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ASSESSMENT OF AGRICULTURAL
RESEARCH RESOURCES
IN THE SAHEL

VOLUME II
SUMMARIES OF NATIONAL REPORTS

1596

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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 Volta²

¹Each national report is printed separately.

²As 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.

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ACKNOWLEDGEMENTS

Volume II of the DEVRES/INSAH project, Assessment of Agricultural Research Resources in the Sahel, presents summaries of the eight National Reports--Cape Verde, Chad, The Gambia, Mali, Mauritania, Niger, Senegal and Upper Volta. Like the Regional Analysis and Strategy of Volume I and the eight National Reports which comprise Volume III, this volume of the report has been financed by the United States Agency for International Development (AID).

A private company, DEVRES, Inc., was hired by AID as its prime contractor responsible for the execution of the study. DEVRES in carrying out its mandate, utilized two sub-contractors: INSAH, a regional inter-governmental organization designated by CILSS (The Permanent Interstate Committee for Drought Control in the Sahel), with specific responsibilities in the field of agricultural research, training and technology transfer, and MUCIA (Midwest Universities Consortium for International Activities). INSAH, under the sub-contract, then engaged one National Coordinator for each country, responsible for carrying out the inventory of agricultural research resources and for preparing the National Report. The National Reports were based on a common questionnaire for the eight countries developed by DEVRES, INSAH, MUCIA and the National Coordinators. Each National Coordinator was asked to hire consultants experienced in pertinent subject areas to assist him in completing the questionnaire.

The DEVRES/INSAH team of agricultural research and development specialists then proceeded to an analysis of the country programs and the regional assessment contained in this report. The organization and methodology used in preparing this study are described in Chapter I.

DEVRES wishes to express its thanks to the National Coordinators and their consultants for their excellent work under difficult circumstances and time constraints. It would especially like to thank its principal partner, the Institute of the Sahel, as well as MUCIA for their contributions. Following this note is a listing of the staff from INSAH, DEVRES, MUCIA and IEMVT (The Institute for Animal Husbandry and Veterinary Medicine in Tropical Countries), as well as the National Coordinators and their consultants who participated in the assessment.

DEVRES is also very grateful to AID/Washington and its field missions (USAID) for their interest and help during the various stages of preparation and execution of the report. We also thank the governments of the Sahelian countries, the representatives of the CDA donor countries, the Club du Sahel, CILSS, the World Bank, International Agricultural Research Centers and other international organizations for their encouragement and assistance in this endeavor.

The International Development Research Center (IDRC), Canada, played a valuable role by allowing that some of its funds granted to INSAH could be used to finance some costs of the National Coordinators and consultants.

Special tribute should be paid to the DEVRES permanent staff, both professional and clerical, as well as to the temporary clerical and translating personnel, all of whom worked long, hard hours to assemble and reproduce this report with great diligence, skill and good humor.

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LIST OF ACRONYMS AND ABBREVIATIONS

Sahelian and International

ABN	Niger River Basin Commission
ACPO	Accelerated Crop Production Officer (SAFGRAD)
AFDB	African Development Bank
AGIR	Project for the Improvement of Research Institution Management in the Sahel
AGRHYMET	Regional Center for Training and Application of Agricultural Meteorology and Hydrology
AID	Agency for International Development
Ag.	Agriculture
Agro.	Agronomic (Agronomist)
Agrometeo.	Agronomy and Meteorology
BAC	Baccalaureat (High School Diploma)
BAD	Arab Development Bank
BCEAO	Central Bank of the West African States
BEPC	General Education Certificate
BIAO	International Bank for West Africa
BICIA	International Bank for Commerce, Industry, and Agriculture
BID	Islamic Development Bank
BIRD	(See IBRD)
BNP	Banque Nationale de Paris
BOSTID	Board on Science and Technology for International Development (NAS)
CCCE	Central Bank for Economic Cooperation (France)
CDA	Cooperation for Development in Africa
CEA	(See ECA)
CEAC	Central African Economic Community
CEAO	West African Economic Community
CEDEAO	(See ECOWAS)
CEDRES	Center for Studies in Documentation and Economic and Social Research
CEE	(See EEC)
CEEMAT	Center for Studies on Farm Machinery in the Tropics
CEPE	Primary Elementary Education Certificate
CERCI	Rice and Irrigated Crops Experimentation Center
CFA	Monetary unit of the West African Monetary Union
CFDT	French Textile Fiber Development Corporation
CIEH	Inter-African Center for Studies in Hydraulics
CILSS	Permanent Interstate Committee for Drought Control in the Sahel
CIMMYT	International Center for Maize and Wheat Improvement

CIPEA	(See ILCA)
CIRES	Economic and Social Research Center of the Ivory Coast
CRDI	(See IDRC)
CRES	Regional Solar Energy Center
CRSP	Cooperative Research Support Program
CRTO	Regional Center for Remote Sensing at Ouagadougou
CTFT	Technical Center for Tropical Forestry
DEF	Diploma of Basic Studies (Elementary school)
DG	Director General
DTA	Agricultural Technician Diploma
ECA	Economic Council of Africa
ECOWAS	Economic Community of West African States
EDF	European Development Fund
EEC	European Economic Community
EISMV	Inter-State School for Sciences and Veterinary Medicine
EU	United States
FAAT	Arab Technical Assistance Fund
FAC	Fund for Cooperation and Aid (France)
FAO	United Nations Food and Agriculture Organization
fCFA	Monetary unit of the West African Monetary Union
FED	(See EDF)
FF	French Franc
FIDA	(See IFAD)
FMI	(See IMF)
FSR	Farming Systems Research
FSU	Farming Systems Unit (SAFGRAD - Purdue University)
FY	Fiscal Year
GDP	Gross Domestic Product
GNP	Gross National Product
GERDAT	Group for Studies and Research on the Development of Tropical Agriculture
GRBC	Gambia River Basin Commission
HF	High Frequency (Short-wave radio)
Horti.	Horticultural Agronomist
IARC	International Agricultural Research Center
IBRD	International Bank for Reconstruction and Development
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IDA	International Development Association
IDRC	International Development Research Center (Canada)
IEMVT	Institute of Livestock Production and Veterinary Medicine in Tropical Countries
IFAD	International Fund for Agricultural Development

IFAN	Fundamental Institute of Black Africa
IFDC	International Fertilizer Development Center
IFPRI	International Food Policy Research Institute
IITA	International Institute of Tropical Agriculture
ILCA	International Livestock Center for Africa
ILO	International Labor Organization
IMF	International Monetary Fund
INSAH	Institute of the Sahel
INTSORMIL	International Sorghum and Millet Cooperative
IPM	Integrated Pest Management
IRAT	Institute for Research in Tropical Agriculture and Food Crops
IRCT	Institute for Research on Cotton and Exotic Textiles
IRFA	Institute for Research on Fruits and Citrus
IRHO	Institute for Research on Oils and Oil Crops
IRRI	International Rice Research Institute
ISNAR	International Service for National Agriculture Research
M.Sc.	Master of Science
MAC	Chinese Agricultural Mission
MUCIA	Midwestern Universities Consortium for International Activities
Mtere	Ministry
NAS	National Academy of Sciences
NGO	Non-Governmental Organization
OUA	Organization of African Unity
OCAM	African and Mauritian Joint Organization
OCCGE	Organization for Cooperation and Coordination for the Control of Major Endemics
OCDE	(See OECD)
OECD	Organization for Economic Cooperation and Development
OIT	(See ILO)
OMM	(See WMO)
OMS	(See WHO)
OMVG	(See GRBC)
OMVS	Senegal River Basin Commission
ONG	(See NGO)
ONU	(See UNO)
ORANA	Organization for Research on Food and Nutrition in Africa
ORSTOM	Office for Scientific and Technical Research Overseas (France)
OUA	(See OAU)
PAM	(See WFP)
PIB	(See GDP)
PNB	(See GNP)

PNUD	(See UNDP)
PPA	African Hog Cholera
PTT	Post and Telecommunications Office
RESADOC	Sahelian Scientific and Technical Documentation and Information Network
SAAR	Strengthening African Agricultural Research
SADCC	Southern Africa Development Coordination Conference
SAFGRAD	Semi-Arid Food Grains Research and Development
STRC	Science and Technology Research Center (of the Organization of African Unity)
TOEFL	Test of English as a Foreign Language
TLU	Tropical Livestock Unit
UMOA	West African Monetary Union
UNDP	United Nations Development Program
UNDRO	Office of the United Nations Disaster Relief Coordinator
UNEP	United Nations Environment Program
UNESCO	United Nations Educational, Scientific, and Cultural Organization
UNICEF	United Nations Children Fund
UNO	United Nations Organization
US	United States
USAID	United States Agency for International Development
UTA	Union des Transports Aeriens (French Airline)
Vet.	Veterinarian
WARDA	West African Rice Development Association
WFP	World Food Program
WHO	World Health Organization
WMO	World Meteorology Organization
Zoot.	Zootechnician (Animal Husbandry Technician)

COUNTRY ACRONYMS AND ABBREVIATIONS

Cape Verde

CDP	Livestock Development Center
CEA	Agrarian Study Center
CPFCDR	Polyvalent Training Center for Rural Development Professionals
INIA-AC	Amilcar-Cabral National Agrarian Research Institute
MDR	Ministry of Rural Development
PAICV	African Party of Cape Verde Independence
PRODESA	Assomada Integrated Development Project
RFA	Federal Republic of Germany

Chad

Arabie S.	Saudi Arabia
BEA	Agricultural Education Diploma
CAP	Vocational School Diploma
CARE	Committee for American Relief Everywhere
CBLT	Lake Chad Basin Commission
CCFAN	Command Council for the Northern Armed Forces
CEPE/T	Chadian Primary Elementary School Certificate
CFPCR	Center for Training Professional Rural Personnel
CFTA	Agricultural Technician Training Center
CM2	Second year intermediate course
CNC	National Consultative Council
Coop.	Cooperation
DE	Department of Livestock
DEP	Department of Water and Fisheries
DRA	Division of Crop Research
ENATE	National School for Technical Agents
FIR	Fund for Rural Intervention
IUTE	University Institute for Livestock Techniques
LABOVET	Veterinary and Animal Husbandry Research Laboratory of Farcha
MEADR	State Ministry of Agriculture and Rural Development
MEHP	Ministry of Livestock and Pasture Hydraulics
MIAEFC	Ministry of Tourism, Industry, Water, Forests, and Hunting
ONDR	National Office of Rural Development
PA	Administrative positions (jobs)
RCA	The Central African Republic
SODELAC	Lake Development Corporation
Yougous.	Yugoslavian

The Gambia

AVRDC	Asian Vegetable Research and Development Center
CAPA	Agricultural Vocational School Diploma
CDSS	Country Development Strategy Statement
DNEF	National Department of Water and Fisheries
GCDB	Gambia Cooperative Development Bank
GOTG	Government of the Gambia
GPMB	Gambia Produce Marketing Board
IPM	Integrated Pest Management
ITA	Agronomic Projects Engineer
LMB	Livestock Marketing Board

OMVG	Gambia River Basin Commission
SRCFJ	Cotton and Jute Fiber Research Station
STABEX	Export Price Stabilization Association

Mali

AB	Wheat Action, Dire
ADRAO	(See WARDA)
ARS	Flood-Recession Action for Rice and Sorghum, Gao
CAA	Agricultural Apprenticeship Center
CAPA	Agricultural Vocational School Diploma
CDR	Center for Rural Development
CFC-ML II	Livestock Extension Training Center - Mali Livestock II
CFPF	Forestry Practical Training Center
CIPEA	(See ILCA)
CMDT	Mali Textile Development Corporation
CNRA	National Committee of Agricultural Research
CNRF	National Center for Fruit Research
CRZ	Animal Husbandry Research Center
DDI	Division of Documentation and Information
DEF	Diploma of Basic Studies (end of middle school)
DNEF	National Water and Forestry Service
DRA	Agricultural Research Division
DRFH	Forestry and Hydrobiology Research Division
DRSPR	Farming Systems Research Division
DRZ	Division of Animal Husbandry Research
-	
ECIBEV	Cattle and Meat Credit Bureau
EIV	Veterinary Nurses School
FM	Mali franc
IER	Rural Economics Institute
ILCA	International Livestock Center for Africa
INRZFH	National Animal Husbandry, Forestry, and Hydrobiology Research Institute
IPR	Rural Polytechnical Institute
ISAA	Engineer of Agricultural Applied Sciences
ISAE	Engineer of Livestock Applied Sciences
ISAEF	Engineer of Applied Sciences in Water and Forestry
IT	Projects Engineer
LCV	Central Veterinary Laboratory
LHM	Mopti Hydrobiology Laboratory
MDR	Ministry of Rural Development
ODEM	Livestock Development Operation of Mopti

ODIB	Integrated Development Operation of Baguineda
ODIK	Integrated Development Operation of Kaarta
ODIPAC	Integrated Development Office for Peanut and Cereal Production
OHV	Upper Valley Operation (of the Niger River)
OMM	Millet Operation, Mopti
OMVS	Senegal River Basin Commission
OMVSO	Sategui Deressia Basin Commission
ON	Niger Office
ONPS	National Seed Production Operation
OPAM	Mali Agricultural Products Bureau
OPSR	Operation for the Protection of Seeds and Conservation of Harvested Crops
OPSS	Operation for the Production of Selected Seeds
ORM	Rice Operation, Mopti
ORS	Rice Operation, Segou
OTS	Tea Operation, Sikassa
OVSTM	Senegal River Valleys Operation - Terekole and Magui
OZL	Lake Zone Operation
PAR	Research Support Site
PEP	Permanent Experimentation Base
PIRT	Land Resources Inventory Project
PPS	Primary Productivity in the Sahel
PRODESO	Western Sahel Livestock Development Project
SOMIEX	Mali Import-Export Corporation
SRCFJ	Cotton and Jute Research Station
SRCSS	Selected Seeds Control Research Station
SRCVO	Food and Oil Crops Research Station
SRFM	Fruit and Vegetable Crops Research Station
SRTPN	Tobacco and New Plants Research Station
TSA	Senior Technician in Agriculture
TSE	Senior Technician in Livestock
TSEF	Senior Technician in Water and Forestry
TSGR	Senior Technician in Rural Engineering
UDPM	Democratic Union of the Malian People
WARDA	West African Rice Development Association

Mauritania

CNERV	National Center for Livestock and Veterinary Research
CNRADA	National Center for Agronomic Research and Agricultural Development
CNROP	National Center for Oceanographic Research and Fisheries
CSA	Food Safety Board
DRIG	Integrated Rural Development of Guidimaka

ENFVA	National School for Agricultural Training and Extension
FAC	Fund for Cooperation and Aid (France)
FND	National Development Fund
IEMVT	Institute of Livestock Production and Veterinary Medicine in Tropical Countries
IRAT	Institute for Research in Tropical Agriculture and Food Crops
MDR	Ministry of Rural Development
RIM	The Islamic Republic of Mauritania
SOMMALIDA	Mauritanian-Libyan Agricultural Development Company
SOMECOB	Mauritanian Livestock Marketing Company
SONADER	National Rural Development Company
SONIMEX	National Import-Export Company
UM	Monetary Unit (Ouguiya)

Niger

AGRHYMET	Regional Center for Training and Application of Agricultural Meteorology and Hydrology
CFEPD	Certificate for the end of primary studies
CMS	Supreme Military Command
CRV	Research-Extension Linkage Unit
DECOR	Department of Rural Economics Research
DEF	Division of Education and Training
DEP	Division of Programs and Studies
DFE	Division of Forestry and Wildlife
DPP	Division of Fisheries and Fish Research
DRA	Department of Crop Research
DRE	Department of Ecology Research
DRF	Department of Forestry Research
DRVZ	Departments of Veterinary and Livestock Research
DS	Division of Statistics
DSA	Division of Agricultural Services
DSEIA	Division of Livestock and Animal Industries Services
ECE	School of Animal Husbandry Technician Training
ESA	School of Agronomy and Animal Husbandry
INRAN	National Agronomic Research Institute of Niger
IPDR	Institute of Practical Training for Rural Development in Kolo
MDR	Ministry of Rural Development
MES/R	Ministry of Higher Education and Research
MH/E	Ministry of Hydraulics and the Environment
ONAHA	National Office for Water Management
ONERSOL	National Office of Solar Energy

PQ Five-year Plan
SAF Administrative and Financial Service
UNCC Division of the Nigerien Union for Credit
and Cooperation

Senegal

ASECNA Association for Air Traffic Safety in Africa
AT Technical Assistant
BEI Elementary Industrial Certificate
BNDS Senegal National Development Bank
BP Professional Training Certificate
BT Technical Training Certificate
BTS Senior Technical Training Certificate
CAPAS Center for Assistance in Small-Scale
Fishing in Senegal
CDH-C Horticultural Development Center of Camberene
CRA-B Agricultural Research Center of Bambey
CRA-D Agricultural Research Center of Djibelor
CRA-K Agricultural Research Center of Kaolak
CRA-RT Agricultural Research Center of Richard Toll/Fanaye
CRF-D Forestry Research Center of Dakar-Hann
CRH Horticultural Research Center
CRO-DT Oceanographic Research Center of Dakar-Thiaroye
CRZ-D Animal Husbandry Research Center of Dahra
CRZ-K Animal Husbandry Research Center of Kolda
DFEM Middle School Diploma
DUT University of Technology Diploma
EATA School for Technical Agents in Agriculture
EATE School for Technical Agents in Livestock
EATEF School for Technical Agents in Water and Forestry
EATOPM School for Technical Agents in Oceanography and
Marine Fisheries
ENCR National School for Professional Rural Training
of Bambey
ENEA National School for Applied Economics
ENFM National School for Maritime Training
ENHC National Horticultural School of Camberene
ENSUT National Graduate University of Technology
FCFA Monetary unit
IDEP/CEA African Institute for Economic Development and
Planning
IFAN The Fundamental Institute of Black Africa
INDR National Institute of Rural Development
ISRA Institute for Agricultural Research
ITA Institute for Food Technology

LNERV	National Livestock and Veterinary Research Laboratory
MDR	Ministry of Rural Development
OCLALAV	Organization for Acridian and Fowl Control
OMVS	Senegal River Basin Commission
ONCAD	National Office for Development Credit and Aid
ORANA	Organization for Research on Food and Nutrition in Africa
ORSTOM	Office of Overseas Scientific and Technical Research (France)
PDES0	Eastern Senegal Livestock Development Project
PIDAC	Lower Casamance Integrated Development Project
PRS	Sedhiou Department Project
SAED	Senegal Delta Development Corporation
SANAS	Food and Applied Nutrition Service
SENPRIM	Senegalese Corporation for Early Fruits and Vegetables
SODAGRI	Industrial and Agricultural Development Corporation
SODEFITEX	Textile Fibers Development Corporation
SODESP	Corporation for the Development of Livestock in the Sylvo-Pastoral Zone
SODEVA	Agricultural Extension and Development Corporation
SOMIVAC	Casamance Agricultural Development Corporation
SONAR	National Rural Supply Corporation
STN	New Land Corporation

Upper Volta

ARCOMA	Regional Workshops for the Construction of Agricultural Equipment
AVV	Volta Valley Management Authority
CAP	Agricultural Training Center of Matouskou
CEPE	Primary Elementary Education Certificate
CNR	National Council of the Revolution
DAFR	Division of Forest Management and Reforestation
DPP	Division of Fisheries and Fish Research
DSA	Division of Agricultural Services
DSEIA	Division of Livestock and Animal Industries Services
ELAT	Anti-Tsetse Fly Training School

ENESA	National School for Animal Husbandry and Animal Health
ENFD	National Forestry School of Dinderesso
IRBET	Institute for Biological and Tropical Ecology Research
ISP	Advanced Polytechnical Institute
IVRAZ	Voltaic Institute for Crop and Animal Husbandry Research
MEC	Ministry of Equipment and Communications
MDR	Ministry of Rural Development
MES/R	Ministry of Higher Education and Research
MET	Ministry of Environment and Tourism
ORD	Regional Development Offices
PAPEM	Mini-Station for Pre-Extension Experimentation

CURRENCY EQUIVALENTS
(November, 1983)

Cape Verde

Currency unit	=	Cape Verdean escudo (C.V. Esc.)
US\$1	=	C.V. esc. 75.56
1 C.V. esc.	=	US\$.013
1 C.V. esc.	=	100 centavos

Mauritania

Currency unit	=	ouguiya mauritanienne (UM)
US\$1	=	UM56.40
1 UM	=	US\$.018
1 UM	=	5 khoums

The Gambia

Currency unit	=	Dalasi (D)
US\$1	=	D 2.42
1 D	=	US\$.41
1 D	=	100 bututs

Mali

Currency unit	=	Franc Malian (FM)
US\$1	=	FM 820
1 FM	=	US\$.0012
1 FM	=	100 centimes

Chad, Niger, Senegal, Upper Volta

Currency unit	=	Franc CFA (FCFA)
US\$1	=	FCFA 410
1 FCFA	=	US\$.0024
1 FCFA	=	100 centimes

WEIGHTS AND MEASURES

cm	=	centimeter
ha	=	hectare
kg	=	kilogram
km	=	kilometer
km ²	=	square kilometers
l	=	liter
m	=	meter
m ²	=	square meter
mm	=	millimeter
t	=	metric ton
TLU	=	250 kg live weight steer

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I. INTRODUCTION

A. Background

The following eight country summaries form Volume II of the DEVRES/INSAH project, Assessment of Agricultural Research Resources in the Sahel. For each of the eight Sahelian countries, a summary is provided of that country's National Report, which is an in-depth study of the national research, training and extension institutions.¹

This Agricultural Research Resource Inventory and Assessment was conducted in the eight countries of the Sahel (Cape Verde, Chad, The Gambia, Mali, Mauritania, Niger, Senegal, and Upper Volta), all of which are member countries of the CILSS, the Permanent Interstate Committee for Drought Control in the Sahel. It 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..."

¹Each of the eight National Reports, which together comprise Volume III of this assessment, is available separately from the United States Agency for International Development in Washington, D.C. Volume I, Regional Analysis and Strategy for the Sahel, can be obtained from AID as well.

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

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 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 the 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 development 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 projects and activities to carry out the strategy elements.

In carrying out the inventory and analysis and in preparing recommendations for programs and projects, the DEVRES/INSAH 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.

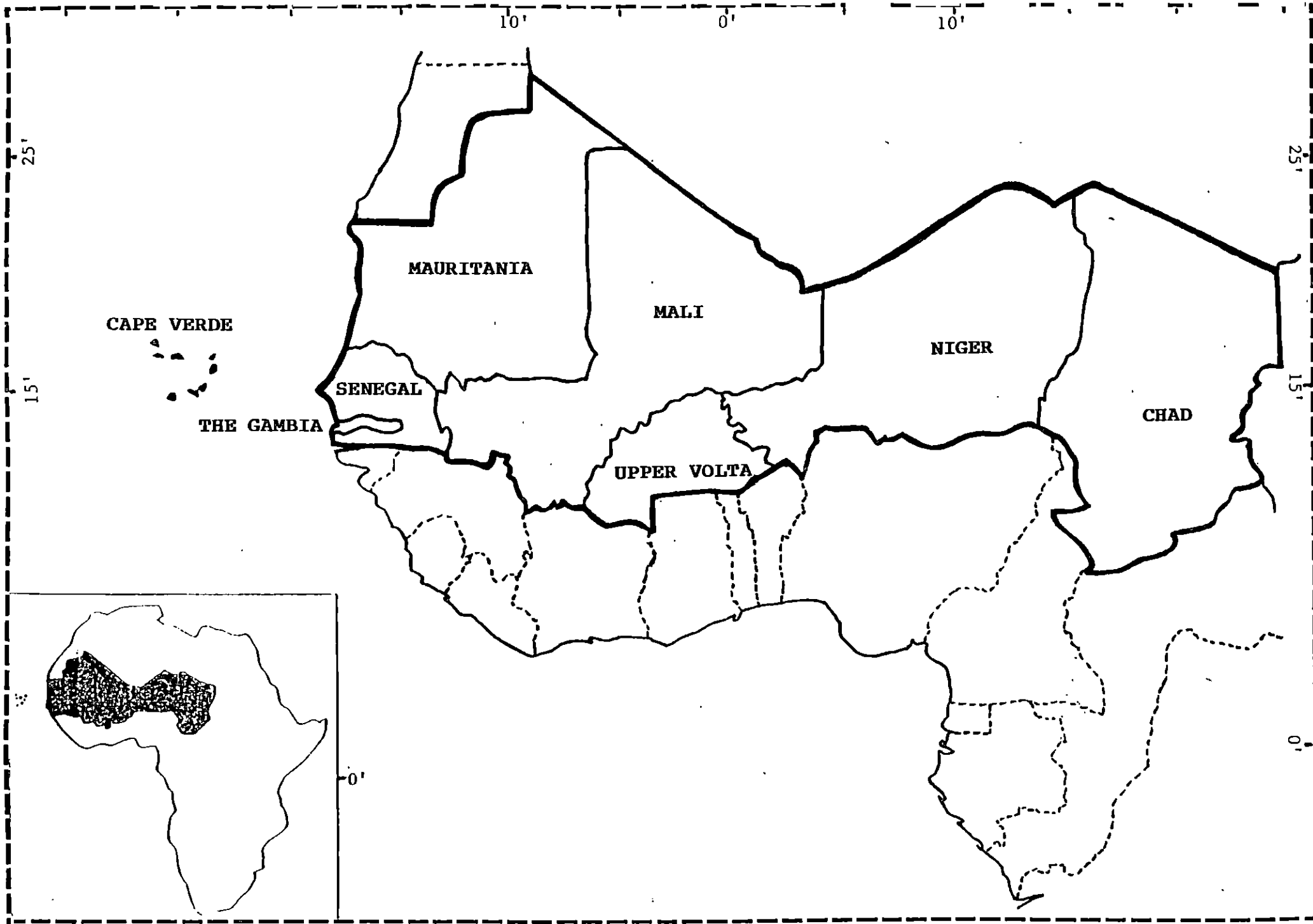
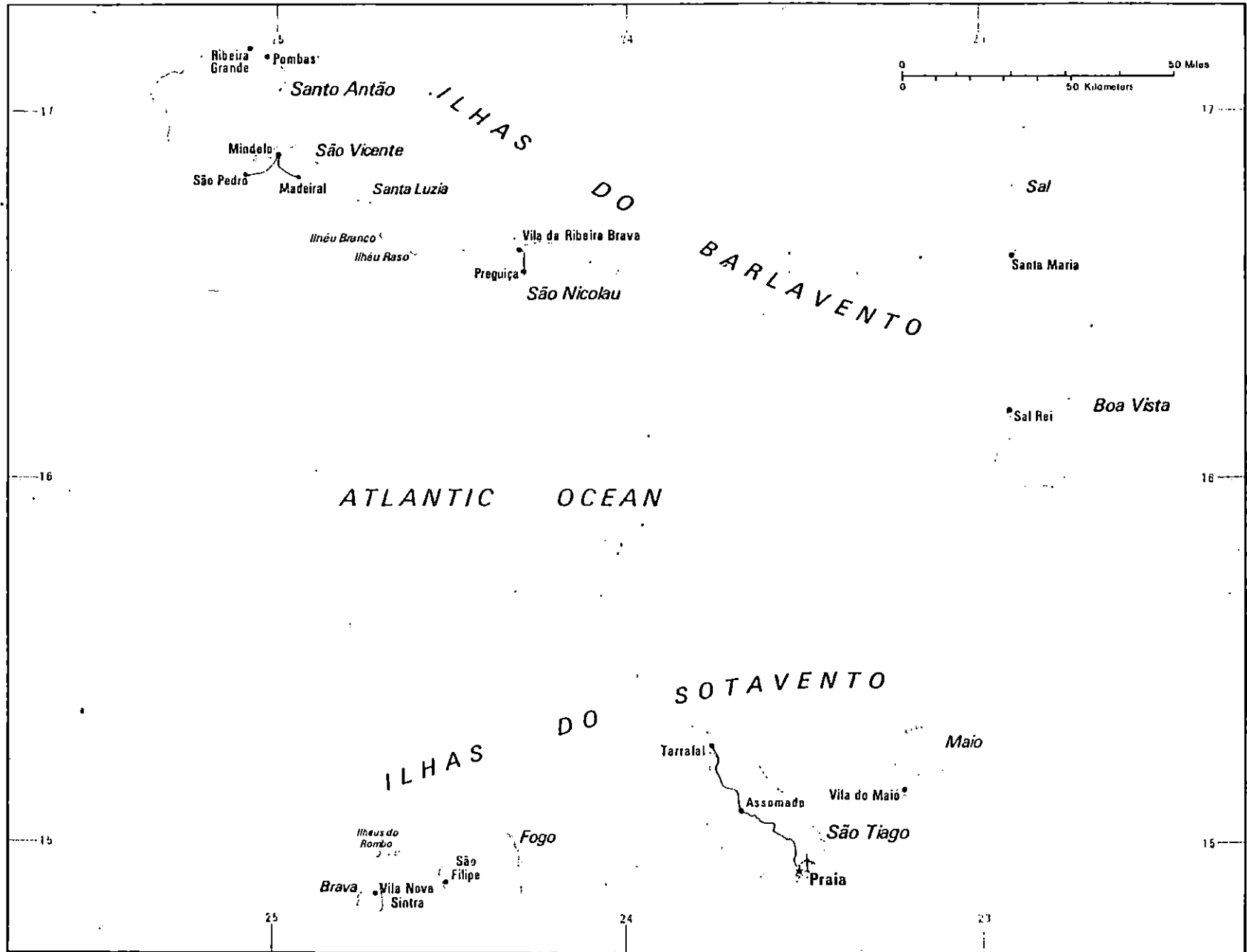


Figure 1: Map of the Sahel



502706 9-77 1542089,
 Lambert Conformal Projection
 Standard parallels 6° and 32°
 Scale 1:1,700,000

— Road
 ↑ Airport

Figure 2: Map of Cape Verde

II. SUMMARIES OF NATIONAL REPORTS

A. Cape Verde

1. General information on Cape Verde

a. Geography

The territory of the Republic of Cape Verde is an archipelago located in the Atlantic Ocean, approximately 400-600 km off of the Western African coast, between latitudes 17°12' and 14°28' North and longitudes 20°44' and 25°22' West. Cape Verde's insularity is therefore a notable geographic feature. It is made up of ten islands (inhabited) and eight islets, with a total surface area of 4,033 km². There are two different regions:

- o The leeward-islands region, the farthest South-Southeast, which includes Maio, Santiago (largest and most populous), Fogo (the highest in elevation), and Brava; and
- o The windward-islands region, the farthest North, which includes Sao Vicente, Santo Antao, S. Nicolau, Sal, Santa Luzia, and Boa Vista.

