading out of production	Important	The following varieties are used in extension: onions--violet de Galmi (30t/ha); potatoes--Claudia and Cardinal (40t/ha); tomatoes--Rossol, Roma (40t/ha)	Continuing research on varietal improvement	--
	Insect attacks	Important	Combination of insecticides is recommended	Directing research towards integrated control	Systematization of treatments
	Pathological attacks	Quite important	Above resistant varieties	Directing research towards integrated control	--
	Seed-related problems	Quite important	Supplying basic onion and potato seed	Development of seed fertilization technique for tomatoes	--
	Post-harvest losses	Important	Development of preserving techniques for onions under aerated hangars and potatoes in refrigerated warehouses	--	Use of a preservation system for potatoes
	Marketing problems	Important for the onion	--	Study of marketing on the nat'l level	Implementation of an effective marketing system
Local Vegetables	Varieties adapted to different growing areas	Important	Following are recommended varieties: okra--popl2 & puso (20t/ha); peppers--SALMON (15t/ha); Diakhaton--Soxma (20t/ha); sweet potato--Koyo & N'Dargu (30t/ha)	Continuation of research in variety improvement	--
	Insect attacks	Important	Same as high-consumption vegetables	Continuation of research in entomology	Systematic treatments
	Pathological problems	Important	Same as high-consumption vegetables	Same as high-consumption vegetables	--

Table 50: Major Constraints to Crop Production (cont.)

Crop	Constraints	Degree of Importance	Proposals Resulting from Research	Actions To Be Taken	
				Research	Institutional & Political
Local Vegetables (cont.)	Availability of seeds	Important	Supply of most seeds	--	--
	Marketing problems	Important	Same as high consumption vegetables	Same as high consumption vegetables	Same as high consumption vegetables

- o The downward determination of prices due to many costs incurred by the professionals.

2. Ecology and nutrition

The drought has caused serious damage over the last few years. Pasture lands have been destroyed, feeding has become a problem, water is scarce, and grazing areas have dwindled with the disappearance of fallow land.

The necessary information is not available which would permit a re-definition of the actual capacities of an improved, coherent management of natural pastures. Similarly, those conditions which would allow for intensified use of pastures by forage crops are lacking as are usable formulas for integrating agro-sylvo pastoral development (the introduction of fallow land forage crop rotation and soil enrichment by the introduction of adapted ligneous fodder species). There is no existing system to supply animal feed to cattle breeders and farmer/shepherds at affordable prices (for example by input subsidies).

The extension of growing zones endangers animal production by reducing the amount of pasture land. Animal husbandry and agriculture are poorly integrated. The lack of seed centers for fodder, which is essential to farming in Senegal, and difficult access to agricultural and agro-industrial by-products, are also constraints.

3. Animal health

The following are constraints on the maintenance of animal health:

- o Persistence of serious diseases (brucellosis, the complex of infectious and parasitic diseases of small ruminants, tsetse flies, ectoparasites);
- o Lack of financial, material and human resources to effectively and continuously control disease. The possibility of using regional development organizations for distributing less expensive medicine should be considered;
- o Health legislation, with a health policy and health inspections mal-adapted to the drought situation, has caused increased movements of animals; and
- o Lack of a compensation fund for reimbursing animal breeders who incur additional expenses to make their farms comply with health legislation.

4. Genetics

Currently cows, pigs, goats and sheep are producing little milk or meat. Advanced genetic practices (artifical insemination,

sale of sires) have not been diffused widely and are not widely practiced.

5. Favorable factors

Wise usage of the factors listed below should help to achieve the goal of 15.7 kg of meat per person per year in 1985:

- o Breeders: The Peuls are highly qualified breeders. They have traditional ideas but they are sensitive to quantifiable improvements. Farmers demonstrate increasing interest in improving their herds;

- o Animals: The quality of animal species and their ability to adapt to different environments are determining factors for the future of this economic sector;

- o Abundance of water tables: Compared to other Sahelian nations, Senegal is certainly fortunate to have water tables available in most regions. Pumping is still a major problem;

- o Improperly-used or unused pasture lands: Establishment of water holes would make for rational use;

- o Animal health: Animals enjoy good health. DSPA should be better equipped to maintain the level of protection now being provided;

- o Production systems: These are very diverse and all show sure signs for development of by-products, fodder, mineral extension, etc. The organizations responsible for managing animal husbandry have had successes in a number of intensification efforts. Research is quite informative and can suggest solutions to pathological, nutritional and genetic obstacles; and

- o Equipment: In Senegal, communication equipment, stock markets, refrigerated slaughterhouses, and installations for processing leathers and hides are excellent.

C. Agroforestry

Survey results show that the major obstacles to the development of agroforestry are:

- o Drought caused by rainfall shortage: Irregularity of rain, both in quantity and distribution over time, has caused problems for most reforestation operations because the seedlings may not grow;

- o Competiton from annual crops: Particularly in the groundnut basin demographic pressure decreased arable land and the farmers are more motivated to cultivate annual crops than

crops for forestry operations which are profitable only in the long run;

- o Brushfires and straying animals: National forest areas are certainly threatened by these two factors, despite steps taken by the agencies concerned;

- o Human and material resources: Lack of both human and material resources impedes efforts of the Directorate of Waters, Forests and Hunting to control desert encroachment;

- o Research advances in shrub species for fodder are not used: A judicious use of research results on the Accacia and Prosopis fodders would certainly have contributed to the development of village fodder cropping in the groundnut basin and in the Sifo-pastoral area; and

- o Financial resources: Most of the forestry products are financed abroad, but increasingly the donors tend to withdraw their commitments. For the Senegalese government to accept responsibility for recurring expenses in connection with these projects poses a serious problem.

D. Fishing

1. Sea fishing

a. Steps for improvement

Small-scale producers dominate this sector. An increase in the development of small-scale fishing products implies removing a number of obstacles that still remain. For the sector to fully develop, the following steps should be taken:

- o Improving product quality at disembarkation; experiments now in progress to introduce containers could partially solve the problem;

- o Improving the cleanliness of the beaches, which now partially prevents small-scale processing and limits the possibilities for storage and sale of fish. Beaches have no available infrastructure; and

- o Increasing the effectiveness of CAPAS, as it alone is able to provide a lasting solution to price fluctuations in the inland market supply.

Despite the consistant performance of CAPAS, much remains to be done for the marketing component.

b. Fish marketing centers

(1) Evaluation

Unfortunately, fish marketing centers have not been very effective at storing and selling fish. The Kayar Center has been operating since November 1981. In December, 1982, or in one year, the center purchased 632 tons, or about four percent of the production, for a capacity of 3,500 tons per year. Thus, use was at 17 percent of capacity. Joal, which began operating in July 1982, is not faring well either as fishermen do not go there to deliver their products. Data on the Center in Rufisque, which opened earlier this year, are not yet available. The centers' problems are related to the fact that the prices offered to the fishermen are low compared to those offered by fish merchants. Therefore, the center has supply problems in the areas where merchants are located. To overcome this problem, fish is purchased at beaches, such as Hann, Joal, Yoff, M'bour, processed in Kayar, and finally sold in Dakar.

(2) Problems

There are numerous management problems at the centers. Studies of the inland markets for fish should be made as soon as possible; CRODT has just begun studying this issue. As well, training cooperative members in management would make it possible to avoid some problems.

The relationship between CAPAS and fish sellers now competing for the market should be defined. Once these marketing obstacles are removed, a new phase should begin which moves toward increasing productivity by developing new techniques (improved hoop nets) and by creating new secondary ports in Djiffère and in Kafountine (or Elinkine) to decentralize fishing activities toward Saloum and Casamance. Of course, a socio-economic study should preceded implementation of these actions. Particular attention should be paid to women fish processors who are still left to their own devices.

For changes in this sector to be effective, literacy training for at least a portion of the population could be crucial.

c. General obstacles

Various types of fishing are grouped here, including development and research, the strict control of fishing tools, fishing efforts, areas and catches and the need for management on a regional level.

As for the first point, many regulations already exist pertaining to small-scale trawling and shrimp fishing in Casamance. Otherwise, regulation of fishing is dealt with in decrees that regulate fishing in all of Senegal.

However, the means of monitoring are still insufficient, and conflicts between the two types of fishing, small-scale and industrial,

are still many. The conflicts, other than the fact that they create social conflicts as well, are dangerous for the balance of provisions, because the trawlers fish in coastal areas and scrape the bottom to catch fish, usually young fish, which may rapidly lead to a depletion of stock, particularly if fishing efforts increase.

The monitoring and regulations problems should be resolved early next year, when the protection and surveillance project for fishing in Senegal takes off. This project will be set up by the Secretariat of State for Sea Fishing, with assistance from Canada. This ambitious oceanography program will use different forms of assistance. The Directorate of Oceanography and Sea Fishing (the prime contractor), will provide the operational component with the navy and army. The scientific component will be the responsibility of CRODT.

2. Analysis of obstacles to continental fishing

a. Constraints linked to production

Analyzing the present situation in made difficult due to the lack of data on continental fishing. Installation, equipment and field team reinforcements responsible for collecting disembarkation statistics and basic managerial tasks should make it possible to obtain the knowledge that is essential to rationally operate domestic fisheries in the River, Eastern Senegal, Sine-Saloum and Casamance.

Nevertheless, it appears that the contribution of fishing was lower than for the years from 1980 to 1982. In fact, severe climatic conditions over these last years have increased the tendency toward lower production and loss of jobs for a number of fishermen who are oriented toward agricultural activities. It should be noted that continental fishing, according to the season, involves fresh water species (in winter), or both residual stocks of fresh water species and brackish water species that are generally amphibious such as stripped mullets (Mugil sp) and etharalose (E. fimbriata).

Without these data, we have estimated the availability of fish from the amount of flooding in the valley. This has been calculated from the correlation of maximum flows in Bakel, a station that has been watched from the beginning of the century and maximum coasts in Kaédi: the latter term of comparison has already been used to calculate the amount of flooding. Thus, for each of the following years the flooded areas were found to be 380,000 ha in 1980, 300,000 ha in 1981 and 220,000 ha in 1982.

These results generally demonstrate a worsening of ecological conditions in the fishery, such as more turbid, hotter and less oxygenated waters, even if these species known as hardy are predominant there, there are fewer substrata for laying psamnophilic species and fewer shelters for the youngphase of the fishery.

The productivity of the soudano-sahelian fisheries has been conditioned by the size of the flood and the extent of resultant

flooded areas, so that availability of fish continues to decrease--23,000 t in 1980, 18,5000 t in 1981 and 15,000 t in 1982.

In the River region, the climatic conditions are such that the lack of fish product conservation causes serious problems. Losses caused by insect contamination, particularly derneestras, of semi-preserved fish affects up to 40 percent or more of the original product weight, which makes the protein/needs resources dilemma more serious in an environment in which undersupply in the fish market is already chronic.

The problem is more one of means than of know-how; the technical qualifications of continental fishermen have never been doubted, particularly in the high and low delta where various equipment is used and is well adapted to variable fishing conditions. Moreover, from the socio-economic standpoint, the ethnic minorities in these regions have specialized (Soulbabé for the River region and Somones for the Faléme for fishing, Peuhls and Maures for transhumant animal raising) and learn the improved fishing techniques of southern fishermen during their dry season migration southward; for example, shrimp fishing in the Casamance.

b. Economic obstacles

It remains clear that, during the period under consideration, the market was undersupplied in the River region, even if sea fish could be found on the markets in the Dagana, Podor, and Matam departments, and sometimes in Bakel. Because of the rural exodus, production is generally consumed locally, or more often, exchanged for other food commodities, such as milk and cereals. Considering this shortage in supply, prices could reach even higher levels in 1976 (FCFA 85) and reach about FCFA 250.

Fishing camps are usually isolated and forced to dry all or part of their production, and thus decrease its value despite the fact that more work is involved. This fish is sold at a price of 30 to 50 percent lower than the equivalent in fresh fish. Transportation, when it exists, is well below sanitary standards and is generally insufficent.

Access to all forms of credit at all times has been a problem for continental fishing. However, in late 1981, there were 21 continental fishing cooperatives in Senegal which included 1,059 member fishermen. The cooperatives were founded in early 1970, in order to facilitate access to credit for fishermen so that they could purchase fishing gear. Even if they were to subscribe a bit more than the 50 percent of all capital subscribed by the sea fishing cooperatives, they are still not able to take advantage of equipment subsidies for items such as outboard motors, fiberglass piroques and other fishing equipment, or gas--all items that marine fishermen have at their disposal.

Construction costs of aquaculture pools, and costs for access to water continue to limit the spread of fish breeding in the River region.

Agricultural by-products of good quality are generally available in sufficient quantities, but only near the coast. High transportation costs make inland use of these by-products quite expensive.

VII. CONCLUSIONS AND OUTLOOKS

The rural sector's contribution to the economy of Senegal is great. The motivating role it plays in overall economic growth and development is measured by:

- The large number of persons or economic operators whose incomes and resources emanate directly from rural activities; in fact, the agricultural sector employs 70 percent of the labor force;
- The important contribution it makes to overall training in the economy and its effects on other sectors; and
- Its decisive particpation in maintaining and safeguarding national budgetary and financial balances, and for the national balance of payments situation.

While we are well aware of the dominant role of the agricultural sector, it is developing under highly difficult circumstances. Four characteristics seem to be illustrated by this background: the first characteristic is that the population has grown faster than the production of goods and services. With an annual population growth rate of 2.7 percent, it is becoming increasingly difficult to produce enough agricultural products for the entire population without resorting to imports. Overall, Senegal is already using about 70 percent of its arable land. Unless there is a drastic increase in yields, the discrepancy between production and national consumption will continue to grow. The second characteristic is that the primary sector is shrinking, not only in the sense of the number of people involved, but in absolute value as well. The third characteristic is that there is a grain shortage that requires rapidly growing grain imports, especially for broken rice and wheat, and the import of other foodstuffs as well. Recent decreases in grain harvest and a groundnut harvest that has literally dropped through the floor cannot be explained solely by citing the effects of the drought. Other explanations must be forthcoming including the fact that cultivation continues without either fallow land or use of humus. Added to these is rapid deforestation. Furthermore, the fourth characteristic is as follows: the groundnut basin, which remains the major agricultural producing area in the country, has become too densely populated to allow land to lie fallow, and the fertililty of the land decreases to an alarming extent. Deforestation is occurring at a rate of 3 percent a year for the composition of the forest and is a major problem for Senegal. The animal husbandry situation is not much brighter; food remains the major constraint. The only sector that shows a healthy dynamism is sea fishing.

Given this context, it appears necessary and urgent to increase agricultural production in order to eliminate the food shortage. In other words, we must increase all activities that contribute directly (production processes and inputs), or indirectly (cooperatives, credit,

marketing, primary health care, training and extension), to enhancing agricultural production and as a result, to bettering living conditions.

However, there are obstacles to the effort to improve agriculture and to implement the gamut of required activities. There must be an inter-sectorial integration, which does not now exist in Senegal. The sometimes conflicting activities mentioned above overlap and are not coordinated. Urban-rural dynamics also have an influence on rural development. Dietary habits change, particularly in the cities, where a preference exists for rice and bread. However, the demand for grains in the city is not suited to domestic supply, which is largely millet and sorghum. The discrepancy between the supply of local grains and demand in the cities determines the price for grains and food crops at the expense of farmers in the countryside, while forcing the country to spend a large and growing portion of its foreign currency, earned from exports, to purchase consumer goods. There is a delicate balance between farming, which is highly subsidized by the government, and is costly, and farming that is financially independent. The use of inputs and foreign technology does not lend itself to profitability in agricultural production. Furthermore, agricultural production creates export revenue, which causes another delicate balance between the labor-intensive profitable crops that provide work and food crops that have less financial value, but are important to national food supplies. Finally, agriucltural production is subject to the influence of neighboring countries, especially where there are border areas consuming the same products at higher prices, which may cause imbalances.

The rather grim picture painted here is mitigated by a more positive side. Senegal has many resources, including water potential from the Gambia and Senegal Rivers and the hydraulic network in Casamance, and available lands for agriculture, such as in Eastern Senegal, making the situation more positive than in other Sahelian nations. Senegal has also qualified resources and has made great accomplishments in research. The resources are vast, even if they are occasionally underused, or if the relationship between senior-level research and elementary education is not as dynamic as possible. Nevertheless, there is a pool of basic experience ready to be tapped on all levels. The farmers are already using various agricultural inputs and extension methods, especially in the groundnut basin. The peasants' experience is especially significant because it represents a base for all future rural development projects.

However, the development potential is difficult to evaluate. First, the idea of translating research into action is relatively recent because projects are still too often designed rigidly as a function of an idealized environment. Also, projects are subject to the influence of a wide range of obstacles and negative factors that are sometimes unpredictable. Thus, it is necessary to set up or redirect administrative and organizational agencies, or to reconcile technological options with the motivations of the target group and the obstacles of the environment. This is why pre-programmed projects, implemented according to set plans and schedules, have until now made it difficult to make and recognize local accomplishments. Considering

Senegal's resources, rural development projects now and in the future will depend increasingly upon two main types of activities: irrigation and development of new lands. It must be understood that these sectors of activity are costly and complex, while development continues to be the crucial variable.

The nature of the stakes and the situation analyzed above during a recent seminar in "agricultural policies and food strategies" point the way to a new understanding of research in Senegal.

A new research and technological innovation policy is now being established to meet these needs. It attempts to emphasize several essential principles that are listed below:

- o The concern for coherency and integration between research and development activities;
- o The need for mobilizing all national organizations involved in scientific and technological research, as well as public or private enterprises, and for integrating the work of the various organizations;
- o Attention paid to developing the research results and distribution of knowledge;
- o The need of mobility of researchers between specialized institutions (training centers, research departments), between these institutions and other research centers, and between these centers and businesses;
- o Development of activities that fit into a regional or multilateral framework; and
- o Exploration of new directions for research connected to the social and economic problems of the rural populations, keeping a pluridisciplinary orientation in all subjects.

Of all the subject areas taken into consideration, two emerge as priorities.

A. Study and Development of Space and Natural Resources

Controlling space and use of natural resources has the special characteristic of extending beyond national and regional limits. It requires simultaneous correlation of problems of a geological, climatic or botonic nature with the various levels of the country, the subregion and the world.

Thus, the study of atmospheric dynamics, (the interaction of atmosphere, hydrosphere and lithosphere) seems especially important and should make it possible for us to improve our knowledge of natural phenomena, such as the causes of desert encroachment and changes in the ecosystem.

As for the lithosphere, areas of knowledge relating directly to water, soil, fuel and fertilizer resources and to the water table can be widened.

In the life sciences field, the study of photogenic resources must become an ongoing activity.