(1) Geology and topographic relief

All the islands are of volcanic origin, and the most prevalent rock is basaltic (80 percent). There is very little sedimentary rock. With the exception of Sal, Boa Vista, and Maio, the islands are very hilly with rough terrain due to the combined action of volcanoes and erosion. The elevation of the volcanic cone (Pico) of Fogo is 2,829 m, of Santo Antao is 1,979 m (Coroa), of Santiago, 1,935 m (P. de Antonio), and of S. Nicolau, 1,309 m (Monte Gordo). The steep and rugged terrain has a major impact on local environmental conditions and gives rise to many diverse microclimates.

(2) Climate

Given its latitudinal position in the northern hemisphere, the archipelago of Cape Verde is located in the continuation of the Sahelo-saharan zone west of the African continent. The main climatic factors that affect the archipelago are similar to those on the continent, with a certain degree of moderation. The rainfall at low altitudes and on the most arid slopes is similar to that of the sub-Saharan zone. The high elevation of some terrain causes heavier rainfall in these areas, especially on highly exposed slopes, and also causes a "layer of persistent fog", as on Fogo at approximately 1,000 m. The average annual precipitation on the archipelago ranges from less than 250 mm in the arid coastal zone to more than 1,400 mm (exceptionally 2,000) in high-altitude humid zones. There are four different zones--arid, semi-arid, sub-humid, and humid--based on average rainfall which depends on altitude and slope exposure.

Compared with the same latitudes on the neighboring continent, the temperature is comfortably moderated, due to the insularity, altitude and oceanic influence. The average of monthly average temperatures ranges from 27°C on the coast to 18°C at medium altitudes, with a difference of less than 7°C between high and low annual averages.

Again, because of the insularity, relative humidity is higher than on the continent during the dry season, and winds are continuous and more regular.

(3) Vegetation

Sahelian type vegetation prevails. Notable features of the natural vegetation on the islands include a severe shortage of ligneous plant life, prevalence of secondary plant formations as a result of human interference, which has irreversibly altered the original vegetation, and the pronounced originality of plant formations depending on altitude and exposure, which correspond to the microclimates generated by these very factors.

Since the occupation of the islands, the population's wood demand and livestock's forage requirements (which are met with foliage, especially during the dry season) have led to the over-exploitation of ligneous plant life. The result is that ligneous vegetation has almost disappeared in the arid and sub-arid zones. Moreover, these zones are generally the low altitude, coastal regions where most major cities have developed and where the flat terrain provides easy access to all areas. The scarce mature ligneous plant life that still exists is found mostly in humid, medium-altitude zones and in places that are barely accessible.

Cape Verde is, however, implementing a vigorous reforestation effort, funded by several donors, including USAID and FAO. Vast lowland areas are being planted in Prosopio, Parkinsonia and other tree species. Cape Verde recently completed its first national forestry seminar, which indicates the importance given by the government to this endeavor.

(4) Soil and water

The soil of Cape Verde is not very diverse because of the steep slopes, but is all of volcanic origin, generally rich in nutrients, and rather well structured. Having been overused and unreplenished for a century or more, the soils are extremely sensitive to the erosion arising from the steep slopes and the sudden, intense rain. Too often, the soils lack adequate water.

For all of these reasons, the soil of Cape Verde is not very productive; however, the top soil found in valleys can be productive if irrigated. The total area suitable for cultivation is 36,784 ha.

(5) Transportation and communications

The insularity of this country makes physical transportation and communications difficult. Two deep-water ports, at Praia (Santiago) and Mindelo (Sao Vicente), can accommodate large ships, and smaller local ports for fishing and coastal trade are found on all islands. Maritime trade with foreign countries is limited. There are two international airports, one in Praia, the other on Sal. The latter is used as a refueling stop for long-distance foreign flights. Air transportation for passengers is limited, both to foreign countries (for example, only 100 seats per week are available from Praia to Dakar) and between islands, where the capacity of the national airline company is insufficient. Telecommunications (telephone, telex, short-wave) are inadequate and too often un-operational.

b. Demography

The population of the archipelago is 296,000, the majority of which is of mixed race. Approximately 50 percent live on Santiago, and almost 40 percent in cities. The annual growth rate is estimated at 2 percent, but is substantially reduced by emigration, which has traditionally been high in Cape Verde. Migration of the population between islands is also high, but especially so in the last 25 years. Because of demographic growth and emigration, approximately 40 percent of the population is under 15.

The "working-age" population (15-64 years old) was 170,000 in 1979. Under-employment affects 63 percent and unemployment, 28 percent. The most seriously affected group is the low-income urban population.

c. Education

The development of the school system has been a priority since independence (1975). The school enrollment rate drops, however, from 80 percent of school-age children in lower primary school to 13 percent in upper primary school, and to only 3.8 percent in secondary school (only established in 1979), with 1.2 percent in technical training.

According to the 1980 census, the adult illiteracy rate is said to average 52 percent, with strong variations depending on geographical region and age (from 31 percent of those aged 15-19 to 67 percent of those over 30).

Higher education is not yet available in the country; it is obtained primarily in Portugal.

d. Government

Cape Verde gained its independence on July 5, 1975 and was first federated with Guinea-Bissau before separating from it on November 14, 1980 to become an independent republic with a single party, the African Party of Cape Verdean Independence (PAICV). The bodies of power are:

- o The National Popular Assembly;
- o The President of the Republic;
- o The Government, made up of 11 Ministries and 6 State Secretariats; and
- o The courts and local powers.

The Ministries in charge of matters that may relate to agriculture, broadly defined, are: The Ministry of Rural Development, Ministry of Economy and Finances, Ministry of Education and Culture, Ministry of Transportation and Communications, and the State Secretariat for Cooperation and Planning.

e. Economic indicators

The national operating budget was 1.878 billion escudos in 1983. The structure of the Gross Domestic Product (GDP) in 1980 was characterized by a weak primary sector (14.3 percent) and a predominant service sector (72.1 percent). In 1983, this trend seems to have become more pronounced.

Since independence, the share of investment in rural development has dropped (from 50 percent in 1976 to 20 percent in 1981) and investments in the manufacturing and especially service sectors have increased. Domestic financing accounts for only 7 percent of all investment financing. Foreign sources (of which 80 percent are subsidies and 20 percent are loans) finance 93 percent of investments. The foreign debt was 4.72 billion escudos in 1981.

The income distribution shows that 70.7 percent of the population (mostly primary producers and the underemployed) have only 42.1 percent of the income. Approximately 42 percent of the total population live under the poverty line, with less than US\$ 170 per year in disposable income.

Imports account for 68 percent of consumer goods and 11 percent of intermediate goods.

The currency is the Cape Verdean escudo (ECV) which is not convertible. (Value in October 1983: One ECV=US\$.0132, One US\$=75.56 ECV).

Since Cape Verde is highly dependent on international aid, the government has established a State Secretariat for Cooperation and Planning which is responsible for managing incoming aid and integrating it into the 1982-85 Economic Plan currently in effect. Total commitments of foreign aid in 1979 were US\$ 55.3 million (of which 34.3 have been disbursed) and US\$ 76.3 million in 1980.

Food aid makes up a very large share of all foreign aid. Food imports have met an average of 80 percent of demand over the last few years, half of which (40 percent) came as food aid. These figures indicate the importance of this aid for Cape-Verde's economy and the need to integrate it into the present economic plan.

f. Rural sector

(1) Agronomy

There are 1,790 ha of irrigated crops and 34,994 ha of rainfed crops on the archipelago. The national average number of people per arable hectare is five and the average farm size is 1.3 ha, divided into plots of 0.5 ha for rainfed land and 0.1 ha for irrigated land.

Principal irrigated crops are sugarcane (used for production of grog, an alcoholic beverage) bananas, sweet potatoes, and Irish potatoes. Over half of the irrigated area is devoted to sugarcane and bananas. Maize, cassava, vegetables, and other crops account for the rest. Staple crops are maize and grain legumes. There is no local production of sorghum, millet or rice.

The breakdown of dryland crops total surface area is 21.6 percent in the humid zone, 45 percent in the subhumid zone, and 33.6 percent in the semi-arid zone. Fifty-eight percent of the national total is on Santiago. Maize and beans are the most prevalent and are often mixed. The average national maize yield is 465 kg/ha. Maximum yields of 800 kg/ha are achieved under optimal conditions of zone and rainfall, so total maize production for the country may vary between 24,000 and 950 tons depending on the year.

(2) Livestock

The total national livestock herd is estimated at 12,000 head of cattle, 72,000 goats, 1,500 sheep, 45,000 pigs, and 150,000 poultry. Hog production is of major importance in the livestock sector. Santiago has 50 percent of the total, followed by 16 percent on Fogo, 16 percent on Santo Antao, and 8 percent on Boa Vista.

Productivity is low (due to fodder and diseases), amounting to an estimated available total of 2,400 tons of meat and offal, or 8.1 kg per capita per year, and 1,750 tons of milk, or six kg per capita per year.

(3) Forestry

The forestry sector is very important for Cape Verde since the forests have practically disappeared due to over-exploitation. Meanwhile, the population's wood demand, and grazing requirements for animals, remain high, and ligneous vegetation is becoming increasingly necessary to protect the environment from erosion and harsh climatic conditions. The priority problem is reforestation for production (wood, forage) as well as for environmental protection; according to estimates, national production satisfies only 18 to 27 percent of wood demand.

(4) Fisheries

Despite its small continental shelf (only 10,450 km²), Cape Verde has acquired potentially valuable maritime resources since its adoption of the 200-mile exclusive economic zone (630,000 km²). Indeed, the extent of its resources has not been inventoried at the present time since there are only 4,000 fishermen (small-scale and industrial combined).

The lack of knowledge concerning the actual amount of marine resources is hampering the establishment of a national fishery policy; traditionally, tuna fish and shellfish are the most important. It is estimated that the annual average catch is 9,000 tons.

(5) Production systems

There are two systems of crop production: irrigated and dryland.

(a) Irrigated land

Although limited, irrigated land is very important for food crops because of the relative stability of this type of production. Certain areas are irrigated only to complement rainfall and are thus called "semi-irrigated."

(b) Dryland

Dryland crops have varying characteristics depending on the bio-climatic zone in which they are grown and the corresponding fluctuations in rainfall. The most prevalent crops are maize and beans, with pigeon peas dominant in humid and sub-humid zones.

As for animal production, given the limited number of animals and the small pasture lands, there is an alternation or mixture of natural pasturage and trough-feeding for ruminants. Pigs and poultry are always trough-fed.

(6) Factors of production

Fertilizer is scarcely used in Cape Verde and only on high-yielding irrigated crops (approximately 35 tons for the whole archipelago in 1981-82).

Seeds for dryland crops (maize and beans) are saved from the local production, except in drought years when production is insufficient and the seeds must be bought from the island of Fogo (which is typically less affected by drought due to its elevation). The other seeds are all imported.

Due to the lack of statistics, the use of pesticides and agricultural equipment is not well known, but imports of the latter are very limited.

(7) Food balance

Cape Verde has a very large deficit in its food balance; in grains it is estimated to be 15,000 t/yr. Because of the small area of irrigated crops, production will probably continue to be inadequate and fluctuate in relation to the change in precipitation.

(8) Agricultural credit

The loans to farmers to buy factors of production are arranged by Bank of Cape Verde and are obtained through the Fomento Agro-Pecuario and the National Institute of Cooperatives. There are no available statistics.

(9) Women in agriculture

In Cape Verde, another consequence of the drought is increased emigration of labor and the ensuing rural labor scarcity. The emigration of the male working population to cities or abroad is a particular hindrance to development projects in rural zones, where there is a predominance of women, children, and elderly. Women are increasingly responsible for agricultural work and for making the decisions pertaining to rural life. (Thirty-six percent of all households have female heads; this percentage reaches 47 percent in the Tarrafal region on Santiago.)

2. Field data analysis: agricultural research

There are two agricultural research institutions in Cape Verde:

- o The Center for Agrarian Studies (CEA) which is being reorganized and will become the Amilicar Cabral National Agrarian Research Institute (INIA-AC); and
- o The Livestock Development Center (CDP).

a. The Center for Agrarian Studies

Its mission is to promote and coordinate research in fields related to rural development, notably in renewable natural resources in agronomy, irrigation, livestock, hydrology and agroclimatology, rural sociology and agricultural technology.

(1) Infrastructure and equipment

Located in S. Jorge dos Orgaos, the CEA was established in January 1981 and is still under development. It is divided into six departments:

- o Renewable natural resources;
- o Agroclimatology and hydrology;
- o Livestock (for animal pathology);
- o Agronomy and rural sociology; and
- o Documentation and information (planned).

The CEA manages two research stations equipped with research and experimentation infrastructures, both on the island of Santiago. Two other centers are also planned, one on Fogo, the other on Santa Antao.

(a) Main station at Sao Jorge dos Orgaos

This is the central station. Located near Praia, it houses the CEA headquarters with the administrative facilities, the marketing facilities for the station's products, offices and research laboratories, (the laboratory for integrated pest control, the laboratory for soil, water, and plant analysis) and other facilities (stables, pig pens, chicken coops).

(b) Tarrafal station

Located in the northern section of Santiago Island approximately 60 km north of Praia, this station focuses on irrigation studies, and has an eight ha irrigated field with the necessary facilities.

(c) Fogo Center (Island of Fogo)

This center is being financed by the Federal Republic of Germany (FRG) and is presently under development. It will include:

- o An agro-forestry and fruit-growing division;
- o A subdivision for irrigated crops and coffee;

- o A subdivision for temperate-zone fruit crops; and
- o An agro-forestry subdivision.

Financing obtained from USAID will provide funds to build and equip a small integrated pest management laboratory, build and furnish housing for the technicians, and pay for technician training and operating costs for three years.

(d) Santo Antao Center (Santo Antao Island)

Plans have been made and financing obtained from the Netherlands to establish a center similar to that at Fogo but with a major emphasis on irrigated crops. An integrated control laboratory and its equipment, housing, training and operating funds are also foreseen.

(2) Programs

The research and development programs directed by the CEA include a total of 42 projects, which are listed below.

- o Improvement of food production:
 - Maize, millet, sorghum and leguminous crops;
 - Vegetable production;
 - Integrated pest management; and
 - Tests on banana varieties and production.
- o Forestry production and reforestation:
 - Introduction of species in arid and high-altitude zones; and
 - Tests on Parkinsonia and Prosopis juliflora, including irrigation tests, assessment of the potential of areas planted long ago, and rooting studies.
- o Hydrological and soil science studies:
 - Use of water runoff for forestry in arid and semi-arid zones;
 - Infiltration measurements on soils in semi-arid zones on Santiago;
 - Tests of the effects of mechanized techniques on soils;
 - Physics and chemistry of soils on Santiago;

- Influence of the soil on rooting of Eucalyptus in nurseries; and
- Study and improvement of soil fertility.
- o Use of pastures (in cooperation with the CDP): Bromatology of leaves and pods of Parkinsonia and Prosopis juliflora and their use in feeding goats, sheep, rabbits, and pigs;
- o Production systems not yet in project form;
- o Characterization of renewable natural resources--23 other projects (financed by various sources) covering:
 - Agro-climatology, hydrometry, facilities, equipment and training of researchers, evaporation, and water-resource balance of various watersheds on Santiago;
 - Plant formations, phytogeography, agro-sylvo-pastoral carrying capacities, and plant identification;
 - Study and mapping of topographic relief and the soils on Santiago; and
 - Assessment, recuperation and conservation of surface runoff.
- o Establishment of an agro-industrial unit at the CEA:
 - Studies of the banana, Jatropha curcas oilseeds, and coffee on Fogo and Santo Antao.
- o Food crop research project (funded by AID):
 - Strengthen the institutional and administrative framework of the CEA;
 - Assist the CEA in developing a research strategy and plan;
 - Assist in a rural baseline study; and
 - Train 12 CEA research scientists in the U.S. at the M.S. or Ph.D. level.

(3) Human resources

The national personnel of the CEA include 27 researchers and technicians, of which two are agricultural ingenieurs (BAC plus five years additional training) and seven have more than five years of experience. There is a great lack of personnel, and the current employees are generally young and inexperienced.

There are four expatriate senior researchers. Plans call for the training of 12 people (two Ph.D.'s and ten M.Sc.'s), some of whom will be selected from among technicians now working with the CEA. Some of the training will be done in Cape Verde (including several training sessions abroad) and some training will be done exclusively abroad.

(4) Financial resources

The resources of the CEA (nine million ECV in 1983) come from:

- o The national budget, for operating costs and some research activities; and
- o Foreign sources, for building infrastructure, for research programs and projects, and for certain complementary research.

(5) Scientific and technical information resources

The Ministry of Rural Development (MDR) already has a library, but it should be reorganized following the establishment of the Documentation and Information Unit planned for the CEA.

In addition, the CEA has available specific technical documentation from the National Documentation Center. It also receives support from the Institute of Tropical Scientific Research of Portugal.

b. The Livestock Development Center

The CDP is located in Trindade (Santiago Island, near Praia); its mission is to support the livestock development program. It is expected to work together with the livestock department of the CEA (which is in charge of animal pathology).

(1) Infrastructure and equipment

The CDP is still under development and will have:

- o Its central station (headquarters) in Trindade, with some facilities; and
- o The animal husbandry subdivision in Calheta (Maio Island), where the Caracul sheep were raised.

(2) Programs

The center has few programs as yet because its creation is recent; current programs deal with improvement of goats and nutrition of livestock.

(3) Human resources

The CDP lacks scientific and technical personnel.

(4) Financial resources

Financial Resources are limited.

(5) Scientific and technical information resources

The resources are those of the MDR library.

c. Comments

In the agricultural research field, the recent creation of two research institutes has played a positive role in developing the agricultural sector.

All of the needs of the research sector can be met by the various departments of the two institutes--the CEA (created in June 1977 and restructured in January 1981) and the CDP (created in 1982).

Unfortunately, there are still major physical constraints (arid climate, fragile soil, scarce water supply); structural constraints (institutions still under development, facilities which are often still rudimentary, limited financial means, and too often a heavy dependence on foreign donations); and personnel constraints (not enough personnel and on average a low level of training).

Moreover, dependence on two institutes (the CEA livestock department for pathology, and the CDP for the rest) does not seem to be advantageous for animal production.

However, considering the enormous efforts already made, the progress and positive results observed in some activities (for example, fishing) and the great receptiveness of the rural people, it is hoped that more significant progress can be made in other sectors, for example, forestry, animal husbandry, and integrated pest control.

3. Field data analysis: agricultural training

a. The Multidisciplinary Center for Rural Development Professional Training

Before independence, technical and scientific personnel were not trained in Cape Verde. Afterwards, to meet the growing need for trained personnel, and with the help of the FAO, the government decided to create the CPFCDR. The Center is supervised by the CEA and located at S. Jorge dos Orgaos. When complete, its mission will be to supervise and organize training and increase proficiency for all rural development personnel in Cape Verde, from farmers to senior-level professionals.

Short-term goals are to:

- o Improve the current system of training senior personnel abroad;
- o Increase the proficiency of the 30 skilled professionals now at work in the fields of organization and development management;
- o Set up and carry out an accelerated training program for 35 middle-level professionals;
- o Increase proficiency of the 60 auxiliary technicians now at work;
- o Establish a practical training system for 120 pilot-farmers; and
- o Prepare and carry out occasional training activities upon request.

The medium-term plans are to:

- o Introduce classes in rural development into the primary-school curriculum;
- o Train national agricultural instructors;
- o Prepare a training program for rural youth; and
- o Set up a unit for research in rural technologies and the "research-training" mechanisms.

(1) Structure and budget

The CPFCDR is under construction in S. Jorge dos Orgaos. It will have its own facilities and will also be able to use CEA facilities.

Financed by Italy, the budget for the first four years totals US\$ 2,012,600 (investment and operations).

(2) Human resources

The professors and teachers of the CPFCDR will be the professionals now working at the CEA and the MDR. They will be assisted by five professors who will be permanent staff at the center and who are now being trained (in socioeconomics, crop production, soil and water conservation, irrigation, and animal production).

b. Comments

Since the CPFCDR is still in the planning stage, it is impossible to assess its strong and weak points.

However, the pragmatic setting of the preliminary goals is a positive point. Likewise, the plan to train 180 B-level professionals and 122 C-level professionals, in addition to the pilot-farmer training, seems to be quite adequate and well-suited to the capacity of the institution being planned and to the country's needs.

In any case, pending completion of the plans, foreign specialists will probably need to be recruited to provide for the training and the operation of the institution.

4. Field data analysis: agricultural extension

a. Extension activities

There are no formal extension institutions in Cape Verde. Current extension activities are a part of rural development projects or directed by departments of the MDR:

- o The crop-production department provides technical support to farmers mainly on Santiago, in particular for locust control;
- o The Assomada Integrated Development Project (PRODESA) on Santiago has an extension unit that works within the project's jurisdiction. Its staff includes two agricultural ingénieurs and seven extension agents. The total budget is approximately ECV 21.5 million per year; and
- o The Santiago watershed development project also conducts extension activities throughout that island. Its staff includes one agricultural ingénieur, one technical ingénieur, and four extension agents. Its budget is ECV 1.875 million per year.

Presently, the only visible result of these extension efforts seems to be an increase in total cropland and in horticultural productivity. An evaluation would be needed to identify other results.

The government is planning a National Agricultural Extension Service, within the MDR, which would have its headquarters in Praia and extension centers in the field. Each center is to be managed by an extension worker assisted by specialized agents.

b. Comments

An assessment is not yet possible since the extension facilities that are currently operational were created only recently and lack organization.

It should be stressed, however, that the government has taken a positive step in deciding to create a formal centralized structure for extension. However, the extension activities that are currently operational are conducted exclusively on Santiago Island.

5. Constraints to increased productivity

a. General constraints

(1) Rainfall

Rainfall is the major physical constraint. It affects all sub-sectors (except Atlantic fishing), with greater severity in the arid and semi-arid zones of the islands. For irrigated crops, drought has often led to a severe decline in the available water supply and the consequent reduction of cultivated land.

(2) Rural outmigration

Many Cape Verdean farmers emigrate to cities or abroad seeking a more secure job and greater opportunities to improve their standard of living, as agricultural production has become too risky. The result is that the population remaining in villages includes many women, children, and elderly, leaving a work force which is frequently insufficient to maintain production.

(3) Insularity

Because of the insular nature of the country, the great distances between islands, and transportation costs, physical communications are rather limited, and efforts and means to improve them tend to be concentrated in the largest and most populous islands. The other islands are thus placed at a disadvantage, despite stated intentions which do show willingness for fair distribution of resources according to needs.

(4) Human resources

In all sectors, and in general for development and institutions, the country has an acute scarcity of high-level specialists, especially for research and training institutions.

There are too few skilled professionals in the country and in many cases (for example in forestry and fishing) the number of those being trained abroad is insufficient to fill the jobs planned upon their return.

b. Agronomic constraints

In addition to the overwhelming constraints caused by the irregularity of rainfall, the National Report stresses other constraints linked to:

- o The lack of technology and information available to producers for the modernization and adaptation of growing methods, or the choice of the most appropriate production systems, species, and varieties. (These limitations are also linked to extension);

- o Difficulties arising from dividing crop land into plots that are too small, thereby precluding the profitable use of means of larger scale production (e.g. animal traction, mechanization);
- o Improper use of water due to lack of technology and poor maintenance of irrigation systems;
- o Non-utilization of both mineral and organic fertilizers (even on irrigated crops, like bananas) which leads to a progressive decline in soil fertility;
- o Erosion, which is a widespread problem in Cape Verde because of the steep slopes, deterioration of plant cover, violent monsoon rains, and torrential runoff;
- o Devastation caused by predators; and
- o Absence of credit possibilities.

c. Livestock constraints

Some limitations on livestock production stem from the lack of knowledge of animal pathology in the field (especially for poultry); farmers do not have access to relevant information. The greatest limitations, however, are the result of insufficient food resources for animals. To wit:

- o Lack of natural forage resources for animals fed on pasture (these resources are limited because of the persistent deficit in rainfall over the last few years); and
- o The relative scarcity of by-products that may be used for feeding pigs and poultry, because on the one hand, these by-products are used in other ways and, on the other hand, they are only available in very small quantities.

d. Forestry constraints

Second only to the rainfall deficit, the major constraint in this sector is identifying or developing a substitute product for the population's irreducible demand for wood.

The National Report also points out the problem of the use of land on the high-altitude, humid zones for reforestation (by the government) while this land is currently used (marginally) for rainfed agriculture.

e. Fisheries constraints

In this sector, the major limitations are:

- o The work force lacks technology and is unable to improve productivity due to lack of opportunities and extension staff;
- o The problem of marketing the products, since there are no appropriate distribution channels;
- o Inadequate availability of production inputs, which are often imported erratically, and lack of credit to buy these inputs (e.g. nets, boats); and
- o Finally, in the research field, the insufficient knowledge of fishery resources is an important constraint to development.

f. Institutional constraints

In the first place, all the research, training, or extension institutions in Cape Verde are either recently established or still being constituted; moreover, they are closely linked to the MDR and, consequently, experience very similar difficulties. These are:

- o Lack (in number and in level of expertise) of technical and scientific personnel, especially nationals, and in particular high-level officials; and
- o Lack of financing, infrastructure (most facilities are under construction or in the planning phase), equipment, and materials. Very often, even the by-laws are still being drawn up.

Some more specific institutional constraints follow:

- o In research there is still inadequate program formulation and coordination.
- o In training the Multidisciplinary Training Center lacks national instructors at a sufficiently high level (there are a few in training abroad). Local training of skilled personnel is inadequate. Education and research have no linkage, and documentation (the MDR library) must be substantially expanded.
- o In extension, there is no formal extension service. The few extension activities that are currently operational are conducted only on Santiago Island. Despite the beneficial contacts with research, little available data is given to farmers and, thus, few solutions are found to their problems.

6. Outline of solutions and priority actions

a. Policy aspect of proposals

Among its recommendations, the National Report proposes a very complete series of measures to be taken in the field of research and development in all sub-sectors. Priority actions planned for research are:

- o Strengthening human capacity quantitatively and qualitatively;
- o Increasing material and financial means to carry out priority activities;
- o Qualitative and quantitative inventory of all the problems in each sector so that solid bases may be available to formulate medium- and long-term programs and/or projects;
- o Structuring the scientific and technical careers of agents to enable them to advance both professionally and financially;
- o Nationwide coordination of different programs in order to harmonize their implementation in the appropriate zones of the national territory;
- o Support for bringing in highly qualified non-national personnel;
- o Organization of a common data bank for use by institutions;
- o Creation of a national germ-plasm bank, which would facilitate the importation of plant material from abroad;
- o Organization of a documentation system with the proper equipment and staff and creation of a communication system with foreign counterparts; and
- o Establishment of the mechanisms enabling permanent contact between national research institutions and foreign counterparts.

The medium-term recommendations for training are:

- o Adapting training institutions to the reforms planned for general education in the country;
- o Increased training of farmers who will begin working at the Multidisciplinary Center soon;
- o High-level training of full-time skilled personnel for the Multidisciplinary Center, and in particular for the director, in techniques of training of staff;

- o Expansion of the proposed library;
- o Acquiring the proper means to link the Documentation Unit of the Center for Agrarian Study to similar centers in other countries;
- o Establishing a Multidisciplinary Center newspaper;
- o Scheduling seminars on training problems linked to rural development in cooperation with similar institutions, whether Sahelian or not; and
- o Integrating education and research.

The report then specifies the following (summarized) suggestions for each research program:

(1) The "characterization and use of renewable natural resources" program

The projects for soils include cartography and characterization of soils used for agriculture and forestry; improvement of water retention; study and reclamation of halomorphic soils, and structural stability of irrigated plateau soils.

Classification of forage and carrying capacity of pasture land are the projects dealing with grazing land.

Forestry projects include: testing of imported species in arid zones, tests on growing Parkinsonia and Prosopis, production in areas planted long ago, training skilled forestry personnel, and promoting forest legislation.

In hydrology, projects include the study of erosion and runoff, water-resource balance in watersheds on Santiago, water flow system in plateau zones, and tests in Tarrafal on "tied ridges".

(2) The "irrigation" program

The program concerns determination of irrigation needs and a timetable for the principal irrigated crops.

(3) The "epizootic inventory" program

This program is composed of a study of internal parasitoses in livestock and poultry, infectious diseases of all domestic animals, and proto-zoology and zoonoses of veterinary-medical interest.

(4) The "fisheries development" program

This program concerns oceanographic study of territorial waters; eco-biology and assessment of stocks of certain species; technology of fishing gear.

(5) The "farming system characterization" program

This program concerns production systems analysis, marketing of agricultural products, a study of the development of two regions.

b. Priority programs

The priority programs proposed in the National Report take up some of the preceding suggestions without change. A summarized list includes:

- o Study and improvement of soil fertility conditions (four projects); reconnaissance of soil fertility on Santo Antao and Fogo, use of brackish water for irrigated vegetable production; techniques to save water in horticulture and fruit crop irrigation; alleviating the limitations of cultivation and edaphic-climatic factors in vegetable crop and fruit production;
- o Characterization of renewable natural resources (two projects); cartography and description of arable soils. Characterization and development of pasture lands;
- o Improvement in production of the principal rainfed crops (two projects); study of production potential for pigeon peas; improvement of maize and bean crops;
- o The epizootics of Cape Verde (nine projects); parasitological studies (liverfluke, gastrointestinal parasites, protozoology, acarology and entomology) and studies on infectious diseases in livestock; studies on zoonoses;
- o Fisheries (two projects); study of the eco-biology and fish population dynamics; fishing gear technology; and
- o Characterization of the agrarian system (two projects); agrarian system analysis; study of agricultural by-product marketing; survey on the development of the Assomada and Ribeira regions (on Santiago).

7. Conclusions and recommendations

a. General recommendations

(1) Climatic study

The poor state of the environment in Cape Verde, and especially the need for information in agriculture (planting dates, characteristics of new varieties, etc.) will require an investigation of the current changes in climate attributable to drought. It is of utmost importance to find out whether a quick return to less harsh climatic conditions may be foreseen, in order to formulate the agricultural research and development policy.

This project concept, which also covers other countries, will be based on the study of all meteorological data collected and processed since the beginning of the records in Western Africa. It is described with the regional projects, since it corresponds to a regional approach.

(2) Environmental protection

Cape Verde has already made major efforts in defining the land use in the various zones or regions of the islands in order to define, in each known ecosystem, the most appropriate methods of use while protecting and restoring the environment. In order to implement the conclusions already reached and to refine certain diagnoses, it is necessary to undertake more in-depth studies and to begin certain actions. In particular, projects already well underway on the protection and restoration of soils and forests, should be pursued. The assessment of needs and methods should be done very quickly.

(3) Marketing systems

There is little circulation of merchandise in Cape Verde because of local transportation problems (between islands and even within islands which have steep terrain), the small population, and the traditional tendency towards autarky. The result is an overall lack of a marketing system for local farmers' products, which does not encourage these farmers to produce marketable surpluses. Further study of this phenomenon seems to be required, as well as of the means to establish a marketing system that would provide incentives for producers (in agriculture, animal husbandry, and fishing) to produce surpluses to sell, by opening up the country more to the exterior.

b. Recommendations on factors of production

(1) General

In all production activities in Cape Verde, there is a lack of opportunity to obtain credit for the purchase of inputs and a lack of information available to farmers on the value, the utility, the availability, and the ways to use factors of production. The solution to this problem lies within the domain of the extension services, but also in an overall improvement of information means of communication (radio broadcasts, meetings, demonstrations, etc.). Moreover, there should be more information developed for producers concerning the benefits of using fertilizer (especially on irrigated crops, sugarcane and bananas) and pesticides for pest control. In addition to the information, there should be an organized system to make the corresponding products available to producers at prices established so as to permit their economic use.

(2) In agronomy

Studies are urgently needed on the behavior of new varieties, mainly staple food plants (maize, beans, pigeon peas) that are best adapted to the present rainfall conditions. These studies should be accompanied by tests on water management using an actual dryland farming system.

(3) In livestock

After informing farmers of the simple means to prevent certain pathological ailments that can destroy livestock (especially poultry and pigs), the priority should be the identification and evaluation of availability and ways of economical use of "unconventional" animal feeds. Cape Verde already has extensive information on this subject, but it seems there is still much to be done, in particular, to improve the initial value of certain basic products by combining them with other elements, possibly imported.

For cattle and goats, an agrostological study is needed on each island in order to determine the overall potential of forage production and the optimal methods for managing this production in relation to local livestock needs. This study could lead to more rational planning of animal production which would also take into account environmental protection and restoration.

(4) In fishing

In order to develop Atlantic fishing, which is an extremely promising sub-sector in Cape Verde, a study must be conducted on the requirements for factors of productions still rarely available locally (nets, larger boats, and motors) and on training of the specialized work force (fishermen, equipment maintenance technicians, specialists in fish preservation methods, etc.)

With this goal in mind, the establishment of a system of credit for the purchase of production inputs, and a more reliable structure for marketing the fish must also be studied in order to have a coherent and potentially successful program.

(5) In forestry

This sub-sector is above all limited by the drought and by the population's irreducible demand for firewood. The Cape Verdean population's general awareness of the danger of desertification is sufficiently widespread for a spontaneous vegetation (especially ligneous) conservation program to be effective as soon as a wood substitute is proposed at the right price.

Everything must be done to find this, or these, substitutes and to quickly publicize information on the improved (higher efficiency) stoves that already exist and arrange to distribute them.

c. Recommendations on institutions

(1) General

The overall problem affecting all the institutions in Cape Verde is that they are either too recent or still in a proposal stage. On the one hand, they must be organized very soon (construction, operating funds) and, on the other hand, since the current personnel are insufficient, high-level personnel must be recruited (or trained). This is essential for the smooth operation of the institutions. Cape Verde has already set up most of the construction, recruitment and training programs, but still lacks some of the adequate financing.

(2) On research institutions

In the field of agronomy, an assessment is needed on the possibility of increasing the number of trial grounds to include all the bio-climatic zones of the archipelago in order to meet the technical and information needs of farmers and to provide a stronger base for extension. There should also be more studies on production systems.

In the field of livestock it must be determined whether the separation of the research on animal production between the CDP and the CEA is a drawback or an advantage. An evaluation must also be made on the effects of having two different institutions to which the farmers and extension agents must turn depending on the nature of the problem--one for animal pathology (CEA) and another for animal husbandry and production (CDP).

In the field of fishing, quick and positive results may be obtained from developing a specialized department which would focus on increasing knowledge of the fish stocks and of new fish species that may be used. The needs must be evaluated for equipment (vessels, materials etc.), for operating funds, and especially for specialists.

(3) On training institutions

In order to make training institutes operational as soon as possible, organization must be speeded up, operating funds must be more readily available, and high-level instructors must be recruited (or trained) as soon as possible.

(4) On extension institutions

Just as in training, a national extension service must be created and become operational (structure, funds, staff), and the necessary managerial competence must be found to manage the supply and distribution of adequate factors of production to the producers under acceptable conditions. Without these steps, no extension activities can be credible.







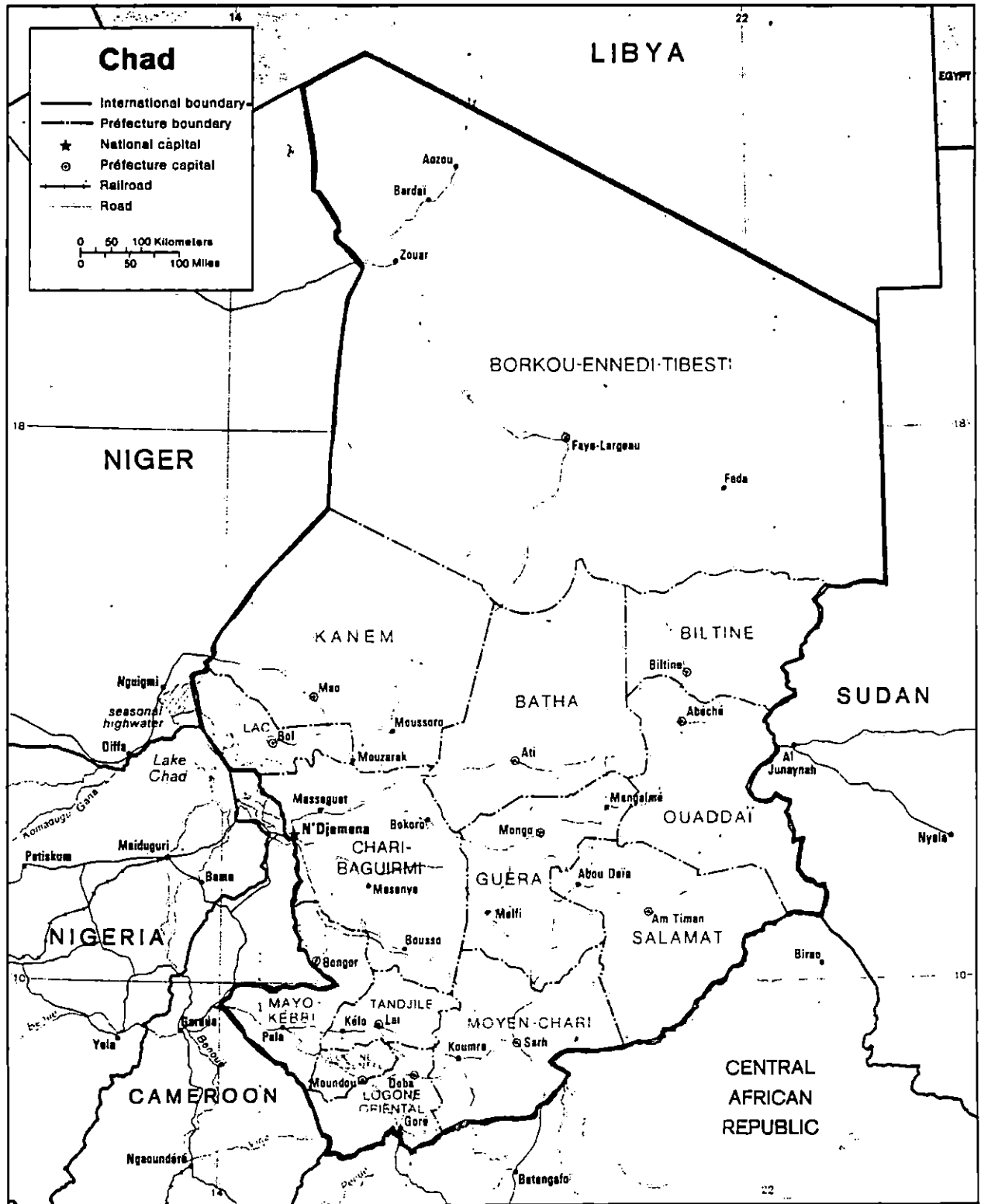


Figure 3: Map of Chad

B. Chad

I. General information on Chad

a. Geography

(1) Location and boundaries

Chad is one of the four land-locked Sahelian countries located in Central Africa. It has a land area of 1,284,000 square kilometers (km²), and is surrounded by six countries--Libya to the north, Sudan to the east, the Central African Republic to the south and Cameroon, Nigeria and Niger to the west.

The elevation varies from 3,315 meters (m), in the Tarso-Tousside area, to about 200 meters in the Egguey area.

The main sources of surface water are the Chari River (1,200 km long), the Logon river (1,000 km long), and Lake Chad (between 10,000 and 25,000 km²).

(2) Ecological zones

Six ecological zones are found within Chad, with the rainfall level increasing from north to south. The level of rainfall for these zones is as follows:

- o In the desertic zone, less than 50 mm/yr;
- o In the sub-desertic zone, 50-150 mm/yr;
- o In the Sahelian zone, 151-500 mm/yr;
- o In the Sahelo-sudanian zone, 500-800 mm/yr;
- o In the Sudanian zone, 801-1000 mm/yr; and
- o In the Sudano-Guinean zone, more than 1000 mm/yr.

In general, the dry season runs from September to May and the rainy season runs from June to October. The duration varies with the ecological zone, however, with the rainy season ranging from three months in the north to six months in the south.

(3) Communications

The internal roadway system is deficient and most of it is impassable during the rainy season. Chad is linked to Cameroon, Niger and the Central African Republic by roads suitable for all vehicles and passable year-round. Until the drought in early 1970, the lake and the two most important rivers provided the most convenient surface transport systems. This method is less possible at the moment.

The international airport of N'Djamena provides most of Chad's external air linkages. Several lines of internal air transport also exist, to Sarh, Moundou and Abeche. Radio is the only long-distance broadcasting system, with the central station in N'Djamena. Regional stations also exist in Moundou and in Sarh, but with very limited ranges. The communications complex of N'Djamena which provided national and international communications was destroyed during the civil war.

b. Demography

In 1981 the resident population was estimated at 4,500,000 inhabitants. The natural growth rate is 2 percent per year. The most important cities are N'Djamena, which is the capital, Sarh, Moundou, Bongor and Abeche. The southern portion of the country is more densely populated than the north.

Because of the great ethnic diversity within Chad, the demographic composition is generally presented by major ethnic and affiliated groups. The major groups are:

- o The Sarh and related groups (Moundou, Sarh area) = 30 percent;
- o The Massa, Moussei, Moulouï and related groups = 21 percent;
- o The Ouaddai and related groups (Eastern region) = 16 percent;
- o Arabs (Central region) = 9 percent; and
- o Others = 24 percent.

Among the many languages found within Chad, Sarh is widely spoken, but the official national languages are French and Arabic.

Religious affiliation is divided between Moslems (43 percent), Christians (30 percent) and other religions (27 percent).

c. Education

The educational system is divided into primary, secondary, and university levels.

There are 880 primary schools, with a total of 228,348 students and 3,750 teachers. Primary education begins at age six or seven and lasts for six years. Those who successfully complete the six year program receive a diploma, le Certificat d'études primaires elementaries tchadien, (CEPE/T).

There are 50 secondary schools, with 43,952 students and 1,170 teachers. Secondary education is divided into two levels. The first level is comprised of four years of study after which students receive the Brevet d'études du premier cycle (BEPC). The second level consists of three additional years of training for those who have

received the BEPC, and those students who successfully complete the program and pass the examinations, are rewarded by the Baccalaureat (BAC).

There are five secondary schools devoted to teacher-training for the primary system. These schools, the Ecoles normales secondaires, also have two levels of training. After the first two years, students graduate to become assistant instructors in the primary schools. The second level, of more advanced training, admits either assistant primary school instructors, with four years of teaching experience, or students who have received the BAC. This advanced-level training also lasts for two years.

There were three secondary schools for technical and professional training prior to the 1979 civil war, two for training in industry and one for training in marketing. In each, there were two levels:

- o An initial three-year program ending in receipt of the Certificat d'aptitude professionnelle (CAP); and
- o As in general secondary education, a second, more specialized program, which for technical students offers concentration in marketing, mechanics, etc., and which ends in receipt of the BAC.

Normally there are two separate tracks of university-level education in Chad--the Ecole normale superieure, and the University of N'Djamena. The Ecole normale superieure, for secondary school teacher-training, offers courses in history, geography, English, French, mathematics, physics and biology. It has a capacity for 200 students, with a permanent staff of 40 instructors.

d. Government

Chad has been independent since 1960. The current government is the third republic. The Conseil de commandement des forces armees du nord (CCFAN) is the only legal political structure; its Secretary General is the President of the country.

The Conseil national consultatif (CNC) is the legislative body. It has 30 members, two representatives from each prefecture and two from the capital city. The 14 prefectures are as follows, with the regional capitals in parentheses: Batha (Ati); Borkou-Ennedi-Tibesti (Faya-Largeau); Biltine (Biltine); Chari-Baguirmi (N'Djamena); Guera (Mongu); Kanem (Mao); Lac (Bol); Logone-Occidental (Moundou); Logone-Oriental (Doba); Mayo-Kebbi (Bongo); Moyen-Chari (Sarh); Ouaddai (Abeche); Salamat (Am-Jiman); and Tandjile (Lai).

The government is composed of the President, 20 Ministries and nine State Secretariats. There are three ministries directly related to agricultural development: The Ministry of Agriculture and Rural Development (MEADR); the Ministry of Livestock and Watering Infrastructure (MEHP) and the Ministry of Tourism, Industry, Water, Forests and Hunting (MTAEFC).

e. Economic indicators

In 1982, the Gross National Product (GNP) was estimated at US\$ 530 million, or US\$ 120 per capita. The greatest contribution to Gross Domestic Product (GDP) normally comes from the rural sector (crops, livestock, fish). This contribution has declined from 70 percent before 1978, to 50.5 percent in 1981. During the same period, total GDP has also declined, from 168.2 billion CFA Francs to 121 billion. This decline can be directly attributed to the effects of the civil war, which intensified over the 1979-81 period.

According to the most recent available data, the external trade situation is that presented in Table 1.

Agricultural products comprise the bulk of exports, of which the largest single item by far is cotton. As seen in Table 1, the trade balance was positive for 1980 and 1981 but went into deficit by FCFA 7,510 in 1982.

f. Rural sector

The arable land in Chad amounts to 16,000,000 ha of which 1,000,000 ha are currently cultivated. The main crops are cotton, sugarcane, millet, sorghum, maize, tubers, and sesame. The livestock products are meat, skins, milk and dairy products.

In 1981, major forest products were firewood, wood for construction, and gum arabic; in 1981 wood production was 8,000 tons. The forested area is estimated at 16,540,000 ha.

Average yearly fresh fish production is estimated at 110,000 tons.

2. Field data analysis: agricultural research

a. Research institutions

There are three agricultural research institutions in Chad, all three of which are considered national institutions:

- (1) Institute of Cotton and Textile Research
(IRCT--L'Institut de recherche du coton et des textiles)

The responsible ministry is the State Ministry of Agricultural and Rural Development (MEADR - Ministère de l'Etat pour l'agriculture et le développement rural). As in many francophone countries, the scope of ICRT's activities is outlined in a memorandum of agreement between France and Chad.

Table 1: External Trade Balance of Chad, 1980-82
(millions FCFA)

	<u>1980</u>	<u>1981</u>	<u>1982</u>
Exports	15,364	22,779	17,833
Imports	<u>12,043</u>	<u>22,708</u>	<u>25,343</u>
Balance	3,321 =====	71 ==	-7,510 =====

Source: Ministère du Plan, 1983

(2) Division of Crop Research (DRA--
la Direction de la recherche agronomique)

The responsible ministry is MEADR.

(3) Veterinary and animal husbandry research
laboratory of Farcha (LABOVET--Le laboratoire de
recherche vétérinaire et zootechnique
de Farcha)

The responsible ministry is the Ministry of Livestock and Watering Infrastructure (MEHP--le Ministère l'élevage et l'hydraulique pastorale). The laboratory has been closed since 1979 because of the civil war.

b. Research programs

Table 2 presents a comparative list of the major agricultural research programs in the three research institutes. The details of each research program are outlined below for each institute.

(1) Institute of Cotton and Textile Research

Research in the following areas is conducted at ICRT:

- o General agronomy--various experiments are conducted at research stations or at regional testing sites;
- o Varietal improvements of seeds, seed selection, reproduction, etc;
- o Entomology, focusing mainly on cotton pests;
- o Phytopathology;
- o Improvement of crop and farming practices in millet, maize, cotton, sorghum, and cowpeas; and
- o Improvement of fertility.

(2) Division of Crop Research

Research at the DRA is conducted in the following categories:

- o Plant improvement and experimentation;
- o Seed reproduction; and
- o Cereal marketing.

Table 2: Agricultural Research Programs in Chad, 1983

<u>Program Type</u>	<u>Name of Institution</u>		
	<u>IRCT</u>	<u>DRA</u>	<u>LABO VET</u>
Food Crops			
Sorghum	X	X	
Millet	X	X	
Maize	X	X	
Rice		X	
Cowpeas	X	X	
Seed Production		X	
Cotton	X		
Forage			X
Plant Protection/Entomology	X		
Phytopathology	X		
Grain Marketing		X	
Animal Health			X
Farming System	X		
Livestock			X

Source: DEVRES/INSAH Agricultural Research Resource Assessment, 1983. See National Report on Chad for more detail.

(3) Veterinary and Animal Husbandry Research
Laboratory at Farcha

LABOVET has two divisions, administration and research. The research section contains the following sub-sections:

- o Bacteriology;
- o Virology;
- o Entomology; and
- o Parasitology.

The virology and bacteriology sub-sectors were responsible for vaccine production and for distribution both within Chad and to such neighboring countries as Cameroon, Gabon, Congo and the Central African Republic. The laboratory has not functioned since 1979.

(4) Other

The Bureau of Studies and Planning is involved in integrating the various rural development programs and contains a data bank of agricultural statistics which can aid these programs. The Bureau contributes to the efforts at defining an agricultural development policy in Chad.

c. Human resources

At the end of 1979, there were 28 researchers working in Chad's three research institutions. The breakdown was as follows:

- o IRCT had three Chadian researchers and five expatriate researchers;
- o DRA also had three Chadian researchers and five expatriate researchers; and
- o LABOVET had two Chadian researchers and ten expatriate researchers.

d. Facilities and equipment

The available information on the facilities and the operation of Chad's research institutions is divided into two sections, one general section concerning infrastructure and equipment and one more specific section on libraries and documentation centers.

(1) Infrastructure and equipment

ICRT's facilities at N'Djamena have buildings in good condition, with adequate office space, laboratories and equipment to conduct their research work in general agronomy.

ICRT's facilities at Bebedjia include a well-equipped laboratory for research in genetics, entomology and phytopathology. In 1983, 40 ha of experimental plots were cultivated at Bebedjia.

The buildings at the Deli Station of the DRA are in need of repair and all facilities such as the seed selection laboratory, garage, and offices, are now out of service. The Deli Station has the use of six other experimental sites, located at Sarh, Kelo, Pala, Moundou, Deba and Koumara.

At the Dougui station, the buildings are in good condition but the offices and laboratories require repair work. Zonal experiment sites have yet to be created. In 1983, 100 ha were cultivated in experimental use.

LABOVET runs a center at Bekamba which has 14 cattle sheds and one dipping tank. All these facilities are in good condition.

(2) Documentation

IRCT possesses well-equipped libraries in N'Djamena and Bebedjia.

Documentation is adequate at the Dougi station of the DRA, but many of the documents at Deli were destroyed during the war.

The library of LABOVET has been closed along with the lab since 1979.

e. Comments

Thanks to the assistance provided by IRCT, Chadian farmers in the Sudanian zone have long been introduced to modern production techniques. This effort has enabled Chad to increase its cotton production, which is the major export crop.

In the South, cotton is often grown in rotation with sorghum, a staple food crop. In the Sahelian zone, which is dominated by a pattern of transhumance, berbere, a sorghum variety with minimal water requirements, is grown and provides the staple food in lean periods. Since 1979, the Sahelian zone has become the center of the civil war, greatly limiting agricultural research in the area.

In early 1979, there were 28 researchers in the Chadian agricultural research institutions--12 at LABOVET, and eight at both IRCT and the DSA. The research stations of IRCT in N'Djamena and Bebedjia are in relatively good condition, but there is an obvious need to repair

facilities and replenish equipment and documentation at both of the DRA's stations. LABOVET has been closed since 1979.

Among the constraints hindering the effective performance³ of the research institutions are the following:

- o Researchers are very few in number, and of the 28 researchers in the three institutes, 20 are expatriates;
- o Existing personnel management policy is not conducive to attracting and retaining qualified researchers and technicians;
- o Operating funds are inadequate, largely because national budget priorities are defense and security needs;
- o Security precautions have reduced research activities to a minimum, especially in the Sahelian zone; and
- o There is insufficient institutional linkage, both between research institutes and between research extension and training.

3. Field data analysis: agricultural training

a. Training institutions

Normally there are five agricultural training institutions in Chad:

(1) Agricultural Technician Training Center (CFTA--
Centre de formation des techniciens agricoles)

The responsible ministry is MEADR.

(2) Agricultural Training College (CETA--
College d'enseignement technique agricole)

The responsible ministry is MEADR.

(3) National School for Technical Agents
(ENATE--Ecole nationale d'agents techniques)

The responsible ministry is MEHP.

(4) Centre for Training Professional Rural Personnel
(CFPCR--Centre de formation et de perfectionnement
des cadres ruraux)

The responsible ministry is MEADR.

- (5) University Institute for Livestock Technicians
(IUTE--Institut universitaire des techniciens
de l'élevage).

The responsible ministry is MEHP.

b. Curricula

The purpose and the courses of each institution of agricultural training are as follows:

(1) Agricultural Technician Training Center

CFTA is located at Doyaba (Sarh) and is dedicated to the training of agricultural works engineers (ITA - Ingénieur des travaux agricoles).

Because of the closure of CETA at Ba-Illa after the events of 1979, CFTA at Doyaba also trains agricultural works managers (CTA - Conducteurs des travaux agricoles) and technical agents (ATA - Agents des techniques agricoles).

The training program for the CTA lasts three years, with both general and technical courses. The technical courses include horticulture, animal husbandry, agricultural engineering, soil conservation, rural economy, and physical education. The general courses are in mathematics, physics, chemistry, French, biology, accounting and general economics. Admission is reserved for BEPC-level students who pass a special entrance examination. The school has the capacity for 60 students.

(2) Agricultural Training College

CETA is located in Ba-Illi and trains lower-level extension agents. The program includes four years of training and practical field work. The courses taught are similar to those of CFTA, but are conducted at a less vigorous level. The school can enroll up to 150 students.

(3) National School for Technical Agents

ENATE trains extension agents in a three-year program. Courses taught are animal husbandry, chemistry, feeds and feeding practices, geography, mathematics, French, anatomy, physiology, microbiology, pathology, pharmacology, parasitology, livestock marketing, meat inspection and administration. Students are admitted at the BEPC-level, after passing a special entrance examination.

(4) Center for Training Professional Rural Personnel

CFPCR has an enrollment capacity of 60 students.

(5) University Institute for Livestock Technician

IUTE trains students who have passed the BAC in a three-year program. The Institut awards a Diplôme d'ingénieur des techniques de l'élevage. It has been unoperational since 1979.

c. Human resources

The personnel for each training institution is indicated below.

(1) CFTA

CFTA has a staff of six administrators, seven full-time professors, six part-time professors and 31 assistants and other staff members.

(2) CETA

CETA has a staff of three CEG professors, five junior instructors, a director and seven other employees.

(3) ENATE

ENATE has a staff of three administrators, one of which is part-time, seven full-time instructors and ten part-time instructors.

(4) IUTE

When operational, the IUTE profited from its close collaboration with the professors of the University, and with the researchers of LABOVET.

d. Facilities and operating funds

The period of civil war, since 1979, has had very serious implications for the operation of Chad's training institutions.

(1) CFTA

The operating budget varies from year to year. An average annual budget is about FCFA 20 million, which covers salaries and most operating costs. The Center's facilities include three classrooms, a 40-hectare farm and a library with a very small number of documents.

(2) CETA

Previously, CETA's facilities included classrooms with a capacity for 150 students. Since the physical structures and equipment were completely destroyed during the 1979 civil war, the students have been temporarily transferred to CFTA in Sarh.

(3) ENATE

ENATE has had no operating budget since 1979. Most of its equipment and library holdings were stolen or destroyed in the 1979 war.

(4) IUTE

IUTE is currently unoperational.

e. Comments

The civil war has greatly disrupted Chad's educational system, particularly in the combat zone. The University has been closed since 1979, as has CETA at Ba-Illi, whose students have been temporarily transferred to CFTA in Sarh. The science faculty at the University of N'Djamena was re-opened in September, 1983, but all of the other departments, including IUTE remain closed.

As of late 1983, the agricultural training institutions employed 67 people, of which 17 were full-time instructors.

The facilities and equipment of most of these institutions, particularly CETA and ENATE, have been stolen or destroyed during the war. Any attempt to strengthen the agricultural training institutions would therefore entail the following:

- o Repairing the buildings, laboratories, and libraries;
- o Furnishing adequate teaching and reference materials;
- o Developing a personnel policy aimed at attracting and retaining qualified instructors;
- o Upgrading the level of training; and
- o Strengthening the links between research and extension institutions.

4. Field data analysis: agricultural extension

a. Extension institutions

There are three agricultural extension institutions in Chad:

- o The National Office of Rural Development (ONDR--Office national du developpement rural), whose responsible ministry is MEADR;
- o The Department of Livestock (DE--Direction de l'élevage), whose responsible ministry is MEHP; and

- o The Department of Water and Fisheries (DEP--Division des eaux et pêches), whose responsible ministry is MTAEFC.

b. Scope of activities

The purpose and principal activities of each of the three extension institutions are outlined below.

(1) National Office of Rural Development

ONDR, which was created in 1965, has its headquarters in N'Djamena. Its activities are divided by ecological zone into two departments. The subdivision of the Sudanian zone, which is based at Moundou, includes the five prefectures of the southern part of the country, which ONDR divides for administrative purposes into nine rural development sections, and 99 sub-sectors.

The sub-division for the Sahelian zone is currently based in N'Djamena because of the civil strife in the North, but should be transferred to Abeche in the future. The Sahelian subdivision includes nine prefectures, administratively divided into seven sectors and 22 subsectors.

The main extension activities in the Sudanian zone are the following:

- o Improvement of crop production practices--seed cultivation, treatment and selection on such crops as sorghum, millet, cotton, groundnuts, rice and, very recently, maize;
- o Introduction of animal traction;
- o Improvement of cotton farming techniques; and
- o Training of small-scale rural tradesmen, such as blacksmiths.

The main activities in the Sahelian zone are the following:

- o Improvement of such crops as millet, sorghum, berbere, and groundnuts;
- o Improvement of livestock practices, for example, by the introduction of animal traction to village groups; and
- o Farmer training conducted in village groups.

(2) Department of Livestock

The DE, in both the Sudanian and the Sahelian zones, is divided into three levels--the circonscription or district level of operation, which is divided into veterinary sectors (zones), which in turn will include a veterinary station (post).

Its major activities are the following:

- o Animal health;
- o Animal production; and
- o Organization and operation of village sanitary groups, aimed at combatting animal diseases.

(3) Department of Water and Fisheries

The principal activities of the DEP are in improving the management of fish production and of forestry resources.

c. Human resources

The composition of the staff at each of the extension institutions is the following:

(1) ONDR

The staff at ONDR's headquarters is composed of two agronomists, three agricultural economists, five generalists, 34 administrators and four other staff members. In the subdivision of the Sudanian zone, there are 73 employees at Moundou, 31 of which are generalists. ONDR also employs 99 members of staff at the sector level, 136 in the subsector level and 955 in the villages. There are 14 additional assistants for the Sudanian zone. In the Sahelian zone, there are 14 staff members at headquarters, 30 at the sector level, 20 at the subsector level and 155 in the villages.

The proposals regarding further training at ONDR specify the need for the following personnel: eight staff members at the level of BAC plus five years additional training (ingenieurs agronomes), thirteen at the level of BAC plus three years additional training (ingenieurs de techniques), 25 at the level of BEPC plus three years (conducteurs de travaux), and 50 who have received the BEPC.

(2) DE

The senior-level personnel of the DE are assigned throughout the country as follows: two veterinarians and three livestock ingenieurs in the Sudanian zone; and six veterinarians and seven livestock ingenieurs in the Sahelian zone.

The personnel requirements of the DE are for 18 staff members at a level of BAC plus five years, 12 at the level of BAC plus three years, 54 at the level of BEPC plus four years, and 261 at the level of BEPC plus three years additional training.

The DE plans to train 400 extension agents in the next ten years.

(3) DEP

The staff of DEP consists of one ingenieur for water and forests, three ingenieurs for forestry and one technician.

In the next ten years, DEP plans to train 40 people in the fisheries division, of which ten will be high-level staff and 30 will be technicians.

d. Facilities and operating funds

The recent budgets for the three extension institutions are as follows:

(1) ONDR

In the Sudanian zone, the average annual budget for the last three years has been FCFA 210 million for investment and FCFA 600 million FCFA for the operating budget.

In addition, the cotton program has a budget of FCFA three billion. No separate allotments exist for operations at the headquarters or in the Sahelian zone; these are maintained through the budget of the Sudanian zone.

(2) DE

In 1981, the budget for the DE was FCFA 195,033,000.

(3) DEP

DEP has not had an operating budget since 1979.

e. Comments

ONDR is the major extension institution in Chad, with the purpose of assisting farmers in adopting improved crop production techniques. Most of the activities are carried out in the Sudanian zone, where about 1300 of its 1600 employees are assigned. Because of the civil war, there are very limited extension activities in the Sahelian zone.