Development of management of ocean environments implies giving an oceanographic description of our ocean areas (overall knowledge of environmental parameters assumes an overall action that goes beyond the sub-regional framework), an in-depth evaluation of fishing resources or fish-raising skills for certain marine species and problems in the environment caused by development and its consequences, and implementing specific development or management techniques and methods to insure higher productivity, reliability and adaptability on the national level.

B. Food and Agricultural Development

Independence and food security are the key words to this program, which involves: the various sectors of agricultural production (food crops, export crops, animal husbandry, forests and small-scale fishing); scientific approaches (production systems measures, by-product, by technical branches and by factors); and finally, it involves the range of disciplines, from elementary knowledge to experimental research and research-development applications.

There are four generally recognized levels of investigations for this subject area:

1. Food systems and politics

The research path is designed with an interdisciplinary approach (economy, agronomy, and nutrition) that must be developed:

- o On the regional level, to make it possible to grasp the regional situation in the Sahel and in Africa, and to describe the food economy; and
- o On the national scale, to make it possible to analyze our food systems and policy in the strategic areas of agricultural development, marketing, and prices.

2. Production systems

This scientific approach, which has already been described, leads to implementation of integrated multidisciplinary programs that deal with the activities of an agrarian society within a prescribed space. The research, dependent on a finalized design, must be sustained by increasing basic skills through continuing exchange with the practitioners.

3. Food technologies and production sector

The production line approach, whether animal or plant, has until now been a privileged path for research that has resulted in great scientific accomplishments and knowledge in a number of fields. This research must be maintained as new products are introduced to local farmers. In lower-level production, research remains insufficiently developed and must be made a priority for the future. More particularly, this involves developing technologies for processing small-scale harvests in order to preserve , store and condition the products in order to eliminate losses and ensure quality. Research on processing and developing local products must explore new paths opened by biotechnology; for example, the special case of controlled fermentations.

4. Production factors

This level of analysis takes a traditional approach dividing subject matter by discipline, and provides the basis for the other analytical approaches which divide subject matter by network or by system. In the special case of agricultural areas that do not enjoy favorable conditions and natural resources, research must foster the following efforts:

- Improving plant and animal species using modern or traditional genetic methods, such as exploration, selection, hybridation, cross-breeding and cloning;
- Physiochemical, organic and biological procedures for maintaining and restoring soil fertility. This mainly involves using new possibilities in microbiology and other disciplines to perfect fertilization techniques at the lowest cost possible, such as symbiotic fixation of nitrogen, phosphorous mining through mycohorizes, and organic fertilizers;
- Protection of crops or species, using integrated control; and
- Agricultural mechanization adapted to the specific conditions of environment and usage.

ANNEX 1

Bibliography

ANNEX 1

Bibliography

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ANNEX 2

Program Operations

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ANNEX 2

Program Operations

A. Sub-sector: Crop Production

1. Program: Millet pathology

o General objectives: Increasing the productivity of millet while assuring stable yields. It will consist of continuing anatomo-histopathological, enzymological and sociological research to support and complete research on the resistance of millet and to permit better control of the mechanisms governing the interactions between the host-plant and the parasites.

o Brief description: At the host plant-level:

-- Physical resistance to breaking in and penetration;

-- Study of the biological and chemical resistance factors; and

-- Study of chemical resistance factors.

At the pathogenic level:

-- Physical actions (actions caused by the formation of tylles or blockage of the stomate); and

-- Chemical actions (enzymatic or spoliatory actions).

o Justification: A multidisciplinary program for the improvement of millet (genetic, physiological, pathological, entomological and agronomic) was established in 1976 in response to the Government's goal of food self-sufficiency.

o Location of project: Bambey Agricultural Research Center (CRA-ISR Plant Physiology Laboratory of the University of Dakar).

o Length of project: 48 months.

o Needs:

-- Human resources: Managerial staff and implementation staff;

-- Equipment: Laboratory materials, glassware, chemical products, furniture, complete remodelling of laboratory and greenhouse;

-- Estimated budget:

Personnel	FCFA 15 million
Travel expenses	FCFA 2 million
Equipment	FCFA 12 million
Operation	FCFA 12 million
Total	FCFA 41 million

-- National contribution: Research personnel.

o Expected results: Increase in grain production and the resulting reduction in food deficit and increase in incomes.

2. Program: Millet diversity in the Bambey Collection: enzymatic polymorphism, adaptive value, gametic imbalance

o General objectives:

-- Increase in the productivity of millet while ensuring stable yields; and

-- To assure a large genetically diverse base for the millet, thereby allowing it to respond to natural variations within the ecosystem and to continue with basic studies focusing on the organization and differentiation of genotypes and their parasites.

o Brief description:

-- To use marker genes to show enzymatic polymorphism, its adaptive value and its organization at the level of linked groups (Electrophoresis method);

-- Analysis of isozymes = esterate, phosphate, peroxydate, catalate; and

-- Eco-physiological study of the working of enzymes (controlled synthesis).

o Justification:

-- The desire to reach food self-sufficiency through the improvement of millet production, principal grain of the country; and

-- Thanks to the existing material (collected on millet since 1979) and the study of the stability of phenotypical polymorphism the project will determine the possibility of direct utilization of these varieties.

o Location of project: Bambey Agricultural Research Center (CRA-ISRA).

o Duration of project: 48 months.

o Needs:

-- Human resources: research personnel and implementation personnel;

-- Equipment: Remodelling and upkeep of greenhouse, lab tools, furniture, upkeep products and chemicals;

-- Estimated budget:

Personnel expenses	FCFA	11 million
Travelling expenses	FCFA	2.6 million
Equipment	FCFA	38 million
Operation	FCFA	4.4 million
Total	FCFA	56.0 million

-- National contribution: Research personnel.

3. Program: Contribution to the development of maize

o General objectives:

-- Increase research on maize, which until now has been ignored, to raise its importance in Senegal;

-- Also, respond to the Government objectives where grain policy depends essentially on a considerable increase in the production of maize (surface as well as yields); and

-- Benefit as much as possible from the great advances made internationally in the production of maize.

o Operations:

-- Extension of "opaque 2" maize in Senegal;

-- Maize agronomy; and

-- Maize physiology.

a. Project No. 1: Extension of maize "Opaque 2"

o Justification: Extension of this type of maize will reduce the protein-energy deficiency in the rural population.

o Brief description: It involves carrying out the following research operations, while supporting a program for the development of "Opaque 2" maize in the countryside:

-- Opaque 2 maize development program in countryside;

-- Nutrition tests for youth based on different culinary preparations (ORANA);

-- Maize technology: incorporation of maize flour in flour for bread (ITA);

-- Industrial processing of broken maize (ITA); and

-- Information and publicity.

o Location of project: Sine-Saloum, Institute of Food Technology (ITA), SOMIVA-SODEVA and the Organization for Research on Food and Nutrition in Africa (ORANA).

o Duration of project: Three years.

o Needs:

-- Human resources: Existing researchers, ITA, ORANA, extension technicians to be recruited, and implementation personnel;

-- Materials: One vehicle, laboratory equipment, and grain mills;

-- Estimated budget:

Production in the countryside (management personnel, materials and operations)	FCFA 40 million
Diet and nutrition studies	FCFA 14 million
Opaque 2 maize technology	FCFA 5 million
Industrial processing	FCFA 26 million
Information and publicity	FCFA 2 million
Total	FCFA 87 million

-- National contribution: FCFA 25 million.

o Expected results: Better knowledge of Opaque 2 maize and its processing potential in Senegal. Full scale test of the farmers' interests in this amino-acid enriched variety.

b. Project No. 2: Improvement in maize productivity through appropriate cultural techniques during the rainy season

- Justification: Production of maize has increased by 13 percent annually for the last five years and yet productivity remains rather low. Therefore, the project aims to improve productivity based on the fact that the farmers are currently very interested in maize.

- Brief description:

  — Study of ridges and wattled mounds;

  — Study of toposequence;

  — Study of mixed cropping and rotation with leguminous crops;

  — Tests of seeding density; and

  — Study of natural fertilizer.

- Location of project: Senegalese Institute for Agricultural Research (ISRA) and Nioro, Sefa, and Sinthiou Centers.

- Duration of project: Three years.

- Needs:

  — Human resources: One part-time agricultural researcher and one full-time technician;

  — Materials: Construction and equipping of laboratory, one vehicle, and agricultural materials;

  — Estimated budget:

Personnel	FCFA 33 million
Equipment	FCFA 6 million
Investment	FCFA 28 million
Operation	FCFA 33 million
Total	FCFA 100 million

  — National contribution: FCFA 10 million.

- Expected results: Find a method for watering crops and at the same time diversify crops by inter-cropping leguminous crops with maize.

c. Project No. 3: Maize physiology

- Justification: There is a lack of studies to date on the physiology of maize in Senegal; maize growth under conditions of mineral nutrition as well as under conditions of water shortage should be studied.

o Brief description:

-- Study of maize growth and yield;

-- Determination of criteria for selection of plant type on the basis of drought tolerance;

-- Study of proliferation and mineral nutrition; and

-- Ecology and nutritional value.

o Location of project: ISRA South Center Sector (Kaolack).

o Duration of project: 36 months.

o Needs:

-- Human resources: One researcher to be recruited, one technician to be recruited, and implementation personnel to be recruited;

-- Materials: One vehicle, two mopeds and laboratory equipment;

-- Estimated budget:

Personnel	FCFA 60 million
Materials	FCFA 10 million
Equipment	FCFA 5 million
Operation	FCFA 30 million
Total	FCFA 105 million

-- National contribution: 10 million FCFA.

o Expected results: Increase in yields in the near future.