Consequently, most of the 200 employees assigned to the Sahelian zone are currently based at the headquarters in NDjamena.

Approximately 1100 of ONDR's agents have not been trained to the level of BEPC; only 5 percent of the staff have an educational background greater than or equal to the "BAC+4 years" level. The rest of ONDR's extension agents have reached the "BAC+2 years" or BEPC level, with the majority in the latter category.

The DE has 345 employees. As with ONDR, most of these agents are now assigned to the Sudanian zone.

DEP has only five employees to implement their country-wide mandate of improving the management of fishery and forestry resources. The DEP has not had an operating budget since 1977.

Some of the major problems for Chad's extension network are the following:

- o Lack of adequately-trained personnel;
- o Insufficient operating budget;
- o Lack of re-training program for extension agents;
- o Weak linkage between extension and research institutions, which is aggravated by the closure of LABOVET;
- o Overload of work and responsibility for current extension agents, who must direct marketing activities, central warehouse stocks, etc.;
- o Lack of such basic infrastructure as offices, warehouses, etc.;
- o Inadequate documentation and data; and
- o Suspension of such valuable programs as ORSTOM's research on Acacia Albida.

5. Constraints to increased productivity

Internal conflict has existed in Chad for the past 20 years, but these conflicts were greatly intensified during the 1979-81 period. The fighting has disrupted all aspects of normal life, including the destruction of much of the research, training and extension infrastructure.

a. Technical constraints

Given this background, the following are the major technical constraints affecting productivity:

- o Poor quality seeds;
- o Prevalence of pests and diseases, including such parasitic weeds as striga;
- o Low literacy level of the population in general;
- o Lack of rainfall, especially in the Sahel zone;
- o Poor soil;
- o Seasonal labor shortage;

- o Shortage of animal feed;
- o Lack of drinking water for animals;
- o Increasing demand for fuel wood;
- o Poor transportation network; and
- o Lack of statistical data.

b. Institutional constraints

Important institutional constraints include the following:

- o Social disruption due to the civil war;
- o Inadequate infrastructure, equipment and documents;
- o Closure of schools, research stations and extension facilities in the Sahelian zone;
- o Closure or reduction in activity of those stores serving as sources of supplies;
- o Insufficient finance and staff for research and development activities, due to the priority allocation of funds to security and defense needs;
- o Frequency of forest fires;
- o Poor working conditions and a lack of any performance standard or reward for work well done;
- o Unavailability and high costs of production inputs;
- o Low prices for agricultural products;
- o Lack of institutional linkages; and
- o Lack of resource conservation.

6. Outline of solutions and priority actions

The following policies and projects are proposed as a means of combatting some of the above constraints:

a. Agricultural production

In the area of agricultural production, the suggestions are as follows:

- o Developing crop production in the river valley of Ouaddis;

- o Furnishing high-quality seeds;
- o Studying product prices and marketing channels for agricultural products;
- o Providing agricultural credit;
- o Improving the extension services for crop production;
- o Improving the lowland flood areas for berbere production by the construction of small dams;
- o Developing irrigated land for vegetable and food crop production;
- o Developing a crop protection program; and
- o Surveying the rice-producing lowlands.

b. Animal production

Suggestions for improving animal production are the following:

- o Increased training of extension agents;
- o Studying the diseases attacking small ruminants and chickens;
- o Donation of the necessary materials and facilities for extension work;
- o Creation of a hatchery for eventual distribution of chicks to farmers;
- o Reactivation of the cheese production unit;
- o Organization of an animal health protection unit in the Sudanian zone;
- o Creation of artificial lakes and watering points;
- o Genetic improvement of the Zebu breed of cattle;
- o Continuing a research program to fight typanosamiasis;
- o Strengthening and creating livestock-raising centers, especially for herder training; and
- o Improving the management of the milk collection network in N'Djamena.

c. Agro-forestry production

Suggestions for the improvement of production in agro-forestry are the following:

- o Improving the extension system by reorganizing the responsible department, improving the working conditions of extension agents, upgrading the training level of agents, and creating a research unit;
- o Conducting research on alternative sources of energy, such as biogas, butogas, solar energy, etc;
- o Attempting to find varieties of trees with quick growth rates and high yields; and
- o Expanding the use of improved stoves.

d. Fish production

The suggestions concerning the sector of fish production are the following:

- o Investigating the possibilities of increased production by studying the migration habits of commercial species and by determining the most favorable zone for reproduction;
- o Intensifying the provision of extension services;
- o Retraining extension personnel;
- o Training high-level researchers;
- o Strengthening documentation resources and exchange of information; and
- o Collecting socioeconomic data on fish production and consumption sectors.

7. Conclusions and recommendations

Based on the information generated herein, the following representation emerges of recent conditions in rural Chad.

Civil strife has existed within Chad for the past 20 years, but the conflict intensified during the 1979-81 period and disrupted all aspects of life. As a consequence of the war, property has been destroyed and managerial skills have been severely reduced, hampering the implementation of agricultural research as well as more broadly-based development programs.

With assistance from international research institutions, particularly the Institute of Cotton and Textile Research, Chad was traditionally able to produce a substantial volume of cotton for export. Cotton was grown in the Sudanian zone, while livestock production was primarily in the Sahelian zone. At the moment, some research and training facilities have had to close because of the war,

and even those institutions which have remained open must conduct their activities in a limited area.

The contribution of the rural sector (crops, livestock, and fisheries) to GDP has declined from 70 percent in 1978 to 50 percent in 1981. During the same period, GDP declined from FCFA 168 to 121 billion. Although a rural reconstruction effort is underway with the assistance of several bilateral and multilateral organizations, the priority of the Chadian government remains in the maintenance of national security and defense.

In addition to the consequences of the war, there are numerous technical and institutional constraints hampering the productivity of the crop, livestock, fishing and forestry sectors. From the broad observations above, and the more specific information presented in the text, the following recommendations are presented, with the aim of reducing these constraints.

a. Field research

Both of Chad's research institutions, the Institute of Cotton and Textile Research and the Division of Crop Research, should be reactivated and made to emphasize field research by means of both mini-station and on-farm trials. A multi-disciplinary team approach must be employed in this task, to achieve a balance between a streamlined farming systems information-gathering mechanism, an appropriate method for testing varietal and agronomic technologies, and an extension/demonstration mechanism whereby agents introduce new technologies to the farmers' fields. The major benefits of this approach are as follows:

- o Promotes farmer participation in the development and testing of inputs such as seeds, fertilizers, pesticides and animal traction equipment;
- o Facilitates better identification of the main factors behind the lower yields for farmers than those achieved in research stations;
- o Enables on-going modification of research methods and objectives;
- o Promotes farm-level adoption of new technologies by ensuring that their components (seed selection, planting dates, techniques of seeding, weeding, thinning, fertilization and replanting) are as location and enterprise-specific as possible;
- o Enhances the effectiveness of field-level interaction between farmers, extension agents and researchers; and
- o Promotes improved decision-making and judicious resource use, both at the local and higher administrative levels, by accumulating data for policy makers.

b. Improvement of incentives

Greater effort should be made to improve incentives at various levels:

- o Farmers should be given a competitive price for their products. Such action implies an improved understanding of the relevant costs of production, and a greater reliance on both autonomous local cooperatives and improved private trade structures for input and product marketing; and
- o A new personnel-management policy is needed to improve working conditions at all institutions. Competitive salaries and other benefits must be offered in order to attract and retain qualified researchers, teachers and extension agents. The focus of the policy should be to institute accountability, reward, and penalty systems that are based on a clear set of performance standards.

c. Other recommendations

Additional recommendations for increasing the food supply in Chad are as follows:

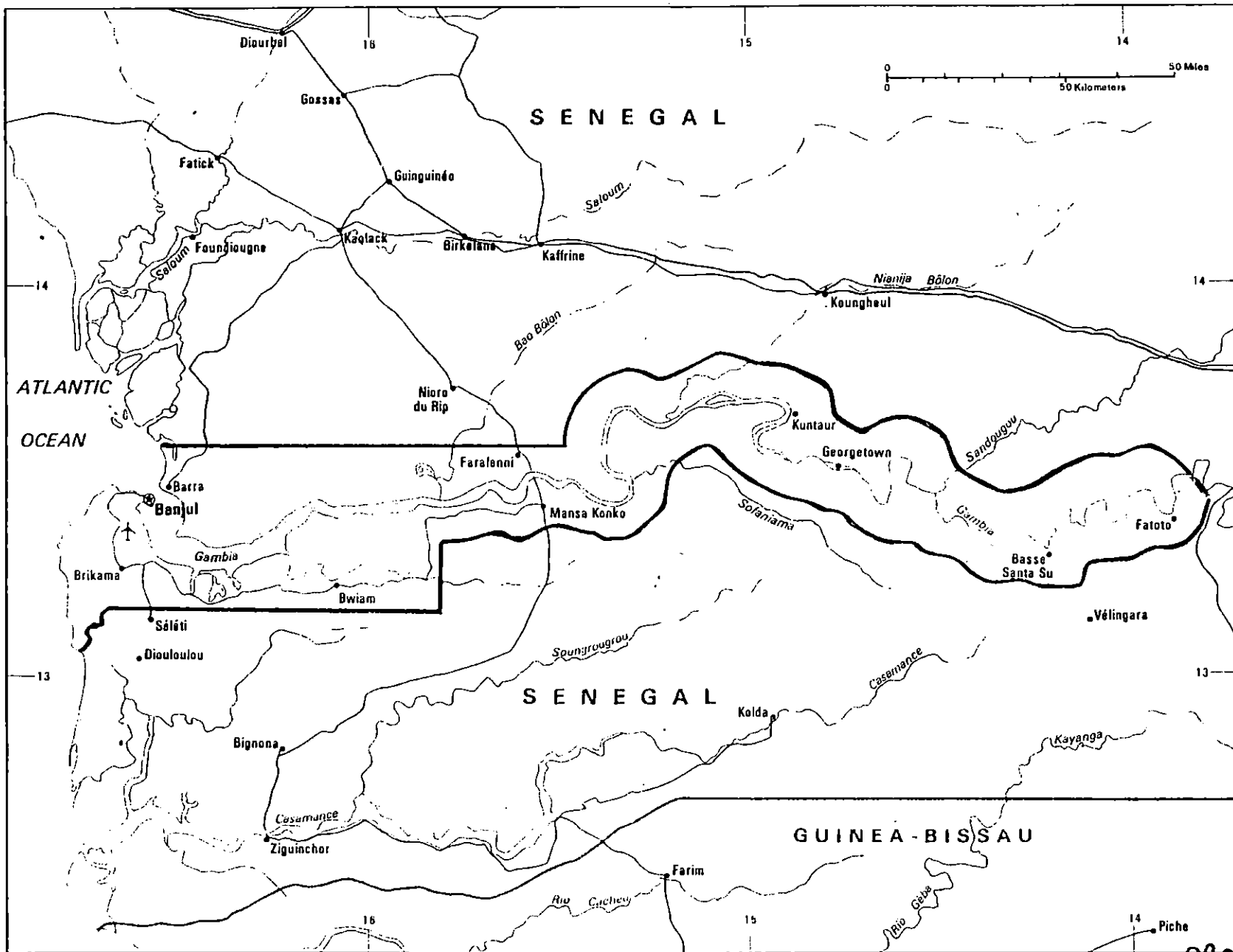
- o Choosing priority crops such as millet, sorghum, and berbere, specific farming systems, for intensive research and extension activities;
- o Selecting and breeding local varieties of millet and sorghum for the desired characteristics in yield, resistance, taste, etc. for use in both the Sahelian and Sudanian zones. Chad is well-endowed with good crop conditions, especially in the southern-most part of the country;
- o Based on information gained from on-farm studies, the production of cash crops for both local and export markets should be encouraged. Where credit is needed, a farm budget must be developed to reflect the repayment capacity of the farming households. Action on income-generating activities must take into consideration the means of mobilizing savings in the rural areas and the development of cost/benefit analysis on the most promising rural small-scale enterprises;
- o Searching for viable options to correct the imbalance between the livestock population and the available pasture land;
- o Improving rural grain storage facilities in order to minimize seasonal hunger and storage loss;

- o Investigating marketing strategies to improve the profitability of small-scale fishing. Both curing by chemical treatment and improved coordination of fishing, processing and marketing activities are needed to reduce the current level of spoilage in the marketing process;
- o Improving collaboration between the research institutions and between the research, training and extension institutions;
- o Organizing periodic meetings for the staff of agricultural institutions to exchange information, and establishing joint institutional appointments;
- o Promoting interaction between Chadian researchers and those from neighboring countries on a network of shared projects; and
- o Upgrading the major agricultural institutions in Chad, which would entail reactivating research, training, and extension programs, reconstructing damaged buildings, laboratories, libraries, etc, and replenishing centers of documentation and laboratories.

d. Selected proposals.

The following are suggestions taken from the country report and from the preceding lists of sectoral recommendations. They are included in this concluding section as they merit priority consideration:

- o Developing a crop protection program;
- o Developing a center for the selection, testing, and reproduction of seeds of major crops;
- o Strengthening research on the diseases attacking small ruminants and poultry;
- o Improving the genetic characteristics of the Zebu Arabe breed of the cattle;
- o Strengthening cooperative research efforts against trypanosomiasis;
- o Furnishing essential documents to the teaching and research institutions;
- o Experimenting with varieties to improve growth rates and yields; and
- o Expanding the use of improved stoves.



502717 9-77 (542121)
 Lambert Conformal Projection
 Standard parallels 8° and 32°
 Scale 1:1,600,000

Figure 4: Map of The Gambia

- Railroad
- Road
- ✈ Airport

C. The Gambia

1. General information on The Gambia¹

a. Geography

The Gambia forms a narrow band on either side of the river Gambia, running for about 500 km into the Republic of Senegal. The area is 10,690 km², of which about 20 percent is the river and its tributaries and swamps. In the lowest part of the valley there are marshes, flat zones which have been or are still flood plains. The colluvial slopes, covered by deposits from the erosion of the plateau, rise up above the marshes; the slopes run up to the plateau, which has an elevation of 40 to 50 m above the river. The soil types are a function of the configuration of the land; there are fine textured clays, clayey silts, and silty clays in the marshes. On the colluvial slopes there are sandy soils, 20 to 50 cm deep, underlain by a finer textured material. The plateau is covered by shallow soils of coarse to medium texture on a laterite base. The river is tidal throughout its length in The Gambia and the salt tongue reaches 150 km up the river during the rainy season and 250 km in the dry season. This factor is a serious constraint to the use of the marshes for farming. The major part of the marshy area has mangrove soils, which oxidize rapidly when dry and then become so acidic that they cannot be cultivated. For this reason the mangrove soils have to be kept flooded, with salt water if there is not a supply of fresh water. They have to be leached free from salt each season before they can be cropped.

With an average annual rainfall of 800 to 1400 mm, the climate is principally Sudano-sahelian, with a small area in the extreme southwest that is Sudano-guinean. The rainy season is intense and lasts four to five months, and the dry season is long. The rainfall is extremely variable. The maximum temperature ranges between 41.6°C and 45.0°C and the minimum from 5.0°C to 9.4°C. The diurnal temperature range is quite large in the east, but it is moderated in the west close to the Atlantic Ocean.

b. Demography

The population was estimated at 695,686 in the 1983 census; the annual rate of growth of the population is 2.0 percent, with an outmigration of 0.8 percent. The migration seems to be declining, particularly from the rural zones. The population is 70 percent rural. Of the urban population, nearly 60 percent live in Banjul and Kombo St. Mary, which is nearby.

¹The introduction is based upon the National Report by Sompo-Ceesay and the USAID Gambia CDSS, FY 1984.

The Mandinka are the dominant ethnic group (42.3 percent), followed by the Fulani (18.2 percent) and the Wolof (15.7 percent). The dominant religion is Islam (80-90 percent); the rest of the population are mostly Christian.

c. Education

There are about 50,000 students in the primary schools, of whom one third are girls; the proportion of girls is rising. There are 10,000 students in the secondary schools, with two-thirds in the technical schools and one-third in the academic high school (lycée). Almost 31 percent of these secondary students are girls. Apart from Gambia College, which has been closed, there is no university-level training in The Gambia.

d. Government

The Gambia is a multi-party democracy modelled on the British system. There are three parties: The Peoples' Progressive Party (in power); the National Convention Party (in opposition); and the United Party (not represented in parliament).

The three main branches of government are the Executive, the Legislative, and the Judiciary. There are fourteen ministries, amongst which the Ministry of Agriculture, the Ministry of Water Resources and the Environment, the Ministry of Education, Youth, Sport and Culture, and the Ministry of Local Government and Lands are directly involved in the agricultural sector, training, etc. The Ministry of Agriculture is responsible for agricultural administration, research, development and extension, livestock development and research, crop protection, and the agricultural census. The Ministry of Water Resources and the Environment is responsible for research and development of these resources, hydrological services, the Gambia River Basin Commission (OMVG), fisheries, forestry, and the natural flora and fauna. The Ministry of Education, Youth, Sport and Culture is responsible for education, libraries, and vocational and technical schools. The Ministry of Local Government and Lands is responsible for the area councils, state lands, land tenure, land development, etc.

The transport system is relatively well developed except that there is no bridge across the river in The Gambia; it is just about to be built. Banjul has an excellent port and barges can be used for river transport practically for the whole length of the river in The Gambia.

e. Economic indicators

The per capita GDP in 1982-1983 was Dalasis 749 (or US\$ 310)¹, which is an increase of 20 percent in relation to that of 1980-1981, or a real increase of 9.6 percent.

¹(US\$ 1.00 = 2.42 Dalasi, 11/83)

The development policy is written into the five-year plans (1976-1981 and 1982-1987). Twenty-five percent of the budget for development is allocated to the agricultural sector. The plan initiated a "comprehensive and intensive development effort aimed at transformation of the Gambian economy from a very low level of output and income mainly dependant on the export of groundnuts, with the consequent vulnerability" to price changes on the world market, "to a diversified economy, progressively self-reliant, and capable of sustained economic and social progress through the development of its own human and material resources." However, the economic situation is serious, and a provisional accord has been reached with the International Monetary Fund (IMF) in an attempt to remedy it. In the first five-year plan, GDP at constant prices increased by 1.7 percent a year, while the population increased by 2.8 percent a year, representing a per capita decline of 1.1 percent. The situation was made worse by a decline in the rate of growth of agriculture of -6 percent, reducing the supply of peanuts for export. In 1982 and 1983 the world peanut price collapsed, but by the end of 1983 it had recovered. Meanwhile, there was a 5 percent rate of growth in the value of imports. In addition, the two sectors which have contributed the most to the growth of the GDP are construction (increasing 75 percent in six years) and the civil service (increasing slightly over 100 percent). This phenomenon has had unfavorable effects on the balance of payments and on the current account, both of which were in the red. In 1980-81, the current expenses exceeded current receipts, giving a negative balance on the current account. During 1976-81, the deficit of the overall balance was only held down by substantial transfers from the peanut account of the Gambia Produce Marketing Board (GPMB). With the subsequent large decline in the world peanut prices this was not possible in 1981-82 and 1982-83.

The terms of trade had deteriorated by 45 percent from 1976 to 1982 with a fall of about 50 percent in the world price of peanut oil. However, in the latter half of 1983, the peanut price recovered its 1980-81 level. Meanwhile, the inflation rate in The Gambia was reduced by 75 percent and has been stabilized at an annual rate of 6.8 percent, accompanied by a strengthening of the dalasi. The government accomplished this by price controls and restrictions on the increase of salaries.

To improve the economic situation, in conformity with the advice (or the conditions) of the IMF, and to get a standby loan agreement, the Gambian government restricted current expenses and attempted to restore the balance of payments. However, the 10 percent decline in peanut exports in 1980 and the reduction in the Export Price Stabilization (STABEX) payments prevented any improvement in the balance of payments. The 1981 peanut production was 129 percent greater than in 1980, and the 1982 production was 40 percent greater than that of 1981.

The depreciation of the dalasi made the situation even worse and caused an increase in the inflation rate. The combination of factors caused a deterioration in the terms of trade. The value of the dalasi

has now recovered. However, the deficit in the balance of trade, although reduced, still continues.

The annual cost of servicing the public debt has increased considerably. The money borrowed during the first five-year plan (1974-1980) was in US dollars. The US dollar had greatly increased in value after the loans were spent but before they were repaid. In 1980-1981, the interest was D1.6 million and the principal D0.3 million; in 1981-1982 this became D4.2 and D1.4 million, respectively. In 1982-1983 it was D6.3 and D8.3 million, and in 1983-1984 the total is estimated at D21.0 million.

It is probable that a combination dam and bridge project on the Gambia River will be started in about 1985; in the short term this will put financial pressure on the Government of The Gambia (GOTG). This, together with the public deficit, has obliged the GOTG to reduce by 20 percent the D131 million agricultural investment budget in the second plan. The objective in the plan is a 35 percent increase in agricultural production over the five years. The 2.8 percent annual growth rate in the population requires an increase of 18 percent in production just to maintain the production per capita. For this reason, the sector should at least increase its production enough to maintain a slight lead over the increase in population.

A summary of foreign aid to the Gambia for the years 1980-1984, including both technical assistance and food aid, is provided in Table 3, on the following page.

f. Rural sector

About 78 percent of the population is rural, living on some 45,000 farms, with an average of 12 residents per farm. An average of six hectares per family is cultivated by hand, using a bush-fallow (shifting cultivation) rotation. The use of modern inputs such as animal traction, fertilizers, and chemicals is not very widespread.

The traditional land tenure system still exists in most of The Gambia. Some land is acquired by the state for public use and the dispossessed families are paid an indemnity.

Agricultural credit is provided through the agricultural cooperatives and the Agricultural Development Bank. The credit consists partly of subsistence credit to buy needed inputs and food during the farming season and is repaid at harvest time. There is also production credit which is used to buy traction animals and machinery and has to be repaid over three years.

About 40 percent of the rural families own cattle. In the west, where the incidence of trypanosomiasis is high, the cattle are of the small, taurin N'Dama breed. In the east, where trypanosomiasis is less prevalent, the large cross-bred (taurin crossed with zebu or metis) cattle are common. Consumption of milk is important in rural areas, but the milk is not collected for industrial processing in the

Table 3: Foreign Aid

<u>Financial Aid</u> (millions of dalasis)	<u>Fiscal Year</u>			
	<u>1980-81</u>	<u>1981-82</u>	<u>1982-83</u>	<u>1983-84</u>
Technical Assistance	NA ^a	NA	22.5	23.5
Grants	NA	NA	36.0	40.0
<u>Food Aid</u> (tons)				
Rice	2000	1010	6659	NA
Sorghum	8000	1230	900	NA
Maize	0	2600	0	NA
Wheat/Flour	1386	1074	2939	NA
Beans	<u>0</u>	<u>0</u>	<u>100</u>	<u>NA</u>
Total Food Aid	<u>10,000</u>	<u>4840</u>	<u>7659</u>	<u>-</u>

^aNA = Not available.

Source: DEVRES/INSAH Agricultural Research Resource Assessment, 1983. See National Report on The Gambia for more detail.

towns. The offtake rate for cattle is estimated at 6 percent a year, which is low for the region. Ownership of sheep and goats is even more widespread as ruminants provide a form of easily realizable savings.

Poultry production is carried out in the traditional system, except for a few "modern" egg and broiler production units, which use improved techniques for the urban market.

The production of pork is of minor importance, as 90 percent of the population is Moslem and eats no pork. The major part of that which is produced is consumed in the large urban centers.

Fishing is an important small-scale activity, especially in the lower river region and, to a lesser extent, along the Atlantic coast. There is also a small amount of industrial fishing with commercial processing plants. One of the companies processes shrimp caught by small-scale fishermen.

The demand for firewood and timber is satisfied by cutting trees in the woodland and on the savannah. Some is removed from the government forests. The local resources are becoming increasingly unable to meet the domestic demand.

The GPMB has had a monopoly in buying, assembling, processing and exporting peanuts and peanut products for a long time. Up to 1981-82 it had been profitable and the surplus was used for the development of agriculture. The GPMB also has a monopoly in buying and milling rice, as well as the importation of rice to meet the domestic deficit (between a half and two-thirds of the total supply is imported). The GPMB also buys and gins cotton.

The Livestock Marketing Board (LMB) has a statutory monopoly in the marketing of livestock. However, for various reasons, including the lack of capital, almost 80 percent of the stock is marketed by private merchants. Fish is marketed by the private sector.

The agricultural sector is the responsibility of the Ministry of Agriculture and the Ministry of Water Resources and the Environment. The state provides limited amounts of agricultural inputs--seed, 5,000-6,000 tons of fertilizer per year, agricultural chemicals, and drugs for livestock.

2. Field data analysis: agricultural research

a. Research institutions

Agricultural and livestock research is the responsibility of the Ministry of Agriculture which is also responsible for production. The integrated pest management program will initiate a program of trials nationwide. Fisheries and agro-forestry research are done in the Ministry of Water Resources and the Environment. In practice, except for agriculture itself, the rest of the research system is only embryonic.

b. Research programs

(1) Crop research programs

The agricultural research service is principally involved in projects associated with the agricultural development projects. There are two general-purpose stations, one in the west, Yundum, and one in the east, Sapu. The research comprises six programs, outlined below and compared in terms of personnel in Table 4, on the following page.

(a) Uplands crops improvement

This program was initiated in 1977 as part of the coordinated Rural Development Project funded from local sources and the UK in association with IBRD. The program has five activities:

- o Screening and selecting varieties under Gambian conditions;
- o Improvement of cereals and cowpeas (INSAH/EDF);
- o Improvement of peanuts (local funding);
- o Trials of maize and cowpea varieties (coordinated by SAFGRAD, locally financed); and
- o Production of foundation seeds of selected varieties for multiplication and diffusion to farmers by the seed multiplication program.

This program is staffed by one principal agronomist and four technicians. A plant breeder will arrive in December and another is in training.

(b) Agronomy and Farming Systems Research (FSR) program of upland crops

Like the upland crops improvement, this program was initiated in 1977 with the same sources of funds. It includes four activities:

- o Time of planting and cropping systems;
- o Soil fertility and fertilizer use efficiency;
- o Rotations and water management studies; and
- o Farm management.

This program has links with SAFGRAD (cropping systems), IFDC (fertilizer), ICRISAT, IITA (agronomy) and FAO. There are also links with the Department of Water Resources and AGRHYMET in relation to climatology. There are four researchers in this program: three are

Table 4: Research Program Personnel

	<u>Researchers</u>	<u>Technicians</u>
Upland crops improvement	2	4
Agronomy and farming systems research of uplands crops	4	10
Farm mechanization	1	5
Horticultural research	1	7
Rice research	2	10
Mixed farming systems research	12	40
	—	—
<u>TOTAL</u>	<u>22</u>	<u>76</u>

Source: DEVRES/INSAH Agricultural Research Resource Assessment,
1983. See National Report on The Gambia for more detail.

agronomists and the fourth is an expatriate agricultural production economist. There are ten technicians. Staff currently in training is expected to join this program.

(c) Farm mechanization

This program is designed to identify machinery suitable for operations which have not yet been mechanized. There are five major activities:

- o Development of a ridge planter and ridging attachments;
- o Development of an improved harness for animals in traction;
- o Development of processing equipment;
- o Use of draft animals in rice cultivation; and
- o Improvement of village-level crop storage systems.

This program has links with IDRC, Dakar, the Intermediate Technology Research and Development Group of the Commonwealth Secretariat, and the Engineering Faculty at Fourah Bay College, Sierra Leone. The program is staffed by one research officer, two senior technicians and three junior technicians (mechanics).

(d) Horticulture

This is a locally-financed program with the objectives of developing adequate production packages for the major horticultural crops, local and exotic, and helping farmers increase the productivity of their horticultural crops. There are four activities:

- o Varietal screening and selection;
- o Cultural agronomy (production practices);
- o Irrigation and water use; and
- o Agronomy of root and tuber crops (mainly cassava and sweet potatoes).

This program has links with the Asian Vegetable Research and Development Center (AVRDC) (vegetables and sweet potatoes) and with IITA (cassava and sweet potatoes). Currently the program is staffed by one agronomist and seven technicians.

(e) Rice research

This program is studying the problems of growing rice in the five ecosystems of The Gambia: uplands, hydro-morphic (Bantajaro), deep flooded swamps, mangrove swamps, and irrigated. There are two activities:

- o Screening and selection of high-yielding adapted varieties; and
- o Development of adequate methods of production and technological packages for the different ecosystems.

This program uses the data from the farm management studies in the design of experiments for crop production practices. The varietal improvement component of the program receives funding from WARDA, with which it is closely linked. There are currently two agronomists and ten technicians working on the program.

(2) Research on animal health and livestock production

The Department of Animal Health and Production was created in 1975, following the merger of the Animal Production Unit of the Department of Agriculture and the Veterinary Department. It has a mandate to carry out research on all problems related to animal health, animal production and development.

Currently it has only one major research program with funding from USAID and the state as part of the Mixed Farming and Resources Management Program. The major objective of this program is to improve farm income through the provision of an adequate year-round supply of forage. The program has four activities:

- o Range ecology and range management;
- o Maize agronomy;
- o Forage agronomy; and
- o Socioeconomic surveys of livestock production systems.

There are six expatriate and six Gambian researchers, 40 technicians, and 12 support staff. The program has linkages with the Agricultural Research Service and with the agricultural and livestock research program in Senegal and also in Northern Nigeria (at the Samaru Station, Ahmadu Bello University--ABU). The program is based at Abuko, the headquarters of the department. Three IBM PCs have been ordered for data processing.

Unfortunately the GOTG has had difficulty in meeting its financial obligations to the program, which has slowed program development. The staff explains that there is a lack of incentives to stay on the job.

It is clear that a livestock research program which only involves mixed farming is not sufficient to satisfy the needs of the sector. Research on diseases and parasites (e.g. ticks and tsetse flies) are needed but the resources are lacking.

(3) Fisheries and forestry

The departments of fisheries and forestry are currently working on developing their respective research divisions but they lack the human and material resources necessary to undertake any research.

c. Human resources

There are currently 46 staff members of the Agricultural Research Service, of whom ten are researchers and 36 are technicians working in the two stations.

Seven students are now in training and can be expected to join the research service (agronomy and FSR), provided funding is available. Researchers continue academically to the M.Sc. level with in-service training in an IARC (e.g. ICRISAT, IITA or IRRI). Technicians receive on-the-job training and, as opportunities arise, are sent to an IARC for a short course.

d. Facilities and operating funds

There is no truly "national" research center. The two stations, Sapu and Yundum, are multi-purpose agricultural stations which lack adequate crop-drying and storage facilities, suitable cold storage to house the national germ plasm collection, and irrigation facilities in the upland area for the crop improvement program.

The support services, such as supply of fuel and spare parts and postal and telephone service for Sapu, are inadequate, and an efficient system for ordering and obtaining supplies does not exist. There is also a lack of housing for the research personnel.

Although the programs are well-conceived, the extreme lack of resources and labor are constraints to the resolution of serious agricultural problems. Varietal trials have been relatively successful with rice, but not so for millet and sorghum. The lack of irrigation equipment has considerably reduced production. Research on fruit production is practically nonexistent.

Both senior and junior scientists indicate that the research service does not have enough personnel and equipment to fulfill its role. The junior staff feels that they have not received adequate training and have not been given sufficient opportunity for in-service training.

e. Comments

The Gambia should clearly continue to have applied research programs associated with development projects (e.g. the Mixed Farming and the Rural Development Projects). Farming systems research, integrated into the Development Project, is also appropriate. The farm level trials provide data on the local adaptation of methods of production, new varieties, etc. Station

research on methods of production and trials of new varieties should be undertaken, together with research on the suitability of farm machinery under local conditions. Trials in the Integrated Pest Management (IPM) program are being initiated. A selection program for peanuts is highly recommended but a large breeding program could monopolize most of the limited resources of the Research Service.

In livestock research, a similar FSR approach is operational. Formerly, the UK financed research on trypanosomiasis and the trypano-tolerance of cattle. There is a diagnostic laboratory and a division of animal health and production. The staff occasionally visits the National Livestock and Veterinary Research Laboratory (LNERV) in Dakar where they obtain diagnoses and information on treatments.

It would also be appropriate to create small research groups in the Ministries of Agriculture and of Water Resources and Environment to study the planning and policy aspects of the programs. These groups should be integrated with the planning, programming and evaluation groups which are directly responsible to their permanent secretariats.

Some applied research on the local environment, ecology, forestry and fisheries is also necessary. This applied research and the personnel involved in it play a crucial role in the support of the extension programs by providing a flow of tested new technologies. In reality, however, the GOTG is not always able to meet its part of the cost of projects, which causes the projects to fall behind schedule.

Improved varieties of rice have been identified and passed on to the extension service. New varieties of peanuts resistant to rosette, leafspot and rust are needed. They are being sought in research from Senegal to Chad as well in some of the coastal countries (Cameroon and Nigeria). It is doubtful that the resources available in The Gambia could contribute greatly to this research. Nonetheless, The Gambia should participate actively in any regional program or network on peanut production, including a program of trials.

Some of the key weaknesses of the Gambian research programs are principally attributable to a lack of qualified personnel and a lack of funds allocated by the state or provided by donors, which are essential for obtaining the necessary infrastructure and for developing the programs. The agronomy and FSR program, for example, has four research workers and ten technicians, and all the other agricultural programs have six researchers and twenty-six technicians.

Apart from the Mixed Farming and Resource Management project, there is no research on livestock production, and in fisheries, forestry and environment, there are proposed programs which have no funding.

3. Field data analysis: agricultural training

Agricultural personnel are trained in two institutions, the Gambia College and the Livestock Training School.

a. Gambia College

The Gambia College was established in 1975 as an independent institution to train staff for the education, health and agricultural sectors. The College is under the joint sponsorship of the Ministries of Education, Health, and Agriculture, which provide most of its funds. There are four schools: Education, Public Health, Nursing, and Agriculture.

In agriculture a certificate is awarded after completion of three years of study. Twenty-five students, who have passed two GCE "O" level examinations, or the college entrance exams, are admitted each year. Ninety percent of the students are of rural origin.

The activities of the college, which were suspended two years ago after student unrest, have been restored for the 1984/85 academic year and the School of Agriculture at the college is expected to re-open for the 1985-86 academic year.

The college has suitable buildings and equipment and is in good condition, being only eight years old. Only the principal and support staff are in place. Recruitment of an instruction staff of seven is planned. Their conditions of service will be the same as for the civil service.

The principal indicated that there were not enough funds to effectively run the school. He noted a lack of trained teaching staff, both senior and junior, insufficient teaching equipment (audio-visual and laboratory), and a lack of transport to take the students to practical classes in the field. The college also lacked the land and equipment for any research by the staff.

Although research results are incorporated into the teaching program, the linkage is currently very weak. The linkages with extension are stronger because the graduates are recruited by the extension service and the college offers in-service and refresher courses for extension personnel.

b. Livestock Training School

The Livestock Training School is run by the Department of Animal Health and Production. The school annually admits up to 35 students who have passed the GCE "O" level examination. A Certificate in Livestock Production is awarded after passing the one-year course. 70 percent of the students are of rural origin. The school is entirely funded by the state and graduating students are employed by the Department of Animal Health and Production.

The buildings are in very good condition and the laboratory is in fairly good condition and is fairly well-equipped. The school also uses the Animal Health Diagnostic Laboratory and the slaughterhouse. The library is small. There are currently 27 students.

The school has one full-time training officer who directs and manages the school. He is supported by ten part-time teachers, all employees of the Department. It has been proposed to merge the school with the Gambia College.

The school budget and personnel are not sufficient to satisfy most needs. There is not enough classroom and teaching laboratory space. There is a lack of books, documents and teaching aids.

There is clearly a close linkage with research (i.e., in the Mixed Farming Project) and with extension, because the part-time staff work on the project as research or extension workers. The school also offers three-month, in-service training courses for livestock extension workers.

c. Comments

There is a demonstrated need for upgrading the agricultural training institutions in The Gambia. With the reopening of the Gambia College, the good facilities, combined with a newly-recruited staff, can lead to a more practical curriculum linking research results and extension. Additionally, there is a proposal to merge the Livestock Training School with the Gambia College. This should be done as soon as possible but the college will require additional human and physical resources to handle the expanded program.

4. Field data analysis: agricultural extension

The extension services are the responsibility of the Department of Agriculture, the Department of Animal Health and Production, the Department of Fisheries and the Crop Protection Service. The country is divided into two regions (east and west) and has five main stations (sub-regions). There are 25 district-level mixed farming centers, with 300 agricultural demonstrators, 20 percent of whom are women. This is a relatively large number for 45,000 households. Table 5, found on the following page, includes a breakdown of the entire extension service personnel.

a. Agriculture

The agricultural extension service, which is administered by the Ministry of Agriculture, has raised the awareness of the farmers to the government's agricultural policy, and promoted an increase in the use of inputs, in particular ox-drawn equipment for land preparation, planting and weeding.

The extension agents expressed concern that they were neither paid any supplementary allowances nor provided with motorcycles or mopeds for mobility. They noted that inputs generally arrived late or were unobtainable for the farmer. The farmer did not know the price of his product until harvest or later because the government made the announcement late. The agents proposed that the subsidy for the inputs be removed and instead, a higher price be paid for the output.

Table 5: Personnel of the Extension Service

<u>Personnel</u>	<u>Agri- culture</u>	<u>Live- stock</u>	<u>Crop Protection</u>	<u>Fisheries</u>
Principal Agricultural Officer	4	12	0	1
Senior Agricultural Officer	1	0	0	
Agricultural Officer	11	11	4	}
Agricultural Superintendents	20	8	5	} 4
Assistant Agricultural Superintendents	11	0	0	} 6
Senior Agricultural Assistants	15	0	0	}
Agricultural Assistants	75	130	15	8
Agricultural Demonstrators	300	117	146	17
Instructors in Mixed Farming Centers	<u>50</u>	<u>0</u>	<u>0</u>	<u>10</u>
Total Personnel (Trained)	487	278	170	46
	===	===	===	==
In Training	25	35	2	0

Source: DEVRES/INSAH Agricultural Research Resource Assessment, 1983. See National Report on The Gambia for more detail.

The linkages between extension and research are weak in spite of the fact that both are in the same ministry and supported by the same project.

b. Livestock

The extension service of the Department of Animal Health and Production is responsible for all extension work in the livestock sector. Its efforts are mainly directed towards cattle, sheep, goats and poultry production. It is also responsible for preventive programs, diagnosis, and free care of animals, as well as problems of production. It acts through associations of livestock owners.

The livestock extension service has strong linkages with the research of the Mixed Farming Project; the livestock phase of the project is in the same department as the extension. However, the research program is very limited due to lack of funds and the extension service does not depend upon Gambian research results. The service offers demonstrations of improved technologies for the use of crop residues for supplementary feed, forage cultivation, and range development.

The director reported that the budget did not provide vehicles, motorcycles, or bicycles for the agents so that the 278 agents were able to organize only 84 meetings with farmer groups in 1982-83. Also there was not enough money to buy the necessary drugs to treat sick animals.

The director reported that there is a need to train more people, especially at the middle and lower levels, and the senior officers should be offered an opportunity for postgraduate training.

Since very little research is currently going on, the extension program is based upon information from the available literature.

c. Plant Protection Service

This service, which is supported by an assistance project, is responsible for all extension activities related to crop protection. It also has a small program of research and demonstrations. The service makes pest and disease surveys of crops on farms, advises farmers on cropping practices and other crop protection measures, applies sprays if necessary and also has a plant quarantine service.

A monthly bulletin on crop protection is distributed, and 9,000 farmers were trained in 1982. Meetings of farmers were also held.

The director indicated that the funds were insufficient to effectively execute the programs and that technical personnel are inadequately trained.

d. Forestry

The forestry department has divisions of reforestation, of inspection and of operations. None of these has an extension role; they are more involved with management of the national forests, protection and rational use of forestry resources, and commercial exploitation of the forestry resources (particularly building and fencing lumber).

e. Fisheries

The fisheries extension division has three units: statistics, technology of equipment (recommending suitable technology), and mechanical (repairing outboard motors and advising on their use).

f. Comments

Considering the size of the extension service, with 940 people for 45,000 farmers, the results are limited. The extension service lacks the financial resources and trained personnel to do the job entrusted to them.

To improve the effectiveness of the extension service the following recommendations are made in the national report:

- o Institute a regular and intensive training program for all personnel, but especially for village-based extension workers, combined with regular visits by them to farmers. Periodic meetings could be organized with farmers' groups. The extension agents would be trained on a particular theme, which they will teach to the farmers' groups and which they will then discuss with individual farmers as needed.
- o Utilize the traditional communication structure as a method of extension in rural areas. The extension services of the Departments of Agriculture, Animal Health and Production, and the Crop Protection Services should be integrated to provide better service to the farmer who usually produces both crops and livestock.
- o Strengthen the links between the Research and Extension Services.
- o Provide sufficient resources to the field staff to increase their effectiveness. Specifically, the extension worker must be mobile to assure regular meetings with his contact group. Perhaps it would be useful to integrate the services, reduce the number of personnel, and use the money saved to help the rest to obtain their own means of transportation, pay them for their travel on duty, and buy drugs for treatment of sick animals. The cost of the drugs should be repaid by the farmers.

- o Make use of a group of subject matter specialists for technical backstopping of the extension workers.
- o Create a board, (already initiated) within the Department of Agriculture, of senior research and extension personnel to better coordinate the various programs. The board might also include members of the Department of Animal Health and Production and the Crop Protection Service, and it would be divided into three subcommittees, when necessary, for each of the areas. There might also be some representatives from the junior level, so that the people closest to the extension agents and the researchers could advise and inform their colleagues during the discussions.

However, this is no substitute for the creation of groups in the extension service to examine and define the research needed, and the development of an almost continuous dialogue between researchers and extension agents on the research needed and research results.

There are already linkages between the Senegalese and Gambian Agricultural and Livestock Research Services which should be encouraged. This should be considered a special relationship based on the political and geographic situation and not as a part of the regional activities. It is, of course, also necessary that the two countries participate in the regional activities.

5. Constraints to increased productivity

a. Constraints to agricultural production

(1) Environmental factors

The distribution of rainfall is reported to be a greater constraint than the total rainfall.

The major constraint in soils is the maintenance of soil fertility by inputs which are very costly in relation to crop prices-- in spite of the fact that fertilizers are sold at subsidized prices.

Pests, especially grain-eating birds, blister beetles, army worms, and bush pigs, are a serious constraint. At present, crop diseases are not a serious constraint.

Crop varieties are not considered a serious constraint.

(2) Economic factors

If it were possible to know the official prices before planting, it would help the farmer to decide which crops to grow. The buying campaigns for rice and maize are not timed early enough to suit most farmers.

The lack of short-, medium- and long-term credit is considered to be a serious constraint. The farmers also complain that the subsistence loans should be available in June or July so that they can buy needed inputs, instead of in August when the credit is usually available.

(3) Socioeconomic factors

Some farmers consider land tenure to be a serious constraint. The lack of farm labor is also a serious constraint. Respondents indicated that the yields in Table 6 (found on the following page) are conceivable if the technologies presently available were used (short-term) and if the constraints could be relieved (long-term). However, there is no indication of the types of research necessary; it is only stated that it is necessary to intensify research on improved varieties and superior systems of production and on cropping systems.

b. Constraints to livestock production

(1) Cattle

The current level of beef production is reported as "high".¹ The production of cow's milk is estimated at 8.1 million liters a year. The number of hides marketed was 21,000.

The survey indicates that rainfall, watering points, supply of natural or other types of forages, and diseases are all considered very important constraints to cattle production. Herd management, use of range lands and technical knowledge of the herders are also considered important constraints. Marketing is considered as the most important economic constraint.

The following types of research are proposed to alleviate these constraints:

- o Pasture development;
- o Cattle diseases;
- o Forage conservation methods; and
- o Herding practices and their effect on productivity.

(2) Sheep and goats

The production of mutton and goat meat is also considered high according to the FAO Yearbook. However, rainfall and

¹FAO, FAO Production Yearbook, 1980, (Rome: Statistics Division, Economic and Social Policy Department, FAO), 1980 This source provides an estimate of 39,000 head of cattle slaughtered, producing 4,700 t of beef; 48,000 head of sheep, and 530 t of meat; 51,000 head of goats, 560 t; and 8,000 pigs, 320 t.

Table 6: Yield Projections
(Metric tons/ha)

<u>Crop</u>	<u>1982 Yield</u>	<u>Average of last 3 years</u>	<u>Yields Possible</u>	
			<u>Short- Term</u>	<u>Long- Term</u>
Upland Rice ^a	1.0	1.10	1.6	2.9
Swamp Rice ^a	1.3	1.34		
Irrigated Rice ^a	4.6	5.02		
Peanuts	1.6	1.27	1.3	2.4
Early Millet	1.2	1.14		
Late Millet	1.0	1.06	0.9	1.5
Sorghum	1.0	1.00	1.3	2.0
Maize	1.8	1.50	2.0	4.5
Cotton	0.9	0.84	1.0	2.0

^aProduction during the last three years was 64 percent swamp rice, 27 percent irrigated rice, and 9 percent upland rice.

Source: DEVRES/INSAH Agricultural Research Resource Assessment, 1983. See National Report on The Gambia for more detail.

the supply of natural forage are considered serious constraints. Lack of access to water supply, disease and lack of curative health facilities are also significant problems. Herd management and use of range land are considered important constraints. Marketing is the most important constraint. There is no marketing system for sheep and goats. Research into these areas is proposed:

- o Pasture development;
- o Animal husbandry research; and
- o Genetic improvement.

(3) Poultry

The poultry production was 684,000 eggs and 16,900 broilers in 1982. The FAO estimated a population of 275,000 birds, which probably produced about 275 tons of meat.¹ No estimate of the medium-term production possibility was provided, but the long-term estimate is for an increase of 20-30 percent.

Rainfall and food supply are considered to be serious constraints to poultry production. Flock management is a serious constraint because of the low level of knowledge of the producers. The cost of inputs is a serious economic constraint.

For poultry, it is suggested that research into the use of local products and by-products for feed can help alleviate some of the food supply and economic constraints.

c. Constraints to fisheries

Production of fish in 1982 was estimated at 17,081 t. The major constraints cited were the supply of fish, and the training of extension agents and fishermen.

Losses after catching and hydroclimatology were considered important constraints. Lack of access to credit, lack of availability of inputs, the market price of fish, distribution problems, and the lack of refrigerated trucks were considered very important constraints.

In the long term, the production could be increased by 15-20 percent, with the removal of these constraints.

The following types of research are needed to overcome the constraints:

¹ FAO Production Yearbook, 1980.

- o Studies on "post-catch" losses and their prevention;
- o Methods of curing fish, including the possibility of solar tent drying;
- o Development of improved, adaptable gear; and
- o Surveys for a better understanding of the market.

For increased productivity both in the medium- and long-term, the following actions are considered urgent:

- o Inputs made available on time;
- o Access to credit for investment and increased productivity;
- o Access to markets by producers using local transportation;
- o Extension advice made available to fishermen; and
- o Market prices that at least cover the cost of production.

d. Constraints to agro-forestry

The production of firewood is estimated at 905,000 m³.¹ The adoption of the available improved technology would increase production to ten m³/ha/year and in the long term, if the constraints were eliminated, to 15 m³/ha/year.

Important environmental constraints to agro-forestry are inadequate rainfall and poor soils. Lack of labor, lack of short- and medium-term investment capital for foresters and insecurity of access to land are important constraints. The lack of useful and adaptable information is also an important constraint. Pricing policies² and inadequate infrastructure are important constraints.

To overcome the constraints, research on improving the productivity of the species grown is needed and species site-specific trials should be undertaken.

In the long term, genetic improvement is necessary, and the results should be made available to the forester.

¹FAO, Monthly Bulletin of Statistics, November, 1983, (Rome: FAO), 1983.

²It is not known if the government had a specific policy on the price of firewood and timber.

e. Agricultural policy constraints

As in many countries in West Africa, there are only limited agricultural statistics or data on the economy of the sector which could serve as a basis of agricultural policy. Nevertheless, the status of the national financial and economic situation should be included in any review of The Gambia's agricultural policy with respect to the constraints it places on agricultural production.

Another important consideration for agricultural policy in The Gambia is the great length of the borders in relation to the size of the country. These borders are permeable to clandestine trade. For example, the Gambian rice prices cannot differ too much from those in Senegal without developing a massive traffic across the border towards the better price. Similarly, it is clear that when the peanut price in The Gambia is significantly higher than that in Senegal, there is a large flow of peanuts into The Gambia. So The Gambia has only limited room for maneuver in the area of agricultural price policy.

In the past, the Gambian policy included exporting peanuts and importing rice, which is certainly optimal from the point of economic comparative advantage. The export of peanuts in 1981 and 1982 incurred a loss on the part of the GPMB, but this is not a reason to abandon the policy in the medium- or long-term (and peanut prices have recovered in 1983). It is easy to propose that agricultural production must be diversified, but replacement of the peanut as an export crop may not be possible in the short- or medium-term. The search for an alternative should be continued, but there is no guarantee that it will be successful.

Subsidies are already provided on farm inputs, such as fertilizer and seed dressings. When available, drugs are given free of charge to the herders, as are crop protection chemicals. A scheme for agricultural credit availability does not meet the needs of many farmers.

Prices for major crops are announced late in the season; it would be helpful to farmers to know these prices before planting season. A further problem is that the official markets, specifically those for rice and maize, do not begin operation when the farmer is ready to sell his crops.

6. Outline of solutions and priority actions

a. Policy suggestions

The government's agricultural policy emphasizes diversification and the development of a progressively self-reliant economy, capable of sustained economic and social progress. In recognition of the importance of the agricultural sector, the GOTG proposed devoting 25 percent of its D131 million to this sector. Financial constraints have reduced this sum, however.

In the national report, no specific proposals are made regarding the general policy goals of diversifying agriculture and reducing the economy's reliance on peanuts and peanut products.

Due to its size and the long border it shares with Senegal, The Gambia has to take into account the agricultural prices and policies of Senegal. Likewise, the Senegalese agriculture development should be aware of Gambian policies. Cooperation between the two countries is essential to discourage transnational commodity flows.

b. Proposals

The Gambian national report lists project proposals in the areas of crop production, livestock and fisheries. In the area of crop production, the project proposals are the following:

- o Strengthen research capability by manpower training, infrastructure development and technical assistance;
- o Improve roots and tubers production by selection, breeding, and improved storage to reduce post-harvest losses; and
- o Develop the research infrastructure of the Department of Agriculture.

Three important proposals are made for the livestock area:

- o Initiate a project to control ticks and diseases caused by ticks; this would first entail the identification of tick species in The Gambia, followed by a control program;
- o Support rural poultry development (no specific research component is included); and
- o Survey tsetse fly distribution/infestation and trypanosomiasis in The Gambia, as a prelude to an eradication campaign.

The proposals in the fisheries sector comprise both research and implementation proposals.

- o Construct a laboratory for fisheries research. This would include buildings, equipment and staff; and
- o Improve the fisheries infrastructure by improving methods of drying fish, developing an inspection and quality control scheme, and providing better information to fisherman.

A seed multiplication program, a soil conservation program and an impact study on the effect of the proposed Gambia river bridge/dam are already underway.

7. Conclusions and recommendations

As stated previously, The Gambia, a country with a rural population of 400,000, shares a long border with Senegal and is thus influenced by the economic decisions of the other country. The Gambia's agricultural policy must, to some extent, be parallel to that of Senegal in order to avoid a massive traffic of commodities crossing the border. For example, should the GOTG set its peanut price above that of Senegal, Senegalese peanuts would tend to flow into The Gambia.

The GOTC should therefore take into account the policy actions of the Senegalese Ministry of Agriculture. Senegal should as well keep informed of prices and policies in effect in The Gambia.

The GOTC should seek to strengthen the linkages with the Senegalese research system, harmonize the program and improve the flow of information.

Besides the necessary additional funds for transportation within The Gambia, the GOTG should make funds available for their research workers to participate in regional meetings. Priority should be given to people who speak French in order to ensure participation at meetings held in French.

Because of the size of The Gambia and diversity of its agriculture, livestock, fisheries and forest resources, the agricultural research program of The Gambia should be concentrated on applied research, for example, farming systems research with application on farmers' fields.

There are two FSR programs currently conducted on crop production and on livestock production, which are parts of the Upland Crops Improvement and the Mixed Farming Projects. Both projects include studies at the farm level and should be coordinated, particularly with respect to the data collected, since mixed farming is very common in The Gambia. The use of on-farm trials is obviously an important part of this type of research.

It is necessary to develop linkages between research and extension activities. Joint visits to FSR trials on farms should help identify problems and permit discussion. Unless the extension agents have additional funds for their transportation, however, it is possible that the extension service will not be improved at the farmer level.

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 Lambert Conformal Projection
 Standard parallels 8° and 32°
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 Boundary representation is
 not necessarily authoritative

Figure 5: Map of Mali

--- Railroad
 ——— Road
 ↑ Airport

D. Mali

1. General information on Mali

a. Geography

Mali is a land-locked country in the center of West Africa. It is bordered by Guinea and Senegal to the west; Algeria to the north and east; Niger to the south and east; Upper Volta to the southeast; and the Ivory Coast to the south.

There are two major river systems which run for part of their course within Mali. The Senegal River runs for half of its length in Mali and has numerous tributaries in the west of the country. The Niger's length in Mali is 1,700 km; it passes through a narrow gorge at Sotuba and flows through a vast interior delta around Mopti, where it forms large lakes in the flood season.

The country is very flat with hills 200-300 m in height. There are mountains, however--the Adrar des Iforhas in the north, the Dogon plateau with the Bandiagara cliff in the center and the Fouta Djallon in the southeast--each with an altitude of 500 to 800 m.

There are five ecological zones:

- o The Saharan zone, north of the 17th parallel, has an average rainfall under 200 mm and very high temperatures. It is a desertic zone used for nomadic livestock herding.
- o The Sahelian zone, between the 13th and 17th parallels, has rainfall ranging from 200 mm in the north to 700 mm in the south. The rainy season lasts three months (from June to September). The zone is predominantly used for transhumant livestock herding but also possesses a considerable area of rainfed crop production (millet, cowpeas, and peanuts).
- o The interior delta of the Niger, 300 km long and 100 km wide, lies in the Sahelian zone. Floods of the river (from October to December) make the delta very rich in fish, flood-recession crops (rice and sorghum), and the semi-floating bourgou grass. During part of the dry season (December to March), this grass provides vast areas of flood-recession pasture. The interior delta works like a lung, drawing a large part of the national herd to the bourgou during the flood-recession season; the herds leave at the beginning of the rainy season to spend the summer months on the rainfed pastures. At the conclusion of the rainy season the herds move back towards the bourgou, entering when the flood level of the river has declined sufficiently.

- o The Sudanian zone has an average rainfall of 700 mm in the north to 1,300 mm in the south, with the rainy season from June to October. This is the main farming zone. It also holds sedentary livestock herds.
- o The Sudano-guinean zone in the south lies between the 11th and 12th parallels. This zone has an average rainfall of 1,300 to 1,700 mm in its six-month rainy season. The major part of this zone is infested with the tsetse fly; the cattle kept in the infested areas are taurin of the N'Dama breed or cross-bred zebu X taurin, which have some degree of trypanotolerance. In the zones where it is not unhealthy to live and which are accessible, agriculture is important. During the dry season, from November to February, the temperatures are "cool", while from March to June they are much hotter, being under the influence of the harmattan.

b. Demography

Mali has seven administrative regions (Kayes, Koulikoro, Sikasso, Ségou, Mopti, Timbuktu, and Gao) and the district of Bamako.

Bamako, the national capital, has 650,000 inhabitants; Ségou has 100,000; Mopti 60,000; Sikasso 55,000; Gao 40,000; Timbuktu 35,000; and San 23,000. Of a total population of 7.2 million in 1983, 15 percent live in the urban areas. Most of the population is engaged in agriculture, herding or fishing.

There are about 15 ethnic groups, with most of the population belonging to the Bambara group (2,500,000). The Peulh (830,000), Saracolais (660,000), Malinké (460,000), Songhai (460,000), Senufo and Minianka (650,000) are the other important ethnic groups. There are almost continuous migratory movements of Malian workers to the Ivory Coast, Nigeria, Senegal, Ghana, and Europe.

In 1981, Mali had 18,000 km of roads, 7,500 km of which were all-season and 1,600 were bitumen (asphalt) covered.

The river Niger is navigable during the flood season (August to December) between Guinea and Bamako upstream and also from Koulikoro to Mopti and Timbuktu downstream.

The railway, with 645 km of line in Mali, runs from Koulikoro through Bamako to Kayes and then to Dakar in Senegal.

Air transport carries a large number of passengers and freight. The domestic airline, Air Mali, makes numerous international connections.

Telephone, radio-telephone, and satellites carry the telephone and telex services to the urban centers and the outside world.

Mali has several radio stations, some of which use a satellite. Color television was introduced in November 1983.

c. Education

To reduce an estimated 90 percent illiteracy rate among adults, the government has made great efforts to develop both a formal education system and an informal system in the national languages. Almost 33 percent of the national budget is directed to these efforts.

The formal system includes:

- o Basic primary education for nine years, divided into two cycles:
 - The first cycle which lasts six years and leads to the CEPE--Certificat d'études primaires élémentaires (Certificate of Primary and Elementary Education); and
 - The second cycle of three years, leading to the DEF--Diplôme d'études fondamentales (Diploma of Basic Studies), equivalent to the former BEPC--Brevet d'études du premier cycle.
- o Some primary schools, known as cantines, operate in the nomadic herding zone. Others which are known as médersas teach in Arabic.
- o Technical and professional schools, which follow primary school and last for two to six years. There are nine different types of technical and professional schools with different programs, each leading to the Brevet d'études.
- o Secondary technical training, which lasts from two to four years. It is taught in eight schools which give specialized diplomas; holders of these diplomas can enter the higher educational establishments.
- o Secondary general education, which lasts three years, leads to the "BAC" (baccalaureat).
- o Higher education, consisting of seven schools (grandes écoles); Mali has no university. These schools train upper level professional workers, awarding a first degree. Some Malian students pursue their studies abroad.

The 1977 school enrollment figures are given in Table 7 on the following page. In addition, there were 1,365 Malian students pursuing higher studies abroad, and the informal system had 35,000 adult students in 1,300 centers throughout the country.

It is important to note that, since 1983, the government has discontinued the practice of hiring all the students awarded a degree in the higher education system.

Table 7: School Enrollment in Mali, 1977

<u>Level</u>	<u>Number of Schools</u>	<u>Teachers</u>	<u>Students</u>
Primary	1,263	8,280	291,966
Secondary	18	540	11,526
Higher Schools	6	435	2,920

Source: DEVRES/INSAH Agricultural Research Resource Assessment, 1983. See National Report on Mali for more detail.

d. Government

Mali obtained its independence on September 22, 1960. It is a republic with a single political party, the Democratic Union of the Malian People (UDPM--Union démocratique du peuple malien). The executive power is held by the President, and the legislative by an assembly of 88 elected members serving four-year terms. The judiciary powers are held by the supreme court, special courts (in which the military holds three quarters of the seats) and the court of appeal.

There are 13 ministries, three of which have a direct relationship with agriculture. These are: Ministry of State for the Economy and Planning (MEEP--Le Ministère d'Etat chargé de l'économie et du plan); Ministry of Rural Development, formerly the Ministry of Livestock Production, Water and Forests (MDR--Le Ministère du développement rural); and Ministry of Agriculture (MA--Le Ministère de l'agriculture).

e. Economic indicators

In the 1970s the economy showed a marked increase in the tertiary sector, a slight increase in the primary sector, and almost no change in the industrial sector. (See Table 8.)

Indicated in the agricultural sector is a stagnation in food output per head, a net increase in cotton production, and considerable fluctuation, probably with a trend towards reduction, in peanut production.

The expenses of the public sector, industries, public parastatal commercial companies, and the civil service caused a financial crisis at the end of the 1970s; the government had to finance the deficits of the statal and parastatal organizations, which comprised 70 percent of industry, and a major part of the trade and transport in the country. The losses of these organizations were equivalent to approximately 20 percent of their sales. The deficit in the government's current account was 19 percent of GDP, and the salaries of the civil servants were paid with increasing delays. The treasury was forced to draw on the deposits in the Post Office Savings Bank. The government borrowed from the IMF and the IBRD and obtained food aid from international agencies.