4. Program: Strengthening ISRA research on groundnuts in the fields of phytotechny, protection from catkins and improvement adaptation to drought

o General objectives: Following the major research efforts in genetics (shortened cycle), fertilization, conservation and grain storage, it was necessary to conduct research on 3 subjects:

-- Better adaptation of groundnuts to drought;

-- Control of catkins (edible groundnuts); and

-- Phytotechny of groundnut oil.

- o Brief description: Scientific analysis of the three subjects outlined above and in particular:

  -- Cross-breeding to obtain an early variety with a growing season of 75-80 days and with good agronomic qualities;

  -- Study of the heredity of resistance traits;

  -- Catkins - Survey of destruction, biology, method of control:

  -- Modernization of foliar diagnosis standards; and

  -- Adaptation of fertilization to limited rainfall.

- o Justification: Research and develop new methods of increasing the productivity of groundnuts, since the total surface area planted with groundnuts, the largest export crop, cannot be extended.

- o Location of project: Bambey Agricultural Research Center (CRA-ISRA).

- o Duration of project: 48 months.

- o Needs:

  -- Human resources: Two researchers to be recruited and implementation personnel;

  -- Equipment: Laboratory equipment, various agricultural equipment, and one vehicle;

  -- Estimated budget:

Personnel expenses	FCFA 57 million
Travelling expenses	FCFA 4 million
Material	FCFA 9 million
Operation	FCFA 14 million
Total	FCFA 84 million

  -- National contribution: FCFA 32 million.

5. Program: Study of viral and micoplasm diseases of market-garden and food crops in Senegal and the countries of the Sahel: etiology, epidemiology, methods of control, genetic selection and improvement

- o General objectives: To provide West Africa with its first plant virology laboratory for the study of observed viral diseases.

o Brief description:

-- Construction of virology laboratory;

-- Training of specialist: (medium term);

-- Inventory and study of principal viral diseases;

-- Production of serum to permit rapid identification;

-- Epidemiology; and

-- Carriers, methods of control, selection of breeding material.

o Justification: Timely studies on viral diseases indicate that they are very prevalent especially in market-garden and food crops. Current identification methods based on symptomology and the use of electron microscopes is very important. The current studies of vegetal material selection are confronted by a lack of knowledge regarding viral diseases.

o Location of project: Center for Horticultural Development (CDH), Dakar Senegalese Institute for Agricultural Research (ISRA) ORSTOM-DAKAR.

o Duration of project: 39 months.

o Needs:

-- Human resources: Two existing officials: ORSTOM and ISRA, two supplementary technical assistance experts and two local counterparts who will have to be trained;

-- Equipment: Establishment of a complete laboratory for viral studies;

-- Estimated budget:

Personnel expenses	FCFA 130 million
Travelling expenses	FCFA 2 million
Materials	FCFA 68 million
Operation	FCFA 10 million
Total	FCFA 210 million

-- National contribution: FCFA 130 million to be paid by ORSTOM.

o Expected results: As a result of better selection or better control thanks to the knowledge acquired regarding viral diseases, cereal production and market-garden crops should increase in yield.

6. Program: Improvement of local genetic resources of sorghum in Senegal.

o General objectives: Improve our local genetic resources by assembling a national collection of sorghums.

o Brief description:

-- Assembling a collection of local sorghums;

-- Description of the collection;

-- Genetic evaluation;

-- Storage - conservation; and

-- Utilization in international and domestic programs.

o Justification: As a result of the limited genetic base of improved varieties, the assembly of local sorghum should provide a new approach to the improvement of sorghum and lead to productive, improved varieties with qualities better adapted to the actual rural environment.

o Location of project: Bambey Agricultural Research Center (ISRA).

o Duration of project: 40 months.

o Needs:

-- Human resources: Three part-time researchers and implementation personnel;

-- Equipment: one four-wheel drive vehicle, one refrigerated room and laboratory equipment;

-- Estimated budget:

Personnel expenses	FCFA	90 million
Travelling expenses	FCFA	10 million
Materials	FCFA	19 million
Operation	FCFA	7 million
Total	FCFA	126 million

-- National contribution: FCFA 60 million.

7. Program: Production of foundation seeds

o General objectives:

-- Make foundation seeds available to development companies in sufficient quantities; and

-- Ensure stable seed production.

- Brief description:

  -- Replacement of agricultural material at existing seed farms; and

  -- Creation of 2 irrigated farms at Bambey and Sinthiou-Maleme.

- Justification: Because of recent droughts, specialized rainfed farming stations cannot maintain a sufficient supply of foundation seeds for development programs. The replacement of agricultural material and the irrigation of two small farms should be sufficient to assure adequate production.

- Location of project: Bambey Agricultural Research Center (ISRA), Kaolack, and auxilliary stations (ISRA).

- Duration of project: Undetermined - operation has been requested for only the first three years.

- Needs:

  -- Human resources: All research and implementation personnel: existing;

  -- Equipment: Replacement of agricultural materials on seed farms and two irrigation systems (2 x 30 ha);

  -- Estimated budget:

Agricultural material and storage	FCFA 60 million
Creation of 2 irrigated farms	FCFA 70 million
Operation	FCFA 30 million
Total	FCFA 160 million

  -- National contribution: research and implementation personnel.

- Expected results: Availability and distribution of selected productive varieties through the Seed Service and the agricultural development companies.

8. Program: Conservation project of plant resources in Senegal

- General objectives: Assemble, conserve, and evaluate the domestic lines of various plant species (vegetable, fruit, forage, forest, cereal, industrial plants) as well as imported seeds by establishing adapted storage methods and appointing a team in charge of project management using conservation fields and full-scale tests.

- Brief description:

  -- Assembly phase (inventory, classification);

  -- Cold storage phase (4°C to 6°C) and constant hygrometry (35°C); and

  -- Evaluation phase with regular testing of seed stocks.

- Justification: ISRA, which is concerned about the fate of its research, wishes to initiate a plant resource conservation project which will improve the genetic patrimony of domestic floristic species.

- Location of project: Senegalese Agricultural Research Institute (ISRA) and different stations.

- Duration of project: Two phases of 24 months each.

- Needs:

  -- Human resources: Recruitment of a project leader, two lab assistants, a refrigeration engineer, a secretary and two drivers;

  -- Equipment: Construction of an office and a laboratory, construction or restoration of a refrigerated room at various regional stations, a vehicle, a small truck, a motorcycle, office and laboratory equipment, and small equipment for workshop of refrigeration engineer;

  -- Estimated budget:

	Phase 1	Phase 2
Personnel	FCFA 65 million	FCFA 79 million
Training	FCFA 3 million	FCFA 3 million
Infrastructure	FCFA 75 million	FCFA 16 million
Equipment	FCFA 7 million	FCFA -- million
Vehicle	FCFA 8 million	FCFA 10 million
Operation	FCFA 130 million	FCFA 180 million
Contingencies	FCFA 8 million	FCFA 2 million
Total	FCFA 296 million	FCFA 290 million

  -- National contribution:

Phase 1	Phase 2
FCFA 106 million	FCFA 138 million

- Expected results: The project will allow the creation or improvement of new crops while maintaining the genetic diversity of the varieties. Moreover, the gene bank thus created will help in the gathering, classification, and exchange of plant genetic material with other countries and specialized international organizations.

B. Sub-sector: Animal Production

1. Program: Promotion of dairy production in the Niayes

o General objectives: To understand the technical and economic problems of intensive dairy production at the start-up stage, as well as the technological potential of local milk production and its various by-products.

o Brief description: Two levels:

— Animal: Study of dairy capacity, dietary rations, milk output, and hygienic conditions on farms; and

— Processing: Study of local milk composition, study of by-products, milk technology (pilot workshop), and economic and marketing analysis.

o Justification: Senegal imported dairy products valued at FCFA one billion per year. The introduction and preliminary distribution of two improved milk breeds (Montebeliard and Pakistani Zebu) have given good results. The continuation of research in an open environment (farm stables) is necessary as is research on curdled milk which is a favorite in Senegal.

o Location of project:

— National Veterinary and Livestock Research Laboratory (LNERV-DAKAR-ISRA);

— Institute of Food Technology (ITA-DAKAR); and

— Inter-state School for Science and Veterinary Medicine (EIESMV-DAKAR).

o Duration of project: Three years.

o Needs:

— Human resources: Existing personnel and implementation personnel (FCFA 2 million);

— Equipment: Material (FCFA 6 million);

— Estimated budget:

Personnel expenses	FCFA 2 million
Travelling expenses	FCFA 1 million
Materials	FCFA 6 million
Operation	FCFA 1 million
Total	FCFA 10 million

-- LNERV contribution: FCFA 2 million.

o Expected results: Rapid expansion of dairy production, now very profitable, but hindered by inadequate technology.