Details of Mali's trade balance in recent years are shown in Table 9. Because of the economic crisis at the end of 1980, which included a current account deficit of one third of national income and increasingly long delays in payment of civil servants' salaries, the government had to concentrate its efforts on the most urgent matters and was unable to give sufficient attention to sectoral programs. Since 1980, the standby agreement with the IMF has enabled the

Table 8: GDP by Sector
(Billions of 1972 FM)

<u>Sector</u>	<u>1970</u>		<u>1980</u>		<u>Annual Growth Rate (percent)</u>
	<u>FM</u>	<u>percent</u>	<u>FM</u>	<u>percent</u>	
Primary	77.2	45	110.0	42	3.7
Secondary	24.4	14	29.6	11	2.0
Tertiary ^a	70.2	41	122.4	47	5.7
	—	—	—	—	—
TOTAL	171.8	100	262.0	100	4.3
	=====	===	=====	===	===

^aServices and government employment are included in the tertiary sector.

Source: DEVRES/INSAH Agricultural Research Resource Assessment, 1983.
See National Report on Mali for more detail.

Table 9 : Trade Balance
Trade (billions of FM)

	<u>1972</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>
<u>Exports, f.o.b.</u>	23.3	50.1	62.7	86.6
Cotton	7.9	24.9	37.9	43.6
Livestock	4.7	14.7	15.1	25.1
<u>Imports, c.i.f.</u>	43.3	128.6	148.0	189.5
Food	11.4	23.6	20.4	33.0
Petroleum products	4.1	19.7	23.6	25.0

Source: DEVRES/INSAH Agricultural Research Resource Assessment, 1983. See National Report on Mali for more detail.

government to reduce the current account deficit by almost 50 percent. The policy of employing all students who complete secondary or higher education was abandoned as of January 1983. The central bank no longer covers the operating deficits of the parastatals. The savings bank has been restored to liquidity.

In the agricultural sector, the programs of the Office of Agricultural Products (OPAM--Office des produits agricoles du Mali) have been greatly reduced. The import monopoly of the Import/Export Society of Mali (SOMIEX--Société Malienne pour l'importation et l'exportation) has been terminated and most of its sales outlets have been closed. Some public enterprises have been sold to the private sector. Until the economy returns to a normal state, however, the government cannot be expected to give a clear priority to the development of the agricultural sector.

f. Rural sector

The current five-year plan, 1981-85, proposes:

- o To increase agricultural production and build an independent and planned economy;
- o To improve the per capita income through a planned economy in which the variability due to climate will be considerably reduced; and
- o To obtain food self-sufficiency.

Among other things, it is expected that for agriculture:

- o Soils will be improved through a well-defined program;
- o Permanent pastures will be protected and improved;
- o There will be a focus of effort on the problem of desertification;
- o The herd will be restored to its size before the drought;
- o There will be development of the Sahelian pastures and improvement of pastures and watering points;
- o There will be an increase in the cattle finishing operations; and
- o More abattoirs and refrigerated storages will be built.

In the plan, the cereal supply needed was indicated as 1,266,000 t in 1981 and 1,435,000 in 1985. The production was estimated as 920,000 t (72.7 percent of demand) and 1,323,000 (92 percent of demand) respectively.

The rural area is to receive 32 percent of the funds, as an average for the five years 1981-1985.

For a resume of production of the agricultural sector in 1981, see Table 10 on the following page.

2. Field data analysis: agricultural research

a. Research institutions

Malian agricultural research is under the responsibility of two ministries. The Institute of Rural Economy (IER--Institut d'économie rurale) is under the Ministry of Agriculture, and the National Research Institute for Animal Husbandry, Forestry and Hydrobiology (INRZFH--Institut national de la recherche zootechnique, forestière et hydrobiologique) and Central Veterinary Laboratory (LCV--Laboratoire central vétérinaire) are under the Ministry of Rural Development.

(1) The IER

The IER has six divisions:

- o Administration and accounting;
- o Documentation and information;
- o Planning and evaluation;
- o Technical studies, including agricultural economics;
- o Agricultural research (DRA); and
- o Farming systems research (DRSPR).

The work of the IER is more extensive than agricultural research, ranging from the conception, planning and evaluation of agricultural projects to agricultural economic studies to the methodology of development. The IER is also involved in advising the minister and his cabinet on agricultural policy.

The Division of Documentation and Information (DDI) is in the process of reorganization, with French cooperation.

The Committee for the Coordination of Studies and Agricultural Development Programs, which falls under the rubric of the Ministry of Agriculture, coordinates agricultural research. This committee acts through the National Committee of Agricultural Research (CNRA) whose meetings are attended by research workers, developers and planners and whose meetings also constitute the most frequent contact between research and extension workers. The DRA and DRSPR implement those

Table 10: Production of the Agricultural Sector, 1981

<u>Crops</u>	<u>Area</u> (000's ha)	<u>Weight</u> (000's mt)	<u>1981 Yield</u> (kg/ha)	<u>Value on farm</u> (billions of FM)
Millet, sorghum, forio	1,420	930	500 - 700	60
Rice (paddy) ^a	172	150	800 - 1,000	8.5
Peanuts (in shell)	207	190	600 - 900	13
Vegetables	135	60		
Cotton (with seed)	121	114	900 - 1,300	11.5
Maize	90	80	600 - 900	40
Pulses	33	36	1,000 - 1,100	
Roots and tubers	12	116	8,500 - 9,500	
Sugar Cane	3	225	60,000 - 75,000	
Food grains		1,146		
Shea nuts		8		

<u>Livestock</u>	<u>Head</u>	<u>Slaughter</u> (000's head)	<u>Meat</u> (t)	<u>Value</u> (millions of FM)
Cattle	5,124	310	46,482	60.4
Sheep	10,311	3,596	53,945	97.1
Goats			11,000	
Poultry	12,500		9,000	
Pork			7,000	7.0
Cow milk			102,000	40.8
Sheep, goat milk			74,000	25.9

<u>Other</u>	<u>Weight</u> (mt)	<u>Value</u> (millions of FM)
Hides	807	6,260
Sheepskins	95	5,075
Goat skins	170	3,360
Honey	300	--
Wool	330	--
Fish		100,000
Firewood		11,700 ^b
Roundwood		276 ^b

^a 1 kg paddy = 0.67 kg rice.

^b m³ x 1000.

Source: DEVRES/INSAH Agricultural Research Resource Assessment, 1983.
See National Report on Mali for more detail.

research programs suggested by CNRA, with the approval of the coordinating committee. There are specialized commodity committees, comprised of representatives of interested agencies (of research, extension, etc.) which then evaluate the results of the research. The annual reports of these specialized committees are presented to CNRA.

The two research divisions of the IER (DRA and DRSPR) are comprised of a number of sections. In the DRA, the sections are Food and Oil Crops (SRCVO); Cotton and Jute (SRCFJ); Fruit and Vegetables (SRFM); Tobacco and New Crops--i.e., Tea (SRTPN); and Selected Seed Control (SRCSS).

In DRSPR, the research sections are Socioeconomics, Agriculture, and Pastoralism.

The research programs of the DRA use seven stations, many substations, and a network of trial fields--PAR (Research Support Site) and PEP (Permanent Experimentation Base). The DRSPR program is currently limited to southern Mali and has three different sites--Sikasso-Bougouni, Fonsebougou, and Tierouala, where a station is being built.

The DRA research programs include those detailed below.

(a) Cereal breeding

This program concentrates on the evaluation of local and introduced varieties and on the improvement of crops with respect to yield, stability, grain/straw ratio, etc. Multi-local trials include millet, sorghum, maize, fonio, panicum and brachiaria. The last two are grass species, new as food grains.

There are also associated projects: ICRISAT-Mali, SAFGRAD, INSAH and OMVS.

(b) Rice breeding

Performance and tolerance are major research objectives, as is adapting short-cycle varieties to obtain two crops per year. Rainfed, lowland, irrigated and floating rice are included. These are multi-site trials.

A project of WARDA is associated with this research.

(c) Pulse breeding

Projects include building a collection of varieties, establishment of a gene bank, and performance of trials of mixed cropping, involving cowpeas and vouandzou (Bambara nuts).

(d) Oilseed breeding

Projects include the performance of introductions, varietal tests of free nodulating soybeans, and also research on peanuts.

(e) Agronomy, pedology, cropping practices

Projects include examination of technical factors of production, organic matter, and soil fertility evaluation. Trials of cropping systems, date of planting, and soil-water relationships are other research subjects.

(f) Agronomy of sugarcane

This project concentrates on improving cultural practices and fertilization.

(g) Crop protection

Crop protection research focuses on the entomology of parasites of millet, sorghum, maize, cowpeas and rice. Resistant varieties are investigated, as are the dynamics of insect populations and the rate of infestations (e.g., with sugarcane).

Other studies include the physiopathology of millet, sorghum, peanuts, and sugarcane and the control of charcoal rot. Weeds associated with millet, sorghum and rice are investigated as well.

Studies are conducted at the National Center for Fruit Production Research to develop methods of control of diseases and parasites of fruits and vegetables.

(h) Cotton research

Projects include the following:

- o Breeding of rainfed varieties and irrigated long fiber varieties (in the Office of Niger). Glandless varieties with a high oil content are being researched;
- o Agronomic research on the effects of production practices and on the conditions for the maintenance of fertility, with trials both on-station and in-field;
- o Improvement of methods of crop protection;
- o Putting the fiber technology laboratory into operation;

- o Agronomic experiments on stations and substations throughout the cotton zone to solve problems faced by the farmers, using the results of agronomic, genetic, and entomological research; and
- o Employment of animal traction and mechanization.

(i) Tree fruit production

At the National Center for Fruit Production Research (CNRF) and its substations, trials are conducted on adapting crop practices, including those concerning irrigation. The Center's research covers mangoes, citrus fruits, avocados, pineapples and bananas. Date palm research will be included.

(j) Vegetable production

Selection of varieties and introduction of technologies, including irrigation are studied.

(k) Fruit and vegetable technology

A pilot processing plant and laboratory is planned at CNRF to do analyses and to study methods of industrial processing of fruits and vegetables.

(l) Tea and tobacco production

The agronomy of tea production and the technology of processing tea are being studied. The research also involves soil science, crop practices, varietal selection, plant protection and technology of tobacco.

(m) Regulation and control of selected seed (OPNS)

Selected seed production is done under SRCSS in the IER, and distribution is under the National Operation of Seed Production (ONPS).

(n) Farming Systems Research Division (DRSPR)

The research program is aimed at defining the farming systems likely to contribute to a better knowledge of the rural population, thereby improving the welfare of the farmer. There are three areas of intervention which are all in the Sikasso region.

- o Bougouni-Sikasso: The farming Systems Research Division conducts research on the typology of farms at this location.
- o Fonsebougou: Research on mixed farming, soil conservation, and typology of farms is conducted. Advice on farm management is given to farmers.

- o Tierouala Research Station: Cropping systems trials, mixed cropping and agronomic trials will be carried out.

(2) The National Institute for Research in Animal Husbandry, Forestry and Fisheries (INRZFH)

The INRZFH has three divisions--Administration and Accounting, Forestry and Hydrobiological (fisheries) Research, and Animal Science Research.

(a) The Division of Research in Forestry and Fisheries (DRFH--Division de la recherche forestiere et hydrobiologique)

The physical plant of DRFH is composed of five centers and a pilot paper manufacturing plant. In DRFH there are four administrative sections: Ecology and Natural Resource Conservation; Wood Technology; Hydrobiology, Fisheries and Aquaculture; and Wildlife.

These sections support six research programs:

- o Woods of the savanna: Studies of wood technology, lumber grading, yield, drying, preservation, and natural durability.
- o The biology of the local species of trees: Studies of germination, transplanting and direct seeding.
- o Irrigated wood production: Selection of species and sources adapted to the milieu; development of simple techniques of plantation that use little or no water; and extension of the results to the local farmers.
- o Fisheries: Survey of fish stocks; experiments with seine net fishing; survey of fish consumption in Mopti, in the area outside the town, and in the camps on the banks of the river.
- o The inventory of land resources (PIRT): Use of Landsat images to inventory the land and water resources; evaluation of the potential of the resources; preparation of maps and reports; and training of Malian technicians on the job.
- o Small-scale production of paper: The use of agricultural and forestry byproducts to make paper; examination of the possible uses of the paper produced; and evaluation of the applicability of the technology for village use.

The most acute problem in the forestry area is firewood, both production and consumption. When a solution is found it will be necessary to disseminate it by an extension service which is not exclusively concerned with forestry.

In a report published in May 1983 by the Club du Sahel and CILSS, the following subjects were recommended for research:

- o The economic aspects of firewood;
- o The social and legal aspects of forestry;
- o The efficiency in the utilization of wood;
- o Technical aspects of the growth of trees; and
- o Inventory of land resources.

The economics of firewood should include comparison between the study of transport, marketing, taxes, and labor, the cost of charcoal and the costs of other possible substitutes.

The social aspects should include the perceptions of people on the ownership of trees, on the rights to plant trees, on the trees that should be preserved, on the village woods, on the control of brush fires, on the grazing of animals, etc.

The efficiency of utilization involves the burning of wood for cooking, making charcoal, and wood used for drying fish. In the last case, it may be possible to use solar energy. The efficiency of combustion in the stoves should also be improved.

In relation to the growth of trees, studies are underway on the reproduction of local species, trees of the dunes, restoration of the soil, and the use of irrigation.

The PIRT project has been discussed above. The National Report gives a high priority to the pilot project for paper production. The pilot factory has already been operational, so it would seem preferable to do a study, based on this experience, to see if such a factory is profitable at the village level.

There is certainly an urgent need for a training program to raise the competence of a number of the Malian forestry research workers to a level closer to that of international scientists in this field.

The National Report proposes a research project on the fauna of the Gourma, which involves a five-year study of the ecosystem, the conditions of feeding, and the biology of the wildlife species. There would also be a census of animals and the possibility of meat production from wildlife would be studied.

From 1977 to 1981, there was a research project on the rational use of game in the Sahel. The project was undertaken in a 12,000 km² area near the Malian National Park of the Boucle du Baoulé. The conclusion was that the area did not have much game, because of the extension of crop production in the area and the grazing of a substantial number of cattle.

Perhaps a project is needed on wildlife, but it should have a broader scope, including the interactions between crops, domestic animals, people, and the environment, including the wildlife.

There is one fisheries research station, the Hydrobiological Research Laboratory, Mopti (LHM). Its purpose is to do research on improving the productivity of fishing, while protecting the stock from overexploitation. Its activities should include information on the fish population, surveys of the fisheries, the boats and equipment and the biology of the species.

Research and experiments on fishing with seine and gill nets, as well as surveys on fish consumption are already underway. In 1980, NOVIB (a Dutch NGO) financed a small research activity which included:

- o Statistics on the fish marketed by species;
- o Survey of the fisheries in a sample village;
- o Experiments on different nets;
- o Studies of growth and reproduction of Bagras, Clarias, and Auchenoglanis species; and
- o Stocking of a reservoir (behind the Sibi-Sibi dam in the Dogon area), which failed in its two attempts.

Extrapolation of the results of the NOVIB program indicates over-exploitation of the fisheries in the Mopti zone.

Outside of the Dutch short-term assistance, the "normal" resources of the laboratory do not permit undertaking any consistent research activities. The operating funds, zero in 1977 and 1978, 1.6 million FM in 1979, 1.2 million in 1980 and 0.8 million in 1981, are completely used to maintain the facilities, vehicles, buildings, fishing equipment, and laboratory. These funds are also used to do some experimental fishing and to gather some marketing statistics in the Port of Mopti in collaboration with the Fisheries Operation (Operation Peches).

(b) Division of Research in Animal Husbandry
(DRZ--Division de la recherche zootechnique

There are four stations operated by the DRZ. The DRZ as a division is comprised of three sections: Animal Breeding and Genetic Improvement, Feeds and Nutrition, and Agropastoralism.

These sections support four research programs:

- o Animal breeding and genetic improvement: Breeding high yielding lines adapted to the local milieu;

- o Animal feeding: Development of rations suitable for a modern livestock production and based upon the local agricultural production;
- o Pasture improvement: Developing techniques for pasture production and for improvement of natural pastures; and
- o Pre-extension: Developing farm models for extension use that are profitable and use rational methods of production.

(c) Other programs supporting INRZFH objectives

The International Livestock Center for Africa (ILCA) maintains a program with seven activities and projects including study and improvement of woody grazing species, management of the pastures of the flood plains of the Niger River, cultivation of millet and cowpeas, research on grain and forage legumes (selection, production, cultivation, and extension), trials at the village level, and feasibility of pastoral units.

(3) The Central Veterinary Laboratory

The LCV (Central Veterinary Laboratory) has four divisions: Administration and Accounting, Vaccine Production, Diagnosis and Research, and Engineering and Maintenance.

The LCV has no stations. However, it has seven research programs--Bacteriology, Virology, Protozoology, Entomology, Acarology, Helminthology, and Ecology and Toxic Plants.

b. Human resources

The main professional staff either actively employed by the research institutions or in training at the end of 1982 is presented in Table 11. For the IER, in addition to the 358 Malian professionals, there are 27 expatriates working in the central unit and the associated programs. Among the nationals, it is estimated that 90 percent are working in research.

The majority of research workers have received their basic training at the IPR, Katibougou; specialized training is done abroad. Most of the researchers are relatively young and have a level of training equivalent to the BAC plus four years of additional training. The number who have a Ph.D. or doctorate or an M.S. is increasing.

In relation to the means available and the programs underway, there seem to be enough research workers.

c. Financial resources

Table 12 presents a resume of the research institutions' budgets.

Table 11: Number of Research Personnel, by Institution, 1982

<u>Classification</u>	<u>IER</u>	<u>INRZFH</u>	<u>LCV</u>	<u>CIPEA</u>	<u>ONDY</u> ^a
Nationals					
Professionals					
Design staff (Category A)	135	72	23	4	4
Implementation staff (Categories B,C and D) ^b	223	83	28	93	10
Non-professionals	<u>357</u>	<u>178</u>	<u>NA</u>	<u>13</u>	<u>0</u>
Total nationals	<u><u>715</u></u>	<u><u>333</u></u>	<u><u>--</u></u>	<u><u>110</u></u>	<u><u>14</u></u>
Expatriates	27	NA	NA	11	2

^aOperation N'Dama Yanfolila.

^bCategories B,C and D correspond to high-level, mid-level, and base-level implementation staff, respectively. At the IER, total implementation staff includes one D-level staff member.

Source: DEVRES/INSAH Agricultural Research Resource Assessment, 1983.
See National Report on Mali for more detail.

Table 12: Recent Budgets of Research Institutions
(millions FM)

<u>Institutions</u>	<u>Investment</u>		<u>Operations</u>		<u>Total Budget</u>	
	<u>National</u>	<u>Donor</u>	<u>National</u>	<u>Donor</u>	<u>National</u>	<u>Donor</u>
IER ^a	-	-	-	-	1,000.7	1,259.4
INRZFH	-	-	-	-	410.0	830.0
LCV ^b	-	-	-	-	285.0	293.0
ILCA	-	76.8	-	691.2	-	768.0
ONDY ^c	-	-	-	-	10.8	96.7

^aThe budget is divided among the six divisions of the IER, not only the two research divisions:

^bThe budget is divided among all the divisions, not only the research divisions.

^cOperation N'Dama, Yanfolila.

Source: DEVRES/INSAH Agricultural Research Resource Assessment, 1983.
See National Report on Mali for more detail.

d. Comments

Agricultural research suffers from problems that are common in African countries--an old infrastructure, inadequate maintenance, non-functional equipment, an insufficient operating budget, and difficulties in producing relevant results. In Mali, because of the policy (recently terminated) of offering government employment to all graduates of higher education, there are enough workers, but they sometimes lack necessary experience and training.

The agricultural research personnel indicate that most of the operational problems are due to lack of funds, material and equipment. They think that the existence of two or three separate agricultural research institutions (IER, LCV, and INRZFH), should be considered a division of the unity of the research workers, which prevents high morale and efficient interaction.

Among problems identified by personnel, then, are the following:

- o Lack of continuous financial support;
- o Inadequate training of the research workers;
- o Old equipment and laboratory installations;
- o Difficulty of access to some agronomic research stations;
- o Scientific isolation, mostly due to the lack of scientific documentation;
- o Insufficient numbers of specialists and lack of experience among the personnel; and
- o Absence of a special status for research workers and poor material situation for the research workers.

Though not identified by research personnel as a problem, it is difficult to find examples of the utilization of the results of research in the agricultural sector, except in the cotton operation. In cotton, there is a complete system of identifying the real problems, communicating them to researchers, encouraging researchers to find solutions, testing them at the farm level, and extending those that are applicable.

The recent evaluation of ICRISAT cereal project provides an encouraging report for the future, but the results are not yet prepared for dissemination. The evaluations of the LCV program are also encouraging and there is hope that their new research project will yield useful results in the future.

The question, however, remains of what must be done to make research and the utilization of research results more productive in Mali. Consideration of currently productive projects leads to the following proposal that, when appropriate, projects should include:

- o Some well trained senior research specialists (cadres de conception), preferably Malian but probably expatriates initially;
- o Close relationships with the milieu and/or the extension service;
- o Well-defined tasks and administrative help to overcome logistical problems;
- o Access to a continuous training program for all personnel at all levels;
- o A high level of professional conscience and a sense of responsibility at all levels; and
- o Adequate external financing of research, necessarily for more than three years at a time, which could be complemented by a Malian contribution.

3. Field data analysis: agricultural training

a. Training institutions

(1) The Rural Polytechnic Institute (IPR-- Institut Polytechnique Rural)

Training in agriculture at the level of ingénieur is provided by the IPR at Katigougou. There is an annual admissions capacity of 200 students with the BAC in biological sciences. After completing a four-year course, the degree of Ingénieur in Applied Agricultural Sciences, Livestock Production, or Water and Forestry (ISA, ISE, and ISEF respectively) is awarded.

There is an additional admissions capacity for 300 students with the Diploma in Basic Studies (DEF). They receive the diploma of Technicien Supérieur in Agriculture, Livestock Production, Water and Forestry and Agricultural Engineering (TSA, TSE, TSEF, and TSGR).

The graduates are employed by the civil service, in development operations or in research. A large number of research workers hold degrees from the IPR. A project is being planned for training people at the IPR for the private sector.

There are 43 full-time and 20 part-time nationals on the teaching staff; there are also ten expatriates. There are 30 assistant instructors and another 30 staff members are in training. The need

for recruitment in the next ten years is for 50 people. The conditions of service are not encouraging and result in a serious turnover in staff.

There has been a third level of training proposed at the IPR, a third cycle providing specialization, but it has not yet been started.

The Institute has too many students for its capacity and the administration is seeking funds for expanding the physical plant.

Other professional agricultural schools exist and admit students after the ninth year of basic studies, the year in which students are prepared for the DEF examination. However, candidates for admission to these other schools usually are not required to have passed the DEF. These schools are administered by the Ministry of Rural Development (MDR).

(2) The School for Veterinary Attendants (EIV--
Ecole des infirmiers veterinaires)

The EIV offers a three year course for the diploma of veterinary attendant. The school has just received funding from the IBRD as part of an education project. The graduates are almost exclusively employed by the government in the national extension and research services. The EIV capacity is for 60 students per year. There are four full-time and 20 part-time teachers, with 15 persons employed in administration. Eighteen more staff members are required in the next three years.

(3) The Center for Training Livestock Extension
Workers (CFC--Centre de formation pratique)

In the Mali Livestock Project, Phase II, a center for training in communications was created to train extension workers for the project. Thirty students from the ninth year of basic studies (DEF level) are admitted annually. The graduates are employed in livestock and rural development operations. There are four full-time and four part-time teachers, with two assistants. There is one full-time administrator. The Center has a program of recruitment of eight more staff in the next ten years.

The external funding (USAID) has ended, and the national budget provided is insufficient.

(4) The Center for Practical Training in Forestry
(CFPF--Centre de formation pratique en foresterie)

CFPF at Tabacoro admits 25 students a year for a two-year course. The Center has seven full-time and four part-time teachers (of which two are expatriates). The graduates are available for employment by DNEF, and work as technicians in fisheries or forestry. The school is funded under the the Swiss-supported Sikasso

regional forestry project and has been operational for two years. It has not yet awarded any diplomas. The Center will need six more teachers in the next five years.

(5) Centers for Professional Apprenticeship
(CAA--Centre d'apprentissage agricole)

There are six centers for training junior-level staff which are in the division of technical instruction and professional training of the Ministry of Agriculture:

- o Center for Agricultural Apprenticeship (CAA) at M'Passoba;
- o Center for Agricultural Apprenticeship (CAA) at Salmanko;
- o Center for Agricultural Apprenticeship (CAA) at Same;
- o Center for Training in Rice Production at Dioro;
- o Center for Training in Vegetable Production at Baguineda; and
- o Center for Training in Vegetable Food Crop and Peanut Production at Kita.

Most of the teachers have an ingénieur de travaux (IT) diploma, or are qualified as moniteurs or as veterinary attendants. Each center has about 30 students; about 20 percent are women.

The courses are of three years' duration. The third year is spent in a research or extension institution, for which a report must be written. The diploma awarded is a Certificate of Professional Ability in Agriculture (CAPA). The graduates are available for employment in the research or extension organizations of the Ministries of Agriculture and of Rural Development.

Each center has a teaching staff of 13-14 nationals and one expatriate. The conditions for the staff are such that the teachers often leave after their first year, making it necessary to train someone else.

b. Human resources

Table 13 provides an overview of the personnel in all of the training institutions. Table 14 provides a summary of the available information on the budgets of the training institutions.

The number of books in the libraries of the training institutions and the annual number of acquisitions is shown in Table 15.

c. Comments

The system of agricultural training in Mali is one of the most developed in French-speaking West Africa. It covers several levels--ingénieurs, higher technicians, monitors, veterinary

Table 13: Agricultural Training Personnel in Mali

Staff	Institutions							
	IPR	EIV	CFC	CFPF	CS ^a	CAA		
			ML II			M'Pessoba	Samanko	Samé
Administration	17	15	1	2	3	1	2	4
Teachers								
Full-time nationals	43	4	4	7	34	13	14	14
Part-time nationals	20	20	0	2	0	0	0	0
Expatriates	10	0	0	2	0	1	1	1
Assistant teachers	30	0	0	0	7	0	0	0
Others	62	6	27	0	0	0	1	0
In training	30	0	0	0	0	0	1	0
New staff needed/year	5	6	1	-	-	1	-	-

^aThere are three specialized schools (rice, vegetables and food grains and peanuts).

Source: DEVRES/INSAH Agricultural Research Resource Assessment, 1983.
See National Report on Mali for more detail.

Table 14: Recent Budgets of Training Institutions
(millions of FM/yr)

<u>Institution</u>	<u>Investment</u>	<u>Operation</u>
IPR	833.3	24.5
EIV		10.8
CFC ML II		12 (presently less)
CFPF	71	35.5 (3.5 state funds)
CAA	778	369 (most for scholarships)

Source: DEVRES/INSAH Agricultural Research Resource Assessment, 1983.
See National Report on Mali for more detail.

Table 15: Library Holdings, Training Institutions

<u>Institution</u>	<u>Number of books</u>	<u>Annual Acquisitions</u>
IPR	5,000	100
EIV	700	50
CFC ML II	300	50
CAA M Pessola	420	-
CAA Samanko	400	-
CAA Samé	425	50

Source: DEVRES/INSAH Agricultural Research Resource Assessment, 1983. See National Report on Mali for more detail.

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attendants, etc., and several subsectors--agriculture, livestock production, forestry and fisheries. The numbers of students admitted and graduated each year are high. The infrastructure is quite large, including some relatively new and well-equipped schools. Many of the graduates from the system, particularly from the IPR, have taken further training in Europe or the United States and they have obtained excellent results.

The principal comments arising from the surveys for strengthening the institutions and their relations with the research system are as follows:

- o Increase the capacity of the schools to accommodate the number of students actually admitted (IPR);
- o Improve the equipment (teaching, library, etc.) of the institutions and their teaching staff, both in quantity and quality;
- o Improve the motivation of the teaching staff by improving their employment conditions (salaries, career employment, etc.) and, if necessary, improve the relationships with research by giving the senior members of the teaching staff an opportunity to do research and by encouraging the research workers to give courses or conferences in the training institutions; and
- o Increase both the operating budget and the budget for scholarships.

Among the problems identified by the personnel, the following should be noted:

- o A lack of policy for "training the trainers." The only school with fellowships for training staff is the IPR;
- o A shortage or a complete absence of operating and investment budget except for the EIV and CEPF, which have recently started to receive support from external sources. Some institutions have received external funding in the past, and are well equipped with good buildings;
- o The lack of senior and junior staff, due to difficulties in recruitment, a lack of supplementary pay and poor working conditions; and
- o At the IPR the classrooms are increasingly overcrowded due to the increase in students admitted.

The training institutions are not providing any special training for research workers or utilizing the results of research in the teaching. Most of the young researchers have received their first professional training at the IPR.

In forestry, research workers teach courses at the IPR in addition to their research at Katibougou. Research and extension institutions accept students from the IPR for their stage (practicum).

Despite these examples, however, functional linkages between the research and training institutions are largely lacking. The use of research centers for practical training is not common. The staff of the IPR should hold short courses for training or retraining research workers, who currently must attend such courses abroad.

The results of research are often ignored by the training institutions; the results are not even used in classes as practical illustrations in an otherwise theoretical course.

The training institutions do hold training and review courses in the development organizations.

4. Field data analysis: agricultural extension

a. Extension institutions

The present system of extension is comprised of 14 operations, each intervening in a specific geographic zone and having a certain management autonomy. Each operation has the mandate to promote economic and social development in its zone of operation. The institutions cover the technical problems of agriculture and livestock production, farm credit, marketing of some agricultural products, road construction, functional literacy training, human health care delivery, etc. They are administered by the Ministry of Agriculture.

Some extension institutions are large. The Malian Company for the Development of Textiles (CMDT--Compagnie malien pour le developpement des textiles) is one example. It covers a large geographic zone, has a substantial agro-industrial section, and has an important national impact. Another large organization, the Office of Niger (ON--Office du Niger), has a plantation type of agriculture (with its sugarcane) and industry (sugar refining, alcohol production). Other organizations are modest in size and have limited extension activities. There are also some zones which are not included in extension operations.

CMDT and the ON are Directorates under the Ministry of Agriculture. CMDT is organized as a "mixed" corporation, partly public and partly private. Other extension operations are attached to the Ministry of Rural Development which is in the Directorate of Agriculture. Administratively, CMDT and the ON are on a par with the Directorate of Agriculture.

The extension institutions in the Ministry of Agriculture include:

- o Malian Company for Textile Development (CMDT);
- o Office of Niger (ON);
- o Rice Operation, Segou (ORS);
- o Rice Operation, Mopti (ORM);
- o Millet Operation, Mopti (OMM);
- o Integrated Development Operation, Kaarta (ODIK);
- o Integrated Development Operation, Baguineda (ODIB);
- o Upper Valley (of Niger River) Operation (OHR);
- o Integrated Development Office for Peanut and Cereal Production (ODIPAC);
- o Flood Recession Action for Rice and Sorghum, Gao (ARS);
- o Lake Zone Operation (OZL);
- o Senegal River Valley Operation, Témko le and Magui (OVSTM);
- o Wheat Action, Diré (AB);
- o Tea Operation, Sikasso (OTS);
- o Operation for the Production of Selected Seed (OPSS); and
- o Operation for the Protection of Seed and Conservation of Harvested Crops (OPSR).

The extension services for livestock production, fisheries and forestry are under the MDR. These include the following operations:

- o Pastoral zone of North Kayes in the Western Sahel (PRODESO);
- o Pastoral zone of East Nara (also in PRODESO);
- o Pastoral activities at Dilly (Mali Livestock II project);
- o Livestock phase of the Integrated Development Operation of Kaarta (ODIK);
- o Livestock and Meat Credit Establishment (ECIBEV);
- o Livestock Development Project in South Mali;
- o CMDT livestock phase;

- o ORS cattle phase;
- o Livestock Development Operation, Mopti (ODEM);
- o Fisheries Operation (Segon, Mopti, Timbuktu, Gao); and
- o Sikasso Region Forestry Project.

b. Human resources

The data in the National Report do not provide the basis for an inventory of personnel.

c. Infrastructure and equipment

The infrastructure is variable; it ranges from the sugar refineries and rice mills of the ON, and the cotton gins of CMDT, to small operations and activities with very little infrastructure and equipment. Without outside financial support, the budgets do not cover the needs of operation and extension. Without paying premiums from external funds, it is even difficult to retain the personnel. When the external funding ends, the personnel look for other positions. The results of the survey do not provide adequate estimates of the extension budgets of most of the institutions because these budgets are not segregated from the overall project budget.

d. Comments

In general, as in many Sahelian countries, the development operations do not succeed in increasing productivity in their area of action. The few exceptions are the cotton operations and the small irrigated perimeters. The chief problems are:

- o Lack of a new technique that is well adapted to the actual farm conditions;
- o Lack of ability to deliver inputs on time;
- o Lack of consistency between agricultural policy and the economic situation of the farmers (price of inputs, price of products, profitability of extension themes in view of actual prices and policy); and
- o Lack of means available to the organization and poor material conditions for the personnel.

If the technology is not adapted to farm conditions and is not profitable for the farmers, there is no basis for launching the program. In this case, it is not necessary to identify further constraints in the extension process.

If the farmers cannot rely on getting the inputs in time, they will not adopt technology dependent upon the inputs.

CMDT provides examples of both the success that is possible through extension and also of a decline in output that can result from changes in policy. The technologies promoted by the extension agents all have to be tested on farms and for various reasons they are not proposed to all farmers. The agricultural statistics, and the volume of grain sold in the area where extension services were provided, indicate the success of CMDT which is involved in increasing food crop as well as cotton production.

However, the recent increase in the price of fertilizer, without a corresponding increase in the price of cotton, caused a decline of about one-third in the area planted in cotton, a decline in yields, and an almost 40 percent decline in production. The change in relationship between the cost of inputs and the price of cotton thus caused one-third of the cotton producers to cease production; the farmers who continued to produce cotton were unable to compensate for the loss of the other producers. Therefore, even with a very effective organization, the policy change in the cost/price relationship produced a significant negative effect on the national economy. After several years, CMDT has succeeded in restoring the trend to increase production, but only after considerable change in the programs.

The results of the survey do not give much information on the success of the different operations. Information on human resources indicates a lack of well-trained and motivated personnel. The lack of continuity in financial support produces cycles of prosperity and poverty for the organization and makes it difficult for an extension worker to make a career in most of the operations.

The relationships between research and extension are usually restricted to the meetings of the technical research committees. The structure of these committees and of their meetings is frequently not conducive to a real dialogue between research and extension.

At CMDT, which has a close relationship with research, there is an almost continuous dialogue between research and extension workers and a system of transfer of funds to research which encourages performance.

The system of collaboration requires work by both sides to be effective. Even after FSR and the improved understanding of the rural milieu, there must be a continuous dialogue between the FSR workers, the biological scientists in the research station, and the extension agents. The improved relationship depends more on individuals and their dialogue than on meetings of official committees.

An individual must also be selected in the extension organization to be responsible for presenting the needs of extension correctly in the technical research committee meetings and also for discussing these needs with the research workers outside the committee meetings.

The extension service needs its own means of monitoring and evaluation to determine which themes are useful to which classes of farmers. In this way, it is possible to strengthen the useful themes and to consult researchers on the themes which are not accepted. This would provide for the final test of the technical themes which lies, de facto, in the hands of the farmers. This system of monitoring and evaluation is operational in some agricultural development projects (e.g. the IBRD projects in the west of Upper Volta and the SOMIVAC in Casamance), where the results of the surveys of one campaign are available in time for discussion and inclusion in the planning of the next campaign.

With such a monitoring and evaluation unit, a development project has a firm basis for evaluating its efforts, strengthening its weaknesses and reinforcing its successes.

In summary, while the farmers seem very receptive to the themes extended, particularly agronomic themes, and the number of extension institutions and operations in Mali seems very favorable, they nonetheless face a lot of difficulties.

The principal problems raised by the extension workers indicate:

- o Difficulties of cash flow associated with the slowness in handling their funds;
- o Insufficient inputs available, with too high a price; and
- o Scientific isolation of the extension workers due to remoteness of the project area and inadequacy of help from researchers, particularly on the technical problems.

5. Constraints to increasing productivity

a. Policy constraints

Agricultural policy decisions are too often made without knowledge of all their economic implications. Research on the effects of the choice of policy on agricultural production is still in its infancy. A research group on agricultural policy should be established under the control of the Director of the Cabinet of the Minister (of Rural Development and of Agriculture) and not in the Directorate of Agricultural Research. If not, the results of the research may not be used.

The need for a source of information on agricultural policy was made clear by the increase in fertilizer price a few years ago. The effect of the sudden increase in price was an even greater decrease in the marketing and export action of cotton, a deterioration in the trade balance and a decline in the amount of tax received from the exportation.

It should be noted that agricultural policy research has to be neutral; it should predict the physical and economic results of adopting the different alternatives available. Then the politician must decide on the choice to be implemented. Other countries in the Sahel have already either established or proposed a policy research unit.

The following were often mentioned in the survey as agricultural policy matters constraining increases in production:

- o Low market prices;
- o High cost of fertilizer;
- o Necessity to subsidize the cost of farm machinery;
- o Lack of an agricultural credit system; and
- o Over-indebtedness on the part of farmers.

Few research workers are providing information on these problems to the relevant decision makers.

b. Agronomic constraints

Various replies were received on questions regarding constraints to agricultural production. An analysis of agricultural change in the CILSS member countries in the last 20 years indicates that, on the main crops (except cotton), the Malian farmer obtains the same output per worker as 20 years ago. Currently there are many more farms, but the person/land ratio is almost unchanged.

However, due to a high rate of urbanization and a decline in the percentage of the population involved in agricultural production, the production per capita has declined. At the same time, there has been an increase in the amount of cereals imported. The world prices of wheat and rice are quite low; and the real (deflated) prices have declined over the last 20 years due to the adoption of new technology by the producers.

In the Sahelian countries, the techniques of production of cereals have not changed much and the price has increased in real terms. To supply the urban populations at the lowest possible price there is a tendency to import wheat and sometimes rice in increasing quantities.

In the absence of technological change, a major constraint is the shortage of labor at certain times in the agricultural calendar (periods of weeding and during the harvesting of cotton).

A research project funded by the Dutch Government (Primary Productivity in the Sahel) has shown clearly that it is generally the very low level of phosphate and nitrogen in the soil which is the most limiting factor in crop production. This should not be interpreted to

mean that it is always profitable to apply fertilizer. If the fertility constraint is relieved, the water supply becomes the limiting factor. For this reason it will always be useful to seek ways of increasing the efficiency in the use of fertilizer and of improving the soil-water relationship, for example by reducing runoff.

Table 16 presents information on crop yields currently being obtained and those proposed as possible for the major crops.

c. Livestock production constraints

In livestock production, the constraints are not uniformly identified by the producers because of the traditional and extensive character of production. The idea of productivity of cattle, by head or by herd, is often not even a conception in the minds of herders evaluating their own situation.

The mortality and reduction in fecundity caused by animal diseases and lack of forage are perceived as a direct loss of production. A generally poor condition of animals does not appear as a direct loss, however, because it does not result in death. Meanwhile, this poor condition is a real loss of potential production and often, in the Sahel, a considerable waste of investment in forage, drugs, labor, etc.

In a rough order of importance based on the numbers of animals involved, the following are the main constraints:

- o The problem of feeding and the shortage of forage. This constraint is caused by the reduction in the productivity potential of the rainy season in Sahelian pastures, which is in turn due to repeated deficits in the rainfall in recent years and to the reduction in the area of the bourgou pastures (the flood recession pastures of the Niger river delta). The problem is exacerbated by the increase in the number of animals grazing on the bourgou due to the poor production of the traditional rainy season pastures.
- o On the national level, the overgrazing and the increased fragility of a milieu under the influence of the unfavorable climate. The climate does not encourage the hope of a rapid and complete return to a situation of abundance of forage in the pastoral region.
- o Bush fires which aggravate the difficulties of the forage supply by the destruction of the "stored" forage and which sometimes cause the drying up of watering points. A related constraint is that drawing water by hand from the very deep wells is extremely arduous.
- o The high cost of inputs (the price of certain drugs and other pharmaceutical products, the price of mineral licks, etc.). For poultry production the basic price of cereals and supplements is a serious constraint.

Table 16: Production and Potential Yields of Major Crops

Crop	Current			Short term			Long Term
	Area (000 ha)	Yield (kg/ha)	Production (000 mt)	Additional Area (000 ha)	Yield (kg/ha)	Production (000 mt)	Yield (kg/ha)
Millet/Sorghum	1,393	569	793	100	1,000-11,000	1,568	1,200-1,500
Maize	74	1,289	92	50	1,500-2,000	217	2,500-3,500
Peanuts (in shell)	91	527	48	65	1,000	156	1,500-1,700
Cotton (with seed)	105	1,217	129	35	1,300-1,400	189	1,500-2,000
Rice:							
Irrigated	70	(1,000) ^a	(70)	(70)	1,700-2,000 ^b	(259)	4,000-5,000
Rainfed and bas fond	15	300-1,500	13.5	6	1,500	31.5	2,000-2,500
Floating	27	955	26	(27)	1,000	(27)	2,500
Other ^c	(38)	(500)	(19)				
Sugarcane	2.3	68,000	155	30	7,000	2,260	90,000
Tobacco	0.2	1,272	0.3	0.3-0.5	1,700-2,000	1.2	2,500

^aFigures in parentheses are our estimates.

^bUN reports 2,500-3,000 kg/ha.

^c"Other" is a category created by us to make the total area and production correspond to the agricultural statistics.

Source: DEVRES/INSAH Agricultural Research Resource Assessment, 1983. See National Report on Mali for more detail.

- o The low level of technical knowledge on the part of poultry producers using intensive systems and on the part of cattle feeders (e.g., knowing, when necessary, how to mix suitable rations based on ingredients which vary in quality, availability and sometimes price).

d. Agro-forestry constraints

The most frequently cited constraints in the national report are physical factors, namely lack of rainfall and lack of security of land tenure.

The problem of insufficient means was often cited by the research and forestry extension workers. The operating funds are divided among several projects with the result that they were insufficient to obtain satisfactory results in any of the projects.

The report Analysis of the Forestry Section and Proposals: Mali and its Annex (Sahel 12(82)165, May 1982) published by the Club du Sahel and CILSS, provides a review and an analysis of the sector. The problems indicated are as follows:

- o The inability of DNEF to protect the national forests (forêts classées) which have been invaded by farmers, herders and gatherers of wood and ravaged by fires; in some cases, the woody species have completely disappeared;
- o The lack of planned programs for the sector;
- o The lack of research results that are applicable;
- o The lack of coordination between research and development;
- o The lack of information on different species which can be planted in the zones with rainfall under 600 mm a year; and
- o The lack of a permanent organization which could provide continuous training in the form of short courses for personnel at all levels of the Water and Forestry Service, thus enabling these personnel to overcome their technical and often human isolation.

e. Fisheries constraints

The National Report does not provide an adequate basis for identifying the constraints in detail. Nevertheless, the following can be identified as constraints:

- o Hydroclimate;
- o Lack of funds; and
- o Lack of infrastructure for aquaculture.

Mali has the most important inland fisheries in the Sahel. This is due to the immense area seasonally flooded in the Niger river delta. However, there is a lack of easy and accessible facilities for unloading fishing boats and the fishing season is much shorter inland than that for sea or lake fishing. It is thus necessary to handle and preserve a large amount of fish, landed over a very large area in a relatively short time period, in a region where firewood is limited in quantity. The amount of fish that can be sold fresh is very small, and the efforts of the OPM to expand the market have not had the success that was desired. The damage caused by insects which attack dried or smoked fish can run to about 25 percent of the total catch and is, therefore, another major constraint. The shortage of firewood should also be mentioned as a constraint, as it leads to marketing of fish that is insufficiently smoked.

The OPM has promoted the use of improved fish-drying ovens using 38 percent less firewood than the traditional ones to dry a similar quantity of fish.

Contrary to expectation, the OPM has not become self-financing and still requires outside assistance. The organization has played an important role in extension and in the supply of improved stoves, ice and insecticide. It is not able to continue its activities independently.

The lack of research on planning and development of the use of the fisheries resources with appropriate controls, and on more developed technology is a constraint which retards the development of fisheries and limits the control of over-fishing. The development potential of the delta fisheries is one of the strongest in the Sahel.

The department of fisheries has neither the personnel nor the necessary means to research the trophic chains in the new lakes (Selingue, Manantali, Tossaye, etc.) nor to control the buildup of stocks of the appropriate species of fish. It also lacks funds for assuring the operation of the extension service. There may not be sufficient outboard motors but a certain number have been supplied for cash or on credit. A code for the fishing industry is in preparation and this should be put into operation quickly to eliminate the over-fishing of the resources.

6. Outline of solutions and priority actions

a. Agricultural policy

The primary problem is that of having two Ministries (Agriculture and Rural Development). Questions which must be considered include: Is the present solution the best? Where should the policy research group be placed? Should it work between the two Ministries or should it be attached to one of the Ministries (e.g., the Ministry of Rural Development which has the coordinating role) or in the Presidency? Examples of agricultural policy research groups exist in the Sahel and there is no reason why there should not be such a group in Mali.

The development of a more appropriate policy of agricultural prices is one of the actions proposed by the IBRD.

b. Agricultural research policy

The research workers proposed that there should be one single institution responsible for research. This would be easier to accomplish if there were only one Ministry. The absence of such an institution is not a major constraint to research. The coordination of research will be assured by the National Council of Scientific and Technical Research, under the authority of the National Education Ministry.

The research workers in Mali, as in other CILSS member countries, proposed that they should have a special status for research workers. This has been proposed to and awaits adoption by the government. At the moment, and for some years past, the government has had difficulty in paying the regular salaries of the civil servants, and it has not seen an increase in the research workers salaries as an immediate need.

It is certain, that due to the lack of funds and of multi-year support, the research system has an aged infrastructure, unoperational equipment and vehicles and a lack of fuel and other necessities. The efficiency of the system is low, except where there are internal funds; the delays in making funds available are very long. The system of release of funds, which seems to be common to all of the services, needs to be improved as soon as possible.

With so many important research policy constraints in agricultural research, it is difficult to identify the most important.

c. Structural problems

(1) Infrastructure and equipment

There are some research institutions with infrastructure in good order (for example the Cinzana Station and the LCV), but the government funds do not suffice to maintain these facilities. If the donors pay for new buildings, funding for their maintenance is needed almost in perpetuity. The lack of funding by the government is beyond any doubt. The question of lack of recurrent funds is not limited to research. The donors need to decide how to ensure, for example, 20 years of support in order to provide a minimum operational infrastructure for research. This should include buildings, equipment (laboratories, research farms, transport and documentation), and their recurrent costs.

(2) Organization of research

The projects have been organized by discipline and by crop; for example, plant breeding, separated from pest management

and cultural practices. It would perhaps be better to organize the projects on a broader commodity basis with multidisciplinary teams.

(3) Conditions of service

Agricultural research requires both a regional and a multi-site approach. To encourage research workers and their families to live a long way from larger towns, they must be furnished with acceptable living conditions, access for transportation, telephone or radio telephone, etc. To visit sites in the bush, vehicles are needed, with fuel and money for travel expenses.

A young research worker must also be able to look forward to a career in research. In the short term, he expects to be trained, and in the long-term, he expects to be promoted and not to have to spend his whole career at a station in the bush.

The conditions of life for a Malian civil servant are far from ideal; if they do not improve, the training provided will be lost to Mali except for those who cannot get jobs abroad. A number of the people who have been highly trained as research workers try, after ten years in the civil service, to find employment outside Mali. Research workers with a doctorate or even an M.Sc. have the flexibility to find employment abroad.

(4) Training needs

The basic training of a research worker needs to include more basic science than that in the curriculum for the IPR. At present, it is difficult to get this basic training in Mali. But the training in research done abroad is very expensive, and except where the thesis research was done in Mali, does not give a real experience suitable for doing research in the milieu where the individual's research career should develop.

One proposal is to have students do their coursework in a university abroad and then do their research in Mali. It may not even be necessary for the student to return to the university to be examined if an exam has been given on the coursework before he leaves the university. For the doctorate, it is usually necessary to return for an examination on the thesis.

There are also possibilities for taking short courses at the IARC--e.g., at ICRISAT, IITA, CIMMYT, ILCA.

The need to train administrators and managers of research institutions must not be overlooked.

To estimate the training needs, the programs for the next ten to 15 years have to be reviewed. The research proposals presented in the National Report do not provide all of the information necessary to estimate the training needs by discipline and by level of degree.

It is also necessary to decide if the training is to be done as part of a training program, as is the business management training program of USAID in Mali, or if the training should be an activity in a research project, like the ICRISAT/Mali project.

There also exists a proposal to create a regional postgraduate college in the Ivory Coast for training of agricultural research workers. This project could perhaps serve all of the Sahelian countries. This would reduce the need for English training and the research could be conducted in the Ivorian savannas or in Mali. Third cycle training is proposed for the IPR, Katibougou, but a qualified teaching staff is not available at present to provide the course.

(5) Management

Research workers who become directors of stations and departments have normally not received training in administration and management. Fellowships are not usually available for such training and the directors do not have the time to take a long course.

USAID finances several projects for training managers. It is possible to design a project for the training of research directors, covering program development, costs, returns, and management. ISNAR has already taught a similar course in several countries.

The method of releasing funds is the same throughout the civil service, and everyone complains of its slowness. Practical methods for removing this constraint must be found as soon as possible in Mali.

d. Priority proposals

Proposals for the various agricultural sectors are outlined below. The budget, personnel and duration required for the proposed projects in crop, livestock, forestry and fisheries production are given in Table 17.

(1) Crop production

Given the objective of national food self-sufficiency, activities related to varietal improvement and cultural techniques of cereals should be given research priority.

(a) Plant breeding

The general objective is the creation of varieties which have a high level of performance, suitable for an intensive agriculture (plowing, fertilization, chemical herbicide), resistant to diseases and insects and producing yields of good quality.

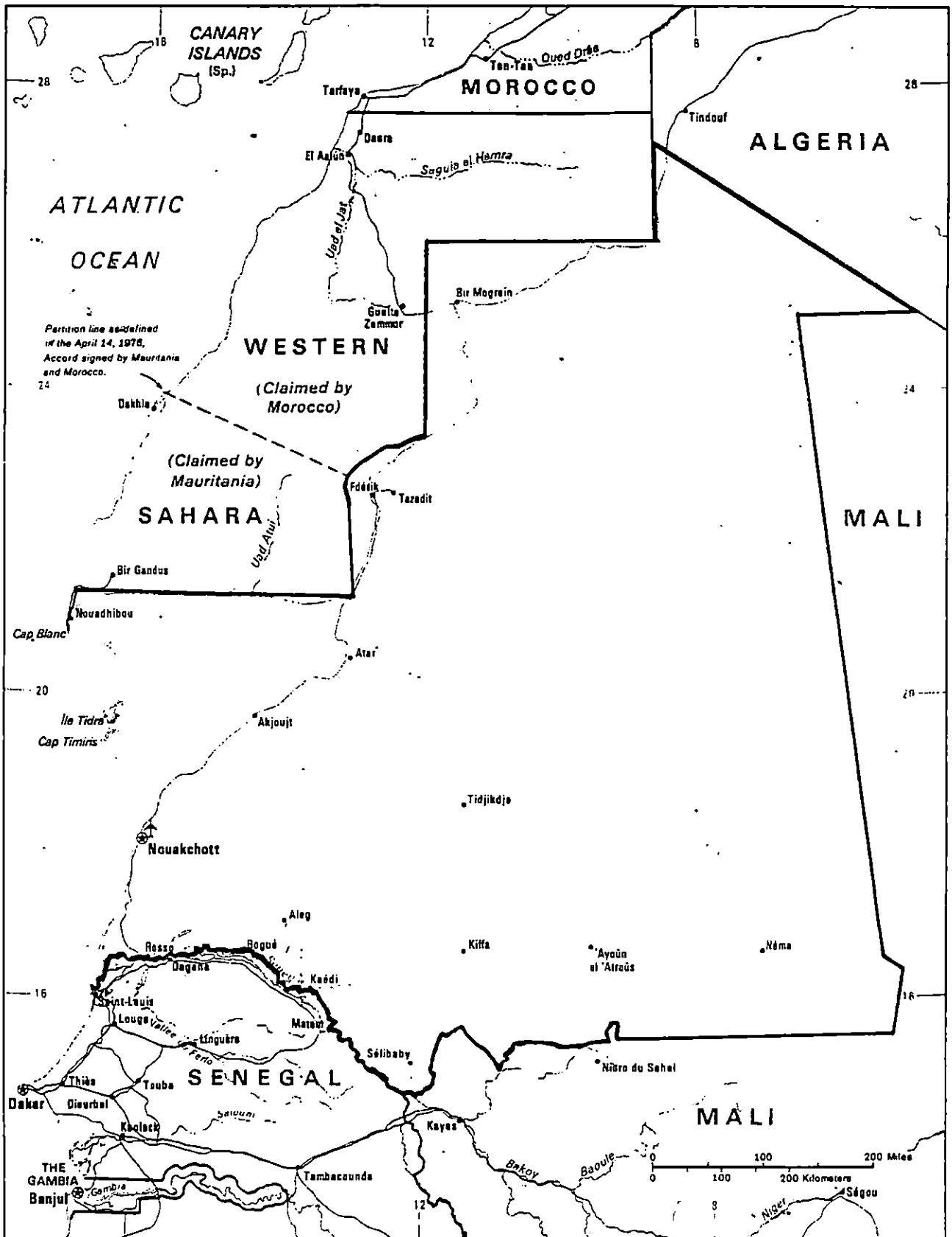
The programs and projects proposed are as follows: in cereal breeding--millet, sorghum, wheat, rice, maize, cowpeas, fonio and vouandzou; in oil seed breeding--peanuts and soybeans (not mentioned in the National Report); cotton breeding; fruit tree breeding--mango,

Table 17: Budgets of Proposed Research Projects

<u>CROP PRODUCTION</u>	Millions FM ^a	Duration	Ingenieurs	Technicians	Others
Milliet	500	5	4	5	7
Sorghum	425	5	3	5	7
Maize	375	5	3	5	7
Rice	--	5	5	7	10
Cowpeas	250	5	2	3	5
Peanuts	150	3	1	3	10
Wheat	400	5	2	5	7
Cotton	650	5	5	7	10
Fruit	135	5	5	10	8
Vegetables	170	5	2	3	5
Tea	375	5	2	3	5
Tobacco	<u>750</u>	<u>5</u>	<u>3</u>	<u>3</u>	<u>6</u>
	4,680		37	61	87
Pedology	250	1	3	5	--
Pedology <5 years	1,250	>5			
Fertilization	890	5	6	7	10
Soil-water-plant	950	5	3	2	?
Cultural practices	<u>175</u>	<u>5</u>	<u>3</u>	<u>5</u>	<u>7</u>
	3,265		15	19	17
Food and oil crop protection	650	5	<5	7	>10
Cotton protection	300	5	3	6	7
Fruit and vegetable protection	<u>200</u>	<u>5</u>	<u>2</u>	<u>5</u>	<u>5</u>
	1,150		<10	18	>22
Cereal technology	100	5	5	2	3
Fibre technology	75	5	1	5	7
Fruit and vegetable technology	75	5	2	4	5
Tea technology	175	5	1	2	4
Tobacco technology	<u>400</u>	<u>5</u>	<u>1</u>	<u>2</u>	<u>6</u>
	900		10	15	23

Source: DEVRES/INSAH Agricultural Research Resource Assessment, 1983.

See National Report on Mali for more detail.



502729 9-77 (542165)
 Lambert Conformal Projection
 Standard parallels 8° and 32°
 Scale 1:8,200,000
 Boundary representation is
 not necessarily authoritative

— Railroad
 - - - Road
 ↑ Airport

Figure 6: Map of Mauritania

(6) Agricultural credit

Agricultural credit was institutionalized in 1980 with the creation of the National Development Fund (FND--Fonds national de développement) but its activities are not yet fully developed. In some irrigated areas, the National Rural Development Company (SONADER--Société nationale de développement rural) grants loans for purchase of agricultural inputs which are repayable after the harvest.

2. Field data analysis: agricultural research.

The agricultural research institutions in Mauritania are:

- o The National Center for Livestock and Veterinary Research (CNERV--Centre national de l'élevage et de recherche vétérinaire);
- o The National Center for Agronomic Research and Agricultural Development (CNRADA--Centre national de recherche agronomique et de développement agricole); and
- o The National Center for Oceanographic and Fisheries Research (CNROP--Centre national de recherche oceanographique et de pêches).

a. The National Center for Livestock and Veterinary Research

Located in Nouakchott, with a branch in Kaedi, the Center was restructured in 1982 and its staff was enlarged. It is under the control of the Ministry of Rural Development. Under the direction of a Director-General are the Division of Administration and Finance and four Research Divisions--Parasitology, Virology, Bacteriology, and Animal Husbandry and Bromatology. CNERV is currently involved in one project managed by IEMVT.

(1) Objectives

The objectives of CNERV are to:

- o Increase animal production by reduction of mortality, by promoting better health care delivery and animal husbandry;
- o Select more productive animals while ensuring that the adaptation to the particular conditions prevailing in Mauritania is maintained or enhanced; and
- o Improve the integration of agriculture and livestock.

(2) Programs

In addition to the diagnostic activities conducted upon user request, the programs under way are the following:

(a) Bacteriology

Mastitis in cattle and small ruminants is being studied and a relationship sought between certain dietary deficiencies and a predisposition to mastitis. Vaccines against staphylococcus mastitis in small ruminants are being investigated.

(b) Virology

Studies of pulmonary disorders and epidemics among small ruminants are undertaken, as well as studies on dromedary pathology, of avian diseases which may be transmitted by migrating birds, and of abortive diseases.

(c) Parasitology

Internal and external parasites of dromedaries, small ruminants, and poultry are being studied. Diagnoses are provided for helminth parasites.

(d) Bromatology

Investigations include bromatological analyses, control of imported feed, and nutritional deficiencies (minerals and oligo elements) of small ruminants. Studies under this program are conducted in cooperation with other divisions or projects.

(e) Pathology

IEMVT manages a project designed to study the pathology and livestock economics of the dromedary and of small ruminants in cooperation with the Virology Division. This project is supported by EDF, IBRD, and USAID. A serology survey of cattle in Mauritania is underway.

(3) Human resources

Personnel at CNERV includes three veterinarians (the Director plus two expatriates). Regarding other personnel, national researchers and skilled specialists are so scarce that technical assistance must be sought from other countries.

(4) Infrastructure and facilities

The headquarters of CNERV, comprised of offices and a laboratory, are located at Nouakchott. There is also a branch in Kaedi and field operations bases for three projects in the south--Projects SE, SW, and Integrated Rural Development of Guidimakha (DRIG--Développement rural intégré de Guidimakha).

b. The National Center for Agronomic Research and Agricultural Development

The Ministry of Rural Development (MDR--Ministère du développement rural) is responsible for this Center which was created in 1974 to conduct research on the principal crops of the country. Before the center was established in 1969, research had been started on date palms, and IRAT carried out a research program mainly on flood-recession sorghum and on millet, maize, and cowpeas.

(1) Organization

CNRADA is directed by the General Administration Section and the Technical Section. It is divided into a dozen divisions and laboratories which, because of the lack of staff, facilities, equipment, or finances, are not operational. The headquarters' facilities are in Kaedi.

The Administrative Directorate of CNRADA consists of the following:

- o An Administrative Department;
- o An Accounting Department; and
- o A Secretariat.

The Technical Directorate consists a Documentation Unit and Divisions and Laboratories of: extension and rural economics; agroclimatology; soil science; soils laboratory; rice production; plant breeding; fruit and vegetable production; food production; entomology and plant pathology, and crop protection. The Technical Directorate also has a seed reproduction service.

(2) Mission

Generally, CNRADA is responsible for all studies, activities, and surveys pertaining to the technical and economic aspects of crop production, and for the practical application of research in biology, physics, chemistry, and social sciences to the agricultural sector.

In particular, the following activities are under its jurisdiction: the breeding, introduction, production, and acclimation of plants and seeds; the study of agronomic factors of production; soil and water conservation; the protection of growing crops and of stored grain; and farm mechanization and farm equipment. In addition, CNRADA will also be entrusted with the study of rationalizing production methods and techniques, by performing pre-extension trials of research results, and by disseminating information on agronomy.

(3) Programs

Following are the programs that are underway or planned:

(a) General agronomy

Research topics in general agronomy include pedology (climatic constraints and risks, water requirements of crops, soils, and irrigation), fertilization (soil analysis, physico-chemical properties of soils, fertilizer application rates, green fertilizer including Azolla), crop techniques, and entomology and plant pathology (laboratory not yet open).