2. Program: Reinforcement and diversification of research on forage crops

o General objectives: Irrigated and dryland planting of a complete series of PANICUM grasses in the different ecological zones of Senegal made possible by the collaboration between ISRA/ORSTOM.

o Brief description:

-- Reinforce the Dakar Support Center - Sangalkam;

-- Create two other bases (River: irrigated and Sine-Saloum with mixed farming);

-- Digestibility studies and chemical analyses; and

-- Creation of grasslands conforming to animal husbandry criteria.

o Justification: To help resolve the national meat shortage, especially at the level of forage crops irrigated by the Senegal River where soon water will no longer be a limiting factor. To find fodder crops that do not require much water.

o Location of project: National Livestock and Veterinary Research Laboratory (LNERV-DAKAR and Sangalkam Farm).

o Duration of project: Four years.

o Needs:

-- Human resources: One cadre (existing) and one additional technician;

-- Equipment: Material for two farms (FCFA 45 million) and small equipment (fencing)(FCFA 15 million);

-- Estimated budget:

Personnel expenses	FCFA 18 million
Material and equipment	FCFA 60 million
Operation	FCFA 25 million
Total	FCFA 103 million

— Contribution from the National Livestock and Veterinary Research Laboratory: one cadre.

3. Program: Evaluation of animal by-products for livestock feed

o General objectives: Improve knowledge and use of animal by-products (beef meal, blood or bones) in a developing country.

o Brief description:

— Inventory of available products (surveys);

— Developing simple processing technology; and

— Developing simple techniques for the use of by-products.

o Location of project:

— Institute of Food Technology (ITA);

— Oceanographic Research Center of Dakar-Thiaroye (CRODT);

— Inter-State School of Health and Veterinary Medicine (EISMV);

— Dahra Animal Husbandry Research Center (CRZ-D); and

— Kolda Animal Husbandry Research Center (CRZ-K).

o Duration of project: Five years.

o Needs:

— Human resources: One existing manager and one additional technician (FCFA 1 million/year);

— Equipment: laboratory materials (FCFA 30 million) and various equipment (FCFA 15 million);

— Estimated budget:

Personnel expenses	FCFA 20 million
Travelling expenses	FCFA 12 million
Material and equipment	FCFA 45 million
Operation	FCFA 8 million
Total	FCFA 85 million

— LNERV contribution: FCFA 17 million.

- Expected results: Improve animal production through an intensification resulting from a richer diet obtained from existing animal by-products.

4. Program: Reinforcement of research capacity on animal parasitology (trypanosomiasis, trematodosis, ticks, and transmitted diseases)

- General objectives: Update previously acquired knowledge and prepare diffusion methods for disease control techniques.

- Brief description:

  -- Trypanosomiasis: Comparative study of 3 breeds of sheep, study of immunological diagnosis and study of economic impact;

  -- Tiques: Tick population dynamics and rickettsiosis in ruminants;

  -- Mollusks and trematodosis: Large-scale control through the utilization of Senegalese mollusk-killing plants.

- Justification: All of this research is being carried out in order to improve the livestock health which is seriously harmed by all of these parasites.

- Location of project: National Livestock and Veterinary Research Laboratory (LNERV-DAKAR) (ISRA).

- Duration of project: Four years, open to renewal after evaluation.

- Needs:

  -- Human resources: One specialized manager (FCFA 3 million) and two technicians (FCFA 4.5 million);

  -- Equipment: Laboratory and analysis material (FCFA 47 million);

  -- Estimated budget:

Personnel expenses	FCFA	47 million
Travelling expenses	FCFA	16 million
Materials	FCFA	47 million
Operation	FCFA	7 million
Total	FCFA	117 million

  -- LNERV contribution: FCFA 35 million.

5. Program: Immunity from African hog cholera (PPA)
Cartography of antigenic varieties

o General objectives: Carry out research on:

-- Hybridomes;

-- The role of cellular immunity;

-- Its eventual strengthening;

-- Absence of conduciveness and sensitivity to interferon; and

-- The development of a safe and effective vaccine.

o Brief description: Three parts:

-- Virology - Research on virus isolation;

-- PPA immunological studies (humoral and cellular immunity); and

-- Medical prophylaxis.

o Justification: Contribute to a better knowledge of African hog cholera which is at present little known in Senegal.

o Location of project: National Livestock and Veterinary Research Laboratory (LNERV-DAKAR) (ISRA).

o Duration of project: Several years - open to renewal after evaluation.

o Needs:

-- Human resources: Existing;

-- Equipment: Materials (FCFA 50 million);

-- Estimated budget (for four years):

Personnel	None (counterpart)
Travelling expenses	FCFA 20 million
Materials	FCFA 50 million
Operation	FCFA 30 million
Total	FCFA 100 million

-- LNERV contribution: Personnel plus FCFA 25 million.

C. Sub-sector: Soil Sciences

1. Program: Creation of a data bank on the water quality in Senegal

o General objectives: Set up a data bank of physical, chemical and biological analyses of water which will be available to all users.

o Brief description:

-- Feasibility study - organization system;

-- Inventory of data and variables;

-- Sample of input cards - test;

-- Data gathering - card-indexing;

-- Application program - test;

-- Gathering of new data; and

-- Routine application.

o Justification: Potential uses:

-- Statistics;

-- Agronomy;

-- Human and animal health;

-- Water resource management; and

-- Industry.

o Location of project: ORSTOM/DAKAR - Senegalese Institute of Agricultural Research (ISRA-DAKAR).

o Duration of project: 36 months.

o Needs:

-- Human resources: Researcher (existing) and implementation personnel (existing);

-- Equipment: Minor computer equipment;

-- Estimated budget:

Personnel expenses	FCFA 13 million
Materials	FCFA 11 million
Total	FCFA 24 million

-- National contribution: FCFA 13 million (personnel).

- o Expected results: Better application of poorly utilized scientific knowledge on water quality and more rapid transmission of information.

D. Sub-sector: Agricultural Mechanization

1. Program: Creation of a National Center for Agricultural Mechanization in Tropical Climates

- o General objectives:
  - -- Training of managers and machine operators;
  - -- Testing of machines in different locations;
  - -- Documentation;
  - -- Design or adaptation of machines; and
  - -- Studies and forecasts on the development of agricultural mechanization.
- o Brief description:
  - -- Principal center at Thies near the National Institute for Rural Development (INDR); and
  - -- Regional branches (Fleuve-Casamance).
- o Justification:
  - -- There has been a National Committee for Mechanization since 1979;
  - -- This committee which is charged with writing mechanization proposals will have back-up support from a mechanization center which has not yet opened;
  - -- Farming and mechanization are of great importance to Senegal (1 million ha of groundnuts and the same area of millet); and
  - -- Important regional development projects depend in part on mechanized, irrigated farming and rainfed farming.
- o Location of project: Thies and two regional branches.
- o Duration of project: Three years.

o Needs:

-- Human resources: Two existing expatriate personnel, two existing national personnel, two national personnel to be recruited, two existing technicians, and implementation staff, part of which will be recruited;

-- Equipment: Construction (340 m2 for offices, 700 m2 for storage rooms, and 2 regional housing units), six vehicles, equipment for tests, workshop, laboratory, and agricultural machines;

-- Estimated budget:

Personnel	FCFA 60 million
Investment	FCFA 130 million
Training	FCFA 9 million
Operation	FCFA 60 million
Travel	FCFA 30 million
Total	FCFA 289 million

-- National contribution: FCFA 60 million.

o Expected results: Rapid increase in production through extending the surface under cultivation (southern and eastern sectors) and by lifting constraints on the crop calendar.

2. Program: Design and construction of simple, small-sized soy bean threshers

o General objectives: Design simple threshers, preferably versatile (rice, sorghum, etc.) that could be manufactured in Senegal and purchased by farmers or farmers' cooperatives.

o Brief description:

-- Documentation;

-- Design of 2 threshers (type 1 = 50 kg/hour, type 2 = 500 kg/hour).

o Justification: Thanks to research, the cultivation of soy beans is beginning to develop in Senegal (1981 = 2 ha; 1983 = 400 ha). Nevertheless, due to the fact that there are no applicable models, threshing poses problems at the village level.

o Location of project: Bambey National Agricultural Research Center (CRA) (ISRA).

o Duration of project: Four years.

o Needs:

-- Human resources: Existing design engineer, one technician to be recruited and implementation personnel to be recruited;

-- Equipment: Acquisition of small-scale mechanical equipment and various tools;

-- Estimated budget:

Personnel expenses	FCFA 17	million
Expert's mission	FCFA 3	million
Travel	FCFA 0.5	million
Materials	FCFA 8	million
Operation	FCFA 14.5	million
Total	FCFA 43	million

— Contribution: FCFA 17 million contributed by Bambey CRA in the form of salaries or training.

E. Sub-sector: Forestry Production

1. Program: Seed harvesting from various Senegalese tree species and evaluation of its potential

o General objectives: As a result of this program, Senegalese researchers can determine the real potential of indigenous tree species and can begin to improve national forest production.

o Brief description:

-- First part: Appoint a team to identify noteworthy tree populations, organization of seed harvests according to scientific criteria, indexing and cards for seeds, and cold storage;

-- Second part: Identification of the soil types appropriate for different tree species, testing the potential of the selected species, conduct tests relating to forestry.

o Justification: In Senegal, the potential for Sahelian tree species is considerable but unrecognized. CNRF of Dakar started a program of seed inventory and cold storage two years ago. A second stage would involve planting various species for present and future testing.

o Location of project: National Center for Forestry Research-Dakar (ISRA) and regional stations.

o Duration of project: Four years.

o Needs:

-- Human resources: Forestry engineer (already on staff), one technician and implementation personnel;

-- Equipment: One four-wheel drive vehicle, one forestry tractor and accompanying material, one vehicle, laboratory and office equipment, photographic equipment, material for surveying, harvesting and developing trees;

— Estimated budget:

Personnel expenses	FCFA 34 million
Travel	FCFA 8 million
Durable material	FCFA 37 million
Non-durable material	FCFA 42 million
Contracts and services	FCFA 24 million
Operation	FCFA 17 million
Total	FCFA 162 million

-- CNRF contribution: FCFA 70 million.

2. Program: Study of the characteristics and problems of preserving different types of Senegalese wood based on its designation as timber or fuel wood

o General objectives: Establishment in Casamance of a technological unit within the framework of a more intensive use of the country's forest resources.

o Brief description:

-- Training abroad of a national researcher;

-- Set-up of a technological unit (workshop and lab);

-- Program for the testing and selection of species to be studied including timber for construction and various types of wood (posts and poles);

— Experimentation program aimed at preserving stored wood; and

-- Studies on sawn timber, natural drying of wood, thinning of forests.

o Justification: More rational and intensive use of Senegalese wood should play an important role in the national economy and result in reduced imports.

o Location of project: Djibelor/Ziguinchor/Casamance.

o Duration of project: Four years.

o Needs:

-- Human resources: one wood expert and one national counterpart (four years): FCFA 16 million; one technician and implementation personnel: FCFA 19 million;

-- Equipment: Buildings: 80 m^2 carpentry workshop, 1000 m^2 shed, and offices (to be borrowed or rented by the administration). Materials: carpentry workshop (ribbon saw...), laboratory (for anatomical studies, tests regarding physics, mechanics and preservation), vacuum injection system, glueing table, and surveying material;

— Estimated budget:

1 expert	P.M.	
Personnel	FCFA	35 million
Durable material	FCFA	77 million
Non-durable material	FCFA	45 million
Travel	FCFA	14 million
Operation (4 years)	FCFA	45 million
Reserve	FCFA	25 million
Total	FCFA	241 million

— National contribution: FCFA 45 million (Senegal); from France - 1 expert.

o Expected results:

-- Better assistance to wood specialists and the administration (contribution to the declaration of regulations and codes);

— Improvement of the physical and mechanical characteristics of wood;

— Promotion of under-exploited or ignored species;

-- Evaluation of thinned woods by simple techniques; and

— Procedures and methods for preserving Senegalese wood from the risks of biological deterioration.

3. Program: Reintroduction of trees into the agricultural landscape and integration of forestry products into the farmers' production system

o General objectives: Research designed to:

-- Improve water and soil conservation;

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— Introduce forestry production into agrarian systems;

— Protect natural formations from excessive grazing; and

— Increase agricultural income and improve farmers' standards of living.

o Brief description: Numerous research activities bear on these four objectives, in particular:

— Installation of wind breaks and plantation of wood plots;

— Crop rotation under Eucalyptus population;

— Creation of forage orchards;

— Study of the economic, energy, and sociological situation of the farming unit;

— Study of the impact of developing forests on farmers' income; and

— Socioeconomic aspects.

o Justification: The forest is not self-perpetuating, it needs man's help; the reservoir of manpower which the rural population holds can attend to all of its needs and provide the necessary protection.

o Location of project: National Forestry Research Center (CNRF-ISRA) Dakar and regional stations.

o Duration of project: Four years at the most.

o Needs:

— Human resources: One agroforestry specialist-project leader, one agronomy generalist, one socio-economist, five technicians, five field workers;

— Estimated budget:

Expert	P.M.
Personnel	FCFA 70 million
Durable material	FCFA 55 million
Renewable equipment	FCFA 30 million
Local business contracts	FCFA 12 million
Travel	FCFA 7 million
Operation - 4 years	FCFA 65 million
Total	FCFA 240 million

— National contribution: FCFA 180 million.

- Expected results: Stopping the destruction of the forestry ecosystem due to the assumption of responsibility by the rural population which will integrate trees into the agrarian environment.

4. Program: Forestry research project in Casamance

- General objectives: Develop basic knowledge and applied research of the Casamance forest with the aim of assuring harmonious development.

- Brief description:

  -- Evaluation of forest resources and development;

  -- Socio-economic studies;

  -- Preservation of genetic and ecological resources;

  -- Nursery and forestry techniques;

  -- Technological, commercial, and industrial potential;

  -- Fast-growing species (for industry or energy purposes);

  -- Mangrove study; and

  -- Study of natural palm groves.

- Justification: Forest regression (by wildfire, stray cattle) and development requirements make the establishment of a forestry research center in Casamance a priority; this region does not have a center of this type though it holds the greatest potential in all of Senegal.

- Location of project: Ziguinchor (Casamance) - ISRA.

- Duration of project: Three years.

- Needs:

  -- Human resources: Three researchers (one already on staff), five senior technicians (two already on staff);

  -- Equipment: Office and laboratory equipment, technology workshop, one tractor and forestry materials, one small truck, one Land Rover, one control vehicle;

-- Estimated budget:

Personnel -		
2 expatriates	P.M.	
Others	FCFA	60 million
Infrastructure (office, lab, store, workshops)	FCFA	48 million
Equipment (office, lab, workshop)	FCFA	19 million
Vehicles and different machines	FCFA	26 million
Technology workshop	FCFA	21 million
Training of national researchers, others	FCFA	16 million
Total	FCFA	190 million

-- National contribution: FCFA 20 million (on staff).

o Expected results: Protection of the forest; supply of fuel and industrial wood.

F. Sub-sector: Fisheries

1. Program: Contribution to the biological study of Macrobrachyum shrimp in Guiers Lake and in lower Senegal

o General objectives and justification: Determine the importance and the distribution of Macrobrachyum shrimp in the regions under study, as well as their biology, with the aim of initiating a breeding program.

o Brief description:

-- Conduct a preliminary survey among fishermen to determine the places where the shrimp are observed and caught;

-- Develop a protocol for a systematic shrimp catch within the framework of a limited fishing policy; and

-- Analyze the catches from a biological standpoint.

o Location of project: Lake Guiers.

o Duration of project: One year.

o Needs:

-- Human resources: management personnel: on staff (FCFA 1 million) and implementation personnel (FCFA 0.5 million);

-- Equipment: Small equipment -- FCFA 3 million;

-- Estimated budget:

Personnel	FCFA 1.5 million
Equipment	FCFA 3 million
Operation	FCFA 3 million
Total	FCFA 7.5 million

-- National contribution: Design staff.

o Expected results: Knowledge of biotechnical guidelines for breeding shrimp and a definite increase in productivity of the waters from a monetary and nutritional point of view.

2. Program: Impact of the construction of salt-retainer dams on aquatic productivity in Casamance

o General objectives: Research on the physical and biological impact on the environment as a result of the installation of salt-retainer barriers.

o Brief description:

-- Physical-chemical and biological studies on the Bignona dam;

-- Study of the development and primary productivity of the environment; and

-- Study of the influence of pesticides during the rice-growing period.

o Justification: The dam already installed at Guidel and the one at Affiniane (Bignona) under construction will allow several thousand hectares of mangrove swamp to be used for rice. Nevertheless, the environmental changes brought about by this development could prove to be unfavorable for the fishing industry.

o Location of project: Ziguinchor with work at Guidel and Bignona.

o Duration of project: Three years.

o Needs:

-- Human resources: Three specialists - one marine biologist (3 years), P.M.; one primary productivity analyst (3 months), P.M.; one biology specialist (2 months), P.M.; one local marine biologist counterpart (3 M x 3), FCFA 9 million; implementation personnel (administrative, technician) (5 million x 3 = FCFA 15 million);

-- Estimated budget:

Personnel	FCFA 24 million
Travel	FCFA 6 million
Material (canoe, vehicle)	FCFA 33 million
Equipment	FCFA 6 million
Operation (3 years)	FCFA 26 million
Total	FCFA 96 million

— National contribution: none.

o Expected results: Maintain or increase the productivity of the bodies of water modified by the salt-retainer dams by better control over fishing, while reducing the negative effects resulting from hydro-agricultural development to a minimum.

3. Program: Development of mullet breeding and fish-breeding at the Diama dam

o General objectives: Limit the negative impact that could result from the salt-retainer dam in the ascent of the mullet in the Senegal River. Improve, as well, the productivity of Lake Guiers and fish-breeding developments.

o Brief description:

-- Documentation;

-- Studies of the biology of various species of mullet; and

-- Develop a plan to catch the fish locally and transfer them in order to stock bodies of fresh water.

o Justification: There are significant quantities of young mullet in the estuaries almost all year round; they have considerable nutritional potential.

o Locacion of project: Diama and Lake Guiers.

o Duration of project: 36 months.

o Needs:

-- Human resources: One specialist (marine biologist) three years; one national biologist; and administrative personnel and technicians (mechanic, fisheries director, building specialist, laborer);

-- Equipment: Miscellaneous equipment (FCFA 12 million), one vehicle (FCFA 4 million) and office-lodgings (FCFA 15 million);

-- Estimated budget:

Personnel (specialist not included)	FCFA	60 million
Infrastructure	FCFA	15 million
Material and equipment	FCFA	16 million
Operation	FCFA	30 million
Total	FCFA	121 million

-- National contribution: one biologist - one technician.

o Expected results: Upstream from the dam at Diama, the potential for development of mullet production is about 500 tons per year.

4. Program: Fish-breeding productivity of the temporary ponds formed by the river

o General objectives:

-- Utilize bodies of water for fish-breeding; and

-- Contribute to improved nutrition of the population as well as to an increase in their financial income.

o Brief description: This project is designed to evaluate the fish-breeding potential of ponds using a full-scale operational model and to improve its productivity - applicable to a controlled stream - ecological and biological development to follow.

o Justification: The productivity of ponds found primarily along the Senegal River is weak and irregular; to correct this situation a small dam and water intake can be built to assure continuous submersion. Planning for fish-breeding should thus improve.

o Location of project: Sites to be chosen along the River Senegal.

o Duration of project: Three years.

o Needs:

-- Human resources: One consultant during three months, one fishing technician (three years), one fisherman and temporary personnel;

-- Equipment: One housing unit/office, one control vehicle, one canoe, a dam and water intake, fishing material (FCFA 3 million);

— Estimated budget:

Consultant + personnel	FCFA 18 million
Investment	FCFA 42 million
Fishing equipment	FCFA 3 million
Operation	FCFA 15 million
Total	FCFA 78 million

— National contribution: One technician = FCFA 6 million.

G. Sub-Sector: Food Technology

1. Program: Determine contaminants to local foodstuffs: research pesticide and mycotoxin residues

o General objectives: Improve local food products using better quality control.

o Justification:

— Preservation of consumers' health by making available healthier foodstuffs;

— Expanding export possibilities.

o Research operations:

— Research on residual pesticides; and

— Research on mycotoxins in foodstuffs.

a. Research on residual pesticides

o Brief description: Use physical chemistry, phytopharmacy and organic chemistry, and thorough documentation to:

— Determine time limits on pesticide use;

— Undertake physical-chemical analyses of residual pesticide levels in foodstuffs.

o Location of project: Institute of Food Technology (ITA) - Dakar;

o Duration of project: 24 months.

o Needs:

— Human resources: one chemical specialist, one chemical technician, one chemical engineering specialist, and one specialist to oversee initiation of pesticide laboratory;

-- Equipment: one distilling machine (FCFA 1 million), one spectrophotometer (FCFA 3 million), one gas phase chromatograph w/ thermoionic detector (FCFA 8 million), and chemicals (FCFA 2 million), totalling FCFA 14 million;

-- Estimated budget:

personnel 5x2 years	FCFA 10 million
equipment	FCFA 14 million
Total	FCFA 24 million

-- ITA contribution: FCFA 6 million/year.

b. Research on aflatoxins in food products

Aflatoxin, which constitutes a serious health risk, is frequently found in food products that are widely consumed in Senegal (groundnuts, millet).

o Brief description: Through the documentation and physical-chemical analysis of the principal mycotoxins (aflatoxin, ochratoxin, zearalenone):

-- Identification of mold responsible for the contamination; and

-- Development of analytical methods.

o Location of project: Institute of Food Technology (ITA) - Dakar.

o Duration of project: 24 months.

o Needs:

-- Human resources: a microbiologist technician (to be recruited);

-- Equipment: glassware (FCFA 0.8 million), products (FCFA one million), gel plate (FCFA 0.5 million), and miscellaneous (FCFA 0.5 million) for a total of FCFA 2.8 million/year;

-- Estimated budget: (2 years)

Personnel:	2 x2 = 4 million
Products:	2.8 x 2 = 5.6 million
Total	FCFA 9.6 million

-- ITA contribution: FCFA 4 million.

2. Program: Standardization of new products developed by the Institute of Food-Technology (ITA)

- o General objectives: Since Senegal is a member of several community development organizations, it is important that those products developed by ITA be standardized for exportation.

- o Brief description: Standardization of products processed from:

  -- Cereals;

  -- Legumes and protein seeds;

  -- Fruits and vegetables;

  -- Beef and beef products;

  -- Fish products; and

  -- Curdled milk and cooked butter.

- o Location of project: Institute of Food Technology (ITA) - Dakar.

- o Duration of project: 24 months.

- o Needs:

  -- Human resources: One senior manager specializing in food law (FCFA 2 million/year), one senior technician in food technology, and one specialist in food law;

  -- Equipment: none;

  -- Estimated budget:

one technical assist. expert (2 years)	
other personnel: 3x2 years	FCFA 6 million
staff (local and expatriate)	FCFA 10 million
Operation (transportation, documentation)	FCFA 5 million
Total (plus specialist)	FCFA 21 million

  -- ITA contribution: FCFA 6.6 million.

- o Expected results: Fewer incidents of meat contamination and more nutritious meat.

3. Program: Application of biotechnology to recycling of fish product wastes: ensilage of fish for the diet of animals

o General objectives: There are enormous losses of fish during periods of overproduction; the wastes produced as a result of artisanal processing are also quite large. The objective is to take advantage of these wastes by using them to improve animal diets (supplementary needs, gap until next crop, demand for products at reduced prices).

o Brief description:

-- Study of the importance of processing wastes and losses: quantification and study of the possibility of intervening at the fish center level;

-- Experimentation of fish ensilage; product study and possibility of introducing it into the animal diet.

o Location of project: Institute of Food Technology (ITA-Dakar) and fishing villages on the small coast.

o Duration of project: 24 months.

o Needs:

-- Human resources;

-- Miscellaneous equipment: FCFA 12 million for experiments;

-- Estimated budget:

Travel and study	FCFA 9 million
Misc. equipment	FCFA 12 million
Total	FCFA 21 million

-- ITA countribution: FCFA 11 million.

4. Program: Study of bacterial contamination of meat in Senegal

o General objectives and justification:

-- Research and identify the germs that cause disease or infection in man;

-- Determine the source of harmful bacteria in meat;

-- Prevent the meat contamination; and

-- Possible intervention plans.

- Brief description: Systematic microbiological study of the meat cycle in Senegal (from the slaughterhouse to the consumer):

  -- Contamination of carcasses;

  -- Contamination after refrigeration, in transport, during retailling; and

  -- Prevention.

- Location of project: Institute of Food Technology (ITA-Dakar), Interstate School of Veterinary Medicine (Dakar).

- Duration of project: 36 months.

- Needs:

  -- Human resources;

  -- Equipment: Misc. equipment-- FCFA 35 million;

  -- Estimated budget:

Personnel	FCFA 8 million
Travelling expenses	FCFA 6 million
Materials	FCFA 35 million
Training	FCFA 3 million
Operation	FCFA 7 million
Total	FCFA 59 million

  -- Contribution: ITA and EIESMV laboratory and staff.

- Expected results: Reduction in meat contamination; better meat nutrition.

5. Program: Study of modernization possibilities in the artisanal fish processing sector

- General objectives: Treat the artisanal fish processing sector as a unified group of activities to be improved overall by the study of all local techniques of consumption, processing, and marketing of fish, and the development of appropriate technology for each type of product from the time of catch to marketing.

- Brief description:

  -- Identification of problems and solutions;

  -- Study of the technological processing techniques;

-- Development of appropriate technologies for the modernization of the artisanal processing centers; and

-- Socioeconomic surveys.

o Location of project: Institute of Food Technology (ITA-Dakar).

o Duration of project: 36 months..

o Needs:

-- Human resources: already on staff;

-- Equipment: material: FCFA 26 million;

-- Estimated budget:

Personnel	FCFA 23 million
Travel	FCFA 26 million
Material	FCFA 26 million
Operation	FCFA 5 million
Total	FCFA 80 million

-- ITA contribution: FCFA 22 million.

o Expected results: Although it processes 60,000 tons of fish per year, artisanal processing results in great losses and is experiencing growth problems. The improvement of the conditions under which processed products are unloaded, processed and sold should bring considerable supplementary income and avoid food losses.

6. Program: Utilization of groundnuts to develop weaning and energy food

o General objectives and justification:

-- Improve early childhood nutrition;

-- Improve the nutrition of those sectors said to be in greatest need;

-- Lower imports of weaning food; and

-- Promote local products.

o Brief description:

-- Determination of the availbaility of groundnuts;

-- Documentation;

-- Training agents;

-- Acquisition of equipment; and

-- Product testing and pre-extension.

o Location of project: Institute of Food Technology (ITA-Dakar).

o Duration of project: 18 months.

o Needs:

-- Human resources: one specialist (18 months);

-- Equipment: Misc. laboratory equipment: FCFA 15 million;

-- Estimated budget: One specialist (18 months) and equipment: FCFA 18 million.

o Counterpart: FCFA 25 million.

7. Program: Utilization of soy beans in traditional Senegalese nutrition

o General objectives: Develop and extend new soy-based products adapted to Senegalese eating habits.

o Operations list:

-- Year 1: Purchase of material-- Survey;

-- Year 2 and 3: Develop products and recipes; and

-- Year 4: extension - Training of participants.

o Location of project: Senegalese Agricultural Research Institute (ISRA-Bambey) and the Institute of Food Technology (ITA-Dakar).

o Duration of project: 48 months.

o Needs:

-- Human resources: already on staff;

-- Equipment: Material = FCFA 42 million;

-- Estimated budget:

Implementation personnel	FCFA 25 million
Travelling expenses	FCFA 3 million
Materials	FCFA 41 million
Operation	FCFA 28 million
Total	FCFA 97 million

-- Contribution: FCFA 50 million.

o Expected results: Two types of advantages:

-- From the agronomic point of view, soy beans produce between two to five times more protein than other crops without nitrogen fertilizer; and

-- From the nutritional point of view: better protein nutrition.

8. Program: Physcial conditions for seed storage in a rural environment

o General objectives: Study of the adequacy of traditional seed storage methods with regard to the physical and biological conditions of the environment.

o Brief description: Successively on three levels: village, regional, and national:

-- Surveys of the current situation regarding food losses and waste (cereals and legumes);

-- Improvement of existing storage methods; and

-- Design of different storage structures.

o Justification: The loss of cereals and legumes in storage is considerable (40 percent of cowpeas, at least 20 percent for cereals) whereas with other products losses due to storage do not go beyond 5 percent. A small investment in this sector could provide considerable advantages.

o Location of project: Institute of Food Technology (ITA-Dakar).

o Duration of project: 36 months of research.

o Needs:

-- Human resources: four staff members (entomologist, chemist, microbiologist, civil engineer), four technicians (laboratory work and field trials), and four workers;

-- Equipment: 300 m^2 laboratory, four regional stations of 100 m^2 each, four vehicles and miscellaneous equipment and supplies;

-- Estimated budget:

Investment:	laboratory (60,000 x 700 m^2 = FCFA 42 million)	
	equipment	FCFA 10 million
	vehicles	FCFA 10 million
Personnel:	All personnel	FCFA 21.5 million
	Local and expatriate staff	FCFA 1.5 million
Training:		FCFA 2 million
Operation:		FCFA 10 million

On the basis of a 36 month project:

Investment:	FCFA 42 million
Personnel: 23 x 3	FCFA 69 million
Training: 2 x 3	FCFA 6 million
Operation: 10 x 3	FCFA 30 million
Maintainance-depreciation: 5 x 3	FCFA 15 million
Total 36 months.	FCFA 152 million

H. Sub-Sector: Environment

1. Program: Establishment of a control and phytopharmacy laboratory

o General objectives:

-- Research objectives: remanence study, periods during which pesticides are not administered, study of residues;

-- Control objectives: abiding by pesticide time-limits, and tolerances; and

-- Litigation settlement.

o Brief description:

-- Construction of a laboratory; and

-- Training of a specialist.

o Justification:

-- Improve the quality of products used in agriculture and thereby contribute in important ways to the increase in agricultural produce;

-- Improve the quality of harvest and foodstuffs; and

-- Respond to the needs expressed by numerous organizations in Dakar (University, ISRA, ITA, Fraud Control and Crop Protection).

o Location of project: A station 15 km from Dakar (ISRA).

o Duration of project: 24 months.

o Needs:

-- Human resources: one expatriate specialist, one national counterpart (trained, already on staff) and technicians (to be recruited);

-- Equipment: laboratory (FCFA 30 million), laboratory equipment (FCFA 15 million), and a vehicle (FCFA 4 million);

-- Estimated budget:

Expatriate specialist	P.M.
National Counterpart (2 years)	FCFA 6 million
Technician	FCFA 12 million
Implementation personnel	FCFA 6 million
Training	FCFA 2 million
Investment	FCFA 49 million
Operation	FCFA 20 million
Total	FCFA 75 million

-- National contribution: FCFA 12 million.

2. Program: Research project for the development of mangroves in Senegal

o General objectives: Starting with the work in the laboratory or in the field, research will be conducted to:

-- Protect potentially sulfated soils from acidification at the time of development of rice farming; and

-- Attempt to replenish the soils already depleted by natural or artificial acidification.

o Brief description: The research work relates to these areas:

-- Water (qulaity and quantity);

-- Soil;

-- Hydro-agricultural development;

-- Farming systems;

-- Forestry;

-- Fishing;

-- Livestock; and

-- Human health.

o Justification: Research which led to concrete findings on the rural environment had been under way on the mangrove and sulfated acid soils. Nevertheless, the current drought and the hydro-agricultural developments underway or planned require the formulation of new technical standards. Actually, cultivated saline land has been partly abandoned and there is little time left.

o Location of project:

-- Senegalese Agricultural Research Institute (ISRA) Djibelor-Ziguinchor;

-- ORSTOM (Dakar); and

-- University of Dakar.

o Duration of project: 39 months.

o Needs:

-- Human resources: ISRA and ORSTOM research staff (already on staff), implementation staff to be recruited, and specialized consultants to be recruited;

-- Equipment: Vehicles, laboratory materials, surveying material, small agricultural machines, and office furniture;

-- Estimated budget:

	(millions FCFA) ISRA	ORSTOM
Personnel	91	130
Travel	16	10
Materials	37	43
Operation	18	26
Total	162	209

-- Contribution:
ISRA FCFA 90 million
ORSTOM FCFA 167 million

- Expected results:

  -- As a result of appropriate techniques, increase productivity and the surface area planted in rice; and

  -- Give suport to hydro-agricultural development.

3. Program: Inventory and continuous monitoring of Sahelian pastoral ecosystems, Phase II

- General objectives: Define the appropriate methods to inventory and monitor tropical ecosystems of grazing land and demonstrate them in order to facilitate short-term decision making and long-term planning with regards to rehabilitation and development. Contribute to the establishment of an international description of renewable resources of arid lands.

- Brief description:

  -- Establish a national structure for ecological monitoring;

  -- Follow up inventories and continuous monitoring;

  -- Extension of inventories and continuous monitoring to other areas and regions;

  -- Pre-extension methodology;

  -- Develop a demonstration model; and

  -- Training.

- Justification: In order to reduce food shortage, it is essential to increase forage production in the Sahel. These actions take place within the framework of an integrated agro-forestry-pastoral development project based on a knowledge of and the improvement of ecosystems such as: the environment, vegetation, animals, man and society.

- Location of project: Forest-pasture area, in the eastern part of Senegal.

- Duration of project: 48 months.

- Needs:

  -- Human resources: six FAO specialists (already on staff) and local counterparts (recruited in part);

  -- Equipment: materials already on hand;

-- Estimated budget:

National staff	FCFA	82 million
Misc. maintenance	FCFA	10 million
Operation	FCFA	35 million
Total	FCFA	127 million

-- National contribution: In fact, the project budget is considerably larger. The national contribution which Senegal will make is FCFA 50 million.

o Expected results:

-- Development of animal density maps and maps indicating the vegetation distribution;

-- Forecasting variations within the ecosystem and, division of the livestock on this basis;

-- Pastoral development plans;

-- Structure, evolution and productivity of vegetation; and

-- Development of a management plan for cattle on forage land.

I. Sub-Sector: Nutrition

1. Program: Development of a regional table indicating food content

o General objectives: Up-dating of the West African food content table.

o Brief description: Two phases.

-- Preparatory phase: food list, choice of nutriments, and costing and analysis methods; and

-- Analysis phase.

o Justification: This up-dating is justified by the marketing of new products ("pamible") or newly processed items.

o Location of project:

-- Organization for Research on Food and Nutrition in Africa (ORANA-Dakar);

-- Institute of Food Technology (ITA-Dakar); and

-- Senegal Food and Nutrition Service (SANAS - Dakar).

- o Duration of project: 48 months.

- o Needs:

  -- Human resources: senior staff (already on staff) and implementation personnel;

  -- Equipment: miscellaneous material: FCFA 26 million;

  -- Estimated budget:

Personnel	FCFA 17 million
Travel	FCFA 4 million
Material	FCFA 26 million
Operation	FCFA 3 million
Total	FCFA 50 million

  -- Contribution from ORANA: FCFA 10 million.

- o Expected results:

  -- Forecast and planning for food resources throughout the country and within regions; and

  -- Teaching and research.

2. Program: Nutritional monitoring in Senegal

- o General objectives: The monitoring aims to provide current information on nutritional conditions of the population and to provided data to help policymakers.

- o Brief description: Two principal research activities:

  -- Nutritional monitoring (chemical tests, biological tests, anthropometric tests); and

  -- Food monitoring (house calls, estimates of food production, estimate of imports amd exports).

- o Justification: In the regions of the Sahel, malnutrition is endemic and is of growing concern to the government; the results of these surveys will be of help in the decision-making process.

- o Location of project:

  -- Organization for Research on Food and Nutrition in Africa (ORANA-Dakar);

  -- Institute of Food Technology (ITA-Dakar); and

  -- Senegal Food and Nutrition Service (SANAS - Dakar).

- Duration of project: 48 months.

- Needs:

  -- Human resources: staff (already in place) and implementation personnel;

  -- Equipment: miscellaneous material (FCFA 26 million;

  -- Estimated budget:

Personnel	FCFA 17 million
Travel	FCFA 4 million
Materials	FCFA 26 million
Operation	FCFA 3 million
Total	FCFA 50 million

  -- ORANA contribution: FCFA 11 million.

3. Program: Quantitative evaluation of childrens' diet in a non-rural environment and how it relates to their nutrition

- General objectives: Carry out a survey of individual consumption among children in a non-rural environment and study how their level of nutrition meets recommended allowances.

- Brief description: Sampling of groups of children in successive three month phases. Then:

  -- Develop a methodology to survey the food intake of children;

  -- Evaluation of dairy product and other consumption;

  -- Food analysis;

  -- Survey of nutritional condition; and

  -- Analysis of the socioeconomic conditions.

- Justification: With the aim of nutritional education activities:

  -- Determination of how well these childrens' diets meet recommended allowances;

  -- Discussion of the validity of these allowances; and

  -- Relationship between food intake and nutrition.

- Location of project: African Food and Nutrition Research Center (ORANA-Dakar).

- Duration of project: 48 months.

- Needs:

  -- Human resources: senior staff (already in place) and implementation personnel;

  -- Equipment: material--FCFA 25 million;

  -- Estimated budget:

Personnel expenses	FCFA 42 million
Material	FCFA 25 million
Operation	FCFA 6 million
Total	FCFA 73 million

  -- ORANA contribution: FCFA 15 million.