(b) Food crops

Food crops research covers rice, millet and sorghum, wheat, maize, cowpeas, and beans. Studies focus on adapted varieties, harvesting and conservation techniques, seed production, cultivation and rotations, and, at a later date, food technology.

(c) Fruit crops

Fruit crops research falls into three broad categories: introduction of adapted species and varieties; crop techniques, multiple cropping, and windbreaks; and economics, water requirements and food technology.

(d) Market gardening

Studies in market gardening concern: introduction and/or breeding of new varieties; crop techniques, water requirements, and conservation; and production systems and economics.

(e) Industrial crops

Industrial crops that are or will be studied are sugar cane (varieties), cotton (varieties and production systems), and date palm (pathology, regeneration, date technology, studies on propagation, pollenization, irrigation, and fertilization).

(f) Extension

Extension activities include programs of pre-extension trials and the application of results, full-scale tests, extension to farmers, creation of nurseries, and training of extension workers.

(4) Human resources

The staff currently includes:

- o Two senior agricultural economists, with doctoral degrees;
- o One rural economist;
- o Eight research assistants (CTA in agricultural economics);

- o Seven prefects (trained at the National School of Agriculture); and
- o Twenty others trained on the job as needed.

The staff undergoing training includes

- o For 1983-1984--three research assistants (fruit crops, documentation, management); and
- o For 1984-1985--five specialists (entomology, Azolla, fruit crops, food crops, and market gardening).

(5) Infrastructure and operating budget

At present, CNRADA operates:

- o The Kaedi Center, which is to be rebuilt with financing obtained from the FAC (FF 6,000,000 or approximately US\$ 750,000). It will include offices, five laboratories, and housing for the researchers;
- o A research station in Belinabe I (50 ha) and a pre-extension testing perimeter (23 ha) in Belinabe II;
- o A pre-extension testing area (10 ha) for fruit crops and market gardening in Rindiao;
- o A seed production center (50 ha) under construction with CEAO financing; and
- o Three testing areas for rainfed crops, at Kaedi, Barkeol, and Selibaby, financed by the INSAH-EDF.

(6) Budget

The sources of funding and the state of the budget are: insufficient funds provided from the national budget, and substantial though declining foreign financial aid, both multilateral and bilateral. Late payments, inflation, and restrictions complicate financing of investments and operations.

c. The National Center for Oceanographic and Fisheries Research

CNROP is located at Nouadhibou and has a branch in Nouakchott. It is under the supervision of the Ministry of Fisheries and Marine Economics.

(1) Organization

The organization consists of a general headquarters and six services:

- o Administrative and Financial Service;
- o Four technical services: Oceanography and Hydrobiology, Economic Data and Biological Statistics, Technology of Fish Products, Technology of Fishing Equipment; and
- o Branch in Nouakchott--the branch is considered a service because its role includes administration and sanitary inspection, as well as research.

(2) Mission

CNROP is responsible for studies related to:

- o The ecology, biology, and stocks of marine species (development of the biomass);
- o The hydrology of Mauritania's maritime resources;
- o Catch techniques and usage (stock and quota determination) of bio-marine resources;
- o Sanitary control, conservation processes and the economics of fish production;
- o Marketing and processing of products (technology, etc.);
- o Technology of fishing gear and equipment profitability of fishing boats; and
- o All studies pertaining to ocean and inland fishing.

(3) Programs

The programs are not yet specified. Numerous projects are awaiting precise design; their themes correspond to the above list of objectives.

(4) Human resources

The national report does not specify any information on the CNROP staff.

(5) Infrastructure and budget

CNROP services direct the following laboratories and divisions:

- o The Oceanography and Hydrobiology Service--the laboratory of hydrology and primary production, population dynamics laboratories 1 and 2, zooplankton laboratory, and inland-hydrology laboratory;

- o The Economic Data and Biological Statistics Service-- statistics laboratory, fishing operations division, production and marketing division;
- o Fish Products Technology Service--bacteriological laboratory, biochemistry laboratory, division of experimentation and extension on techniques and processes of product conservation;
- o Fishing Gear Technology Service--experimentation division;
- o Information and Documentation Service;
- o Administrative and Financial Service; and
- o Nouakchott Branch--administration, statistical data collection, sanitary inspection, marine hydrology.

d. Comments

The positive points observed are the following:

- o Because of the drought, research goals and objectives are even more directed towards meeting the population's food requirements;
- o Results are now available from research on crop and live-stock production, adapted to the difficult conditions of the country, principally in the milieu of the Senegal River basin;
- o The livestock program has accentuated the work on drome-daries and goats which are the best adapted livestock for the current climatic conditions;
- o The use and rehabilitation of natural pastures, and of the ecosystem in general, have been researched intensively and there has been a considerable effort spent in alerting the (rural) people to the problem;
- o The urgent need for studies on the soil-water-plant relationships in irrigated production and for the application of the results is accepted at all levels; and
- o Researchers as well as political authorities recognize the benefits of agricultural research work for the country, especially in these years when climatic hazards make problems worse for agricultural production and producers.

The negative points are the following:

- o Budgets are insufficient and poorly managed, especially with respect to foreign funds. This hinders current operation, and development and extension of programs. Inadequate

financing also affects equipment maintenance and replacement, and capital investment;

- o Buildings are usually obsolete or inadequate (laboratories, offices, annexes, housing). Equipment (vehicles, capital goods) and facilities are very often not functional, inappropriate, with little or no maintenance, and in inadequate quantities for the planned research programs;
- o Lack of senior-level researchers, the low level of training of the staff, and extremely rare opportunities for in-service training;
- o The relative lack of incentives for researchers. The best ones are often ignored, and have problems in getting promoted more rapidly than their much less productive colleagues to positions with more responsibility, possibilities or advantages; and
- o Inadequacy (sometimes extreme) and unavailability of scientific and technical information (all forms of documentation, contacts with other institutions, researchers, etc.);

These problems result in the lack of development of the research programs, sometimes stagnation, if not regression. This can be made worse by climatic problems.

3. Field data analysis--agricultural training

a. National School for Agricultural Training and Extension

The National School for Agricultural Training and Extension (ENFVA--l'Ecole nationale de formation et de vulgarisation agricole), located in Kaedi and created in 1964, is the only agricultural training institution in Mauritania.

(1) Curriculum

The school trains technical agents (conducteurs de travaux agricoles-cycle B) and agricultural instructors (moniteurs d'agriculture-cycle C) in agronomy, livestock production, and environmental production.

The conducteurs are recruited in either of their last two years of secondary school and training lasts three years. The moniteurs are recruited from the third class of secondary school (BEPC level) and also receive three years of training.

At the end of their training, they are sent to work in rural development centers as skilled professionals. They are employed in:

- o The agricultural administration at sector level, extension institutions, development organizations or projects;

- o The agricultural administration at the regional level or livestock production projects; and
- o Forestry inspection units and stations in environmental protection.

(2) Human resources

Training is given by 22 people, all of them nationals (12 instructors, eight assistant instructors, and two part-time instructors).

However, due to a lack of qualified personnel, some subjects are not taught (for example, agricultural engineering). With the possible exception of one staff member who has had five years of training, none of the teaching staff have the equivalent of a B.S. degree. Plans are being made to fill this gap.

Beginning with the 1984-85 school year, a training program in Arabic will be introduced to better integrate the school in national affairs. This "Arabization" may pose new problems for the students trained abroad.

(3) Facilities and budget

The school has a farm of 112 ha, 37 of which are used for demonstration crops and teaching experiments (rice, millet, market gardening), and the rest for forestry studies and pastures for the animals on the farm.

The library is in good physical condition, but is short of books, periodicals, and scientific publications in general. It is not kept up to date.

Until 1981, financing for the school and for technical assistance to train students and national instructors, was provided by FAO and UNDP. Now, all of the instructors are nationals and the school budget has been taken over by the State.

b. Comments

The school's major strength seems to lie in the instructors' using local Mauritanian resources. For example,, instructors are nationals, the school is located in Kaedi (the region most directly involved with agronomic issues) and the emphasis is on maximum student integration into the environment in which they will be working. The school and its testing and demonstration fields are located in the most promising area of Mauritanian agriculture.

The emphasis on training at home instead of abroad should result in skilled professionals who have a sound understanding of local conditions, rather than office theoreticians.

The principal weaknesses are the following:

- o No training is given in the field of fisheries. However, the CEAO plans to participate in the creation of a regional school in Nouadhibou, the Higher Education Institute of Fishery Sciences and Techniques (Institut supérieur des sciences et techniques halieutiques);
- o The national trainers urgently need more advanced technical training, as well as training in teaching methods. The number of refresher courses during vacations, scientific conferences on new agricultural techniques, training sessions in development projects, etc. should be increased and made more accessible to trainers so they can be as competent as possible;
- o There is a need for a plan to formalize the collaboration between the school and research and extension. The instructors must be informed of research results, so that students can know about new advances. A permanent institutional linkage should be established with the research and extension departments. This could be done, for example, with lectures given by visiting teachers; and
- o Considering the growing need for skilled professionals in agricultural extension, the school's capacity is becoming inadequate. An expansion project financed by Saudi Arabia for 100 million ouguiyas should begin soon (an international call for tenders has already been placed). With this expansion, a training program for ITA (Ingénieurs de travaux) should be set up.

4. Field data analysis: agricultural extension

a. Extension institutions

There are no formal extension institutions, in the strict sense of the word. The work is being done by "units" of different levels--either in a project or in the administration:

- o Extension Service in the Department of Agriculture in the MDR;
- o Extension Service of CNRADA (operational in development companies or projects);
- o Extension Department of SONADER, or of ENFVA;
- o Extension Department of ENFA;
- o Cooperative Training Center of Boghe; and
- o Extension teams responsible for technical subjects in projects with various sources of financing.

(1) Activities

SONADER replaces the extension services of the MDR and CNRADA, which are not operational, to do extension work with farmers in the irrigated areas of Rosso, Boghe, Kaedi, and Gouraye.

ENFVA provides extension on themes related to food and vegetable crops and to livestock (castration, parasite control, disinfection, and the use and conservation of forage).

The Boghe Cooperative Training Center trains farmers in cooperative activities and management.

Other projects and institutions disseminate information on technical themes related to reforestation and environmental and crop protection, timing of cultivations, production techniques, animal traction, market gardening, irrigation and water management, fertilization, variety and seed selection, herd management, and other special topics, or on subjects meeting particular needs.

In addition, topics related to health, training, and leadership in rural areas are often included.

(2) Human resources

The number of staff in these departments, centers, divisions, organizations or projects specializing in extension is hard to estimate, for a number of reasons. Firstly, extension is generally not the sole activity of a given staff person. Secondly, with few exceptions, extension agents are scattered throughout several departments. Only SONADER is equipped with a structured "Extension Service" with a hierarchy of a director, workshop chief, credit manager, and extension agents working directly with farmers on irrigated crop lands.

Finally, the national report does not specify the number of agents in other "units" who devote at least 50 percent of their time to extension.

(3) Facilities and budgets

It is rarely possible to evaluate the proportion of the budget that each of these units uses for extension because it is not listed separately either in terms of operations or salaries. Moreover, the share of the total budget allocated to extension can vary greatly depending on the unit involved. The total operating budgets of the main units mentioned above are listed in Table 18.

Agricultural extension infrastructure is extremely limited since there is no actual extension institution and since the activities are carried out by agents spread throughout the rural areas, whose role is to teach new techniques or knowledge to rural producers.

Table 18: Budgets of Extension Institutions

<u>Unit</u>	<u>Time Period</u>		<u>Budget (in UM)</u>	
	<u>Beginning</u>	<u>End</u>	<u>Total</u>	<u>in 1983</u>
SONADER	June 1978		NA	NA
ENFVA	NA	NA	NA	NA
Boghe Center	1979	1986	13,000,000	NA
Barkeol IRD	1979	1983	51,800,000	10,125,000
Rosso IRD	1979	1983	64,400,000	13,300,000
Gorgol ID	1980-83	1986	95,800,000	17,400,000
Assaba-Guidimaka Dry-farming	1979-82	1983	104,000,000	NA
Karakoro Rural Training	NA	1984	59,000,000	NA
DRIG	1977	1983	330,000,000	NA

NA = Not Available.

Source: DEVRES/INSAH Agricultural Research Resource Assessment, 1983.
See National Report on Mauritania for more detail.

b. Comments

Since there is a large number of extension agents scattered throughout several institutions, the government has become aware of the need for coordination. Therefore, in 1983, it organized a colloquium for them in Nouakchott, together with researchers and agricultural teachers.

The extension agents have easy access to research results and work well with research field workers and farmers--especially if the farmers have already had contact with extension agents.

Among the problems that confront extension agents is a lack of formal professional training, for which there is no institution in Mauritania. Extension agents are also too isolated from each other and cannot therefore benefit from mutual discussion of their problems and experiences. Finally, their work is not sufficiently coordinated, despite the colloquium held in Nouakchott.

Financial resources are inadequate, both for purchasing working materials and agricultural inputs whose use is to be presented in extension, and for investments that may become necessary.

5. Constraints to increased productivity

a. Policy constraints

(1) Deterioration of the terms of trade

Despite state-set incentive prices to stimulate grain production, rising input and energy costs and competition from low-priced imports have resulted in stagnant agricultural production output.

(2) Rural outmigration

The riskiness and unprofitability of agriculture have caused farmers to migrate to urban areas for more secure salaried jobs. The rural population now consists mostly of women and children who have remained behind. Consequently, the rural labor force is inadequate to do all of the effective agricultural work required.

(3) Access to land

Sharecropping is the most common form of acquiring the right to use agricultural land. Despite the 1983 land tenure law, agricultural production is limited by the continued uncertainty about access to land caused by the complexity of farmer-land owner relationships.

b. Agronomic constraints

(1) Climate

Climate is the chief physical constraint to productivity. Since 1968, rainfall has repeatedly been slight and poorly distributed. Thus, rainfed crop yields are low, and flood recession production has been reduced by a reduction in the area available.

(2) Pests

A multitude of pests accompanies a rainfall, and when rainfall is better there are even more insects. Thus, in 1980-81, it was estimated that pests caused a loss equivalent to 15 percent of expected output.

(3) Lack of credit

The lack of credit to buy inputs for rainfed crops because of the riskiness of the profitability is often noted. The FND was created to solve this problem, but it is not yet operational due to unresolved problems in securing guarantees for debt recovery.

c. Livestock constraints

(1) Forage supply

Mauritanian livestock herding is extensive; that is, the livestock is fed almost exclusively on natural pastures. With the more frequent rainfall deficits, spontaneous forage growth has dropped sharply and pastures are now overexploited. Despite the sharp decrease in stock numbers they do not provide enough feed for the livestock. Since the first drought years (1968-70), forage capacity is no longer adequate for a satisfactory level of average animal output. Commercial forage supplements may help keep animals alive, but they are offered at prices that are too high to allow profitable production.

(2) Watering

Meeting the water requirements of the herd has also become increasingly difficult due to lowering of the water table, reduced flow of water at wells, and because there is little male labor for the strenuous work involved in drawing water from wells.

(3) Pathology

Since livestock has been weakened by lack of feed and water, a new outbreak of disease has occurred. Not only have known diseases become more virulent, but "new diseases" are appearing and proliferating among the anemic stock.

d. Fishery constraints

(1) Inland fisheries

Inland fishing is possible only in the Senegal River and has been sharply reduced since 1968 because of the low water level caused by the drought.

(2) Atlantic fisheries

Major constraints are the lack of small-scale fishermen, and inadequate equipment. There is also a lack of adequate marketing channels to sell the fish in inland cities that are very far from the Atlantic coast. A boat motorization project is currently underway to assist fishermen with their equipment problems.

e. Forestry constraints

There is a growing discrepancy between potential production (and the regeneration) of woody species and human and animal demands for it. This has caused a rapid decline in ligneous plant growth that could lead to total disappearance over the medium-term. This denudation process is unlikely to be reversed in the near future.

The danger is even greater for the ecosystem since the destruction of protective plant cover leads to a deterioration of soils that were already fragile. According to some, this could have serious consequences for the microclimates.

Reforestation measures such as planting of ligneous species are underway only in relatively small areas. Highest priority should be awarded to protection and restitution of plant life, and through it, the restoration of the ecosystem.

f. Other constraints

(1) Institutional

The access to useful information on farming is difficult for the Mauritanian farmer because of the lack of a continuous and efficient extension service, which in turn is due to the inadequate level of training of the extension workers. Lack of communication between producers, extension workers and research workers due to the remoteness, isolation and insufficient mobility of the agents (who have inadequate and unreliable communication) contribute to limiting the progress of agricultural research and development.

The national report also stresses the lack of credit (and of capital, in general) for agricultural equipment, particularly for animal traction. In addition, extension service is inadequate (SONADER) and not readily available, particularly in irrigated areas.

(2) In research

The lack of promotion of research workers in relation to their success, the fact that their efforts are not sufficiently taken into account in the advancement of their career, their "status" of employment often not providing sufficient job security, and the need to spend a lot of time overcoming everyday difficulties, lead the research workers to leave their jobs very easily.

(3) In training

There is only one training school, with limited capacity and a lack of diversity in training levels. Agents should be trained at a minimum of three levels, and the hierarchy and timetables should be specified according to a plan that identifies the country's actual requirements. It has also been noted that it would be better if the lowest-level agents were not always directed to be extension workers.

(4) In extension

Problems include the insufficient number of extension agents and their inadequate training, particularly to properly assume their role of transferring information from researchers to producers. Because of their status as salaried employees, it appears that they do not participate enough in the concrete and everyday problems of rural life.

There is another major problem in the area of livestock. Extension agents are having problems providing information to livestock producers since they are scattered around the country and the communications infrastructure is inadequate to cover these great distances.

6. Outline of solutions and priority actions

The National Report suggests solutions to the constraints in the agricultural sector. The suggestions were made by the National Consultative Commission on Agronomic and Veterinarian Research which met in Nouakchott in September 1983. They reflect the proposed strategies for which draft programs are then defined.

a. Strategic aspect of the proposals

In the areas of agronomic and veterinary research and agricultural development, the national report advocates the following:

- o Equip research institutions with the proper financial, human, and material resources to attain fixed goals;
- o Create an administrative environment in which researchers may thrive;

- o Develop initiatives and activities for cooperation between institutions and research and development agents;
- o Reinforce exchanges and contacts between national and sub-regional institutions;
- o Fully consider the need to conduct agronomic, veterinarian, and animal husbandry research on a region-wide basis;
- o Bear in mind the importance of disseminating research results (by creating a scientific journal) and documentation (by creating a publishing center to be shared by all research structures, and which would also be in charge of publishing scientific, technical, and extension documents);
- o Consider the benefits of integrating multi-disciplinary teams into research programs and associating them with the developers in integrated projects (with well-formulated and defined objectives for protocol agreements);
- o Develop a policy to integrate agriculture and livestock production, and range management and livestock management;
- o Establish research programs designed to address the problems of: water control and management; animal husbandry research; mechanization of agriculture; research on renewable energy sources; knowledge of the rural environment and production systems; and techniques to obtain livestock herders' participation;
- o Restructure research by decentralizing it so that it will cover the various ecological zones of the country;
- o Create a single structure for research and rural development in order to save on management costs and to improve coordination between the different centers;
- o Develop information exchanges between research and development agents, using every possible means in order to better identify actual needs;
- o Develop opportunities to train agents inside the country and improve their working conditions and career prospects so that they will remain on the job; and
- o Develop research in the field, listening to producers to better understand their production systems.

b. Proposed projects

The following projects are advocated:

- o Reinforce the research capacity of CNRADA (fruit crops, market gardening, date palms);

- o Strengthen the technical structures of CNRADA (to include all traditional crops);
- o Construct buildings at CNRADA;
- o Support research in food crops (maize and sorghum);
- o Support research and testing of sugar cane (nurseries, varieties);
- o Support date palm production and palm tree crops in Kankossa (bring the station back into operation);
- o Create a unit for research-development liaison, for recording, synthesis, and dissemination of research results, and for setting priorities and orientation for work;
- o Standardize production units (formulation, assistance, and monitoring of new projects);
- o Research in the world literature for new techniques and innovations in agriculture (biogas-compost, intermediate mechanization, agricultural diversification);
- o Establish a multi-site testing network (in the five ecological zones);
- o Inventory traditional crop production systems; and
- o Finance training of national professionals and missions designed to establish the directions of national programs for research in vegetable, fruit and other food crops.

7. Conclusions and recommendations

a. General recommendations

(1) Climatic study

The degraded state of the environment in Mauritania requires an investigation of the current changes in climate that result in drought. In order to reformulate agricultural research and development policy it is of utmost importance to find out whether a quick return to less harsh climatic conditions may be expected.

This project, which also extends to other countries, will be based on the study of all of the meteorological data collected and processed in Western Africa from the very beginning of such data collection. Since a super-regional approach is being employed to attack the problem, it will be discussed with the regional projects.

(2) Environmental protection

Since the environment is deteriorating at an alarming rate, a study must be conducted as rapidly as possible which sets forth criteria for the rational management of environmental resources. In order to stop the progression of desertification, methods of use and protection of natural vegetation must be developed and promoted in extension programs. In particular, the means must be found to strike a balance between grazing requirements and forage production; a way must also be found to meet the population's need for wood without further destroying the plant environment.

(3) Information

Information systems are inadequate both in terms of collection and dissemination. This is true for institutions of research and development and in extension activities as well. An investigation is needed into the possibility of setting up an information center which would have a two-fold role:

- o First, to organize meetings bringing together all persons involved in research and development, by sector or area of research, so that they may exchange experiences and information; and
- o Second, to disseminate the minutes of these meetings, and to publish all other information on research work done or of interest to agricultural research in Mauritania, and inform extension agents of these publications.

b. Recommendations on factors of production

(1) General

Given widespread poverty among Mauritanian producers, an evaluation is required of their needs for technical, food, and financial assistance to induce them to stay in the rural areas, in order to check massive rural migration to cities. Farmers' land tenure status must be made more secure, so that they benefit from the efforts made to improve their well-being.

(2) In agronomy

Given current conditions and the goal of food self-sufficiency, research must be promoted on:

- o Improvement of traditional food crops (millet, sorghum, cowpeas, and maize), in particular, by conducting more tests on varieties in the field and by ensuring the development of an effective system to make seeds available;
- o Use of Azolla and other crops each year, in associated rice production;

- o Improvement of vegetable conservation techniques, and the importance of vegetable crops in cropping systems; and
- o Restarting the Kankossa station, with an emphasis on the control of the date palm mealybug and the development of vegetable crops in the palm groves of oases.

(3) In animal production

In this sub-sector the objectives are three-fold. They include focus on food self-sufficiency, the vital importance of stopping environmental degradation, and the need to promote livestock species that are already best adapted to the conditions of the current drought. To attain these goals, the following measures are needed:

- o Improved livestock productivity, bearing in mind the priority to strike a balance with forage production;
- o Stepped up research on goats and dromedaries; and
- o Promotion of integrated crop-livestock farming (forage, manure, animal traction) in the southern region and in oases.

(4) In forestry

The main objective is to reestablish plant life in order to stop the advance of desertification while trying to meet human demand for wood and animal demand for forage. The strategy should be:

- o To implement a large-scale and widespread campaign to protect existing woodlands. This operation would focus on providing people with information on environmental conservation and their duty to limit their demands from it. Methods of non-destructive use of the environment must be developed and extensively demonstrated to the population;
- o To provide the population with products to substitute for wood in order to meet their needs. Research on this whole subject is very urgently needed; and
- o To pursue reforestation operations with an emphasis on local species.

(5) In fisheries

In this sub-sector, the urgent requirements vary depending on whether it is inland fishing, which has been severely afflicted by the drought, or Atlantic fishing. The latter is in a phase of rapid expansion; its development can be further accelerated by establishing an adequate organization for the supply of equipment (motors, nets, and other materials). The first thing to do for the whole sector is to strengthen CNROP in Nouadhibou by providing it with the necessary staff, equipment, and operating budget.

c. Recommendations on institutions

(1) General

From the outset, research objectives and the choice of priorities must be clearly defined at the decision-making level. Research is often confused with agricultural extension activities, probably because skilled personnel lack research training. After close consultation with farmers, researchers, and policy makers, clear objectives must be set and researchers must be fully informed of them.

Moreover, problems arise because of erratic budget support and from attempts to evaluate the "profitability" of research and researchers through a system of sanctions or bonuses. Competent units with authority to intervene and handle these problems should be created.

(2) Research institutions

The national research structures were created fairly recently and have not yet reached full production. Consequently, they must be strengthened and their development accelerated, focusing on three priorities:

- o Formulating global research planning;
- o Creating the proper conditions whereby skilled research workers will remain on their jobs in research institutions; and
- o Drawing up and finding reliable financing for research programs that emphasize very important subjects that have not yet been considered, for example, forestry and the protection and regeneration of plant cover, research on aquaculture, and the analysis of traditional production systems.

(3) Training institutions

A study must be conducted on the reorganization of ENFVA--after solving its budget, infrastructure, and equipment problems--with the following medium- and long-term goals:

- o Train more higher-level researchers at the institute itself (too many are still trained abroad). Researchers must also receive more practical training, in particular, by having them participate as students in current research or development operations;
- o Provide in-service training in teaching and scientific methods to field agents (researchers, extension agents, developers); and

- o Include the participation of high-level researchers and developers in training courses for agricultural extension agents.

(4) Extension institutions

Three types of priority problems need solutions in the field of extension:

- o Farmers are incapable of fulfilling their needs on an individual basis. The training of village groups for communal action should therefore be encouraged;
- o Extension activities lack consistency. The units do not consult enough with each other, and the extension agents' working methods are too disparate. The latter problem results from the absence of training institutes for extension agents. Agents also do not have access to higher-level jobs in rural development. A study should be conducted to develop a training center to train new extension agents and to hold refresher courses for those already on the job. When training is completed, they must be given a status commensurate with their skills, and the possibility for advancement; and
- o Within extension units, funds and planning are inadequate for the purchase of vital inputs that would enhance the credibility of extension programs. Financing for this must be found, and greater priority must be given to providing farmers with the appropriate quality and quantity of inputs at the correct time.

F. Niger

1. General information on Niger

a. Geography

(1) Location and boundaries

Niger is one of the four land-locked Sahelian countries. It has an area of 1,267,000 km². It is bordered by Upper Volta and Mali to the west, Algeria and Libya to the north, Chad to the east, and Nigeria and Benin to the south. Distance to the closest seaport is more than 1,000 kilometers.

(2) Climate and ecological zones

The climate varies from north to south with greater rainfall in the south. The four types are described below:

- o The Saharan climate where there may be no annual rainfall;
- o The North-Sahelian climate which has less than 200 mm of rain per year (called Saharan elsewhere in this report);
- o The South-Sahelian climate where the rainy season is longer but the rainfall does not exceed 500 mm a year (this is called Sahelian elsewhere in this report); and
- o The North-Sudanian climate in the southern-most part of the country which has a 3-1/2 month rainy season and over 500 mm of rainfall a year.

The agriculture of Niger is divided into six ecological zones forming bands running more or less east and west across the country. The rainfall pattern varies from 300 mm in the north to 800 mm in the south. The distribution of rainfall in the ecological zones tends to determine the pattern of production activities (crop and/or livestock production).

(a) The pastoral zone

The pastoral zone to the north covers an area 50 to 100 km wide, from the Malian border in the west to Lake Chad in the southeast. It is the largest of the zones. The main vocation in the zone is livestock production. The conditions are not suitable for crop cultivation.

(b) The transition zone

A transition zone, south of the pastoral zone, includes the northern limit of the crop production area. Nonetheless, because of the low average rainfall, the main activity is livestock production.

(c) The agricultural zone with low potential

Still further south, the third zone has some agricultural potential, although it is quite low, mainly due to inadequate rainfall. Drought-resistant crops like millet are traditionally grown in this zone.

(d) The agro-pastoral zone

The agro-pastoral zone is suitable for both crop and livestock production. Rainfall is rated from average to good. The soils have an average fertility. The zone is somewhat sparsely populated and potential exists for improving productivity.

(e) The critical agricultural zone

This fifth zone is described as "critical" because of the high population density and the increasing threat of soil degradation. It is comprised of several isolated areas, particularly in the Dosso and Maouri Valleys and near Maggia, and a 50 to 100 km wide band along the Nigerian border.

(f) The river valleys and oases

This category includes the Niger River valley (Niamey and Dosso departments), the Takka Valley and Konni Plain, the Goulbide Maradi, the shores of the Komadougou River and of Lake Chad, and the oases and gardens are in the Agadez area.

The last zone shows the importance of water resources. The country benefits particularly from the Niger River which runs a length of 500 km in the western region. The two other important water resources are the Komadougou-Yobé River and a portion of Lake Chad.

(3) Communications

The road system totaled 19,000 km in 1978; 3,607 km are all-weather roads and 1,520 km are of average quality. No railroad system exists in the country. Niamey, the capital city, has the only international airport in the country which is used by several airlines: Air Afrique, Nigerian Airways, Air Algerie, UTA, Air Niger, Air Volta, etc. Several internal airlines exist in the country. Other internal means of communication are telephone, short wave radio, and television. Similarly, external communications are assured by telephone, telex, and satellite services.

b. Demography

The 1977 census showed a total population of 5,098,427 inhabitants, with 6,006,600 inhabitants projected for 1983. The population growth rate for 1970-75 was 2.68 percent per annum, and is projected at 2.97 for the 1985-90 period. In 1983 it was estimated that the rural population comprised 84.7 percent of the total. The

average population density is estimated at 4.4 inhabitants per km². There is, however, a very unequal population distribution over the national territory. The population distribution in the seven départements (regional administration units) is shown in Table 19.

There is a high concentration of population in the southern portion of the country, where 75 percent of the population occupies 12 percent of the national territory. Urban population represents 7.3 percent of the total but may receive temporary migration flows, particularly after the cropping season.

There are seven important ethnic groups within Niger, with populations as follows (1975 census):

- o Hausa: 2,837,950; more than half of the population;
- o Sonrai-Djerma: 1,124,371;
- o Kanouri: 219,540;
- o Peul and Rimaibe: 433,102; sparsely settled around the country;
- o Touareg-Bella: 405,711;
- o Toubou: 17,523; in the eastern region;
- o Arabs: 24,652; essentially livestock producers; and
- o Others: 28,880.

The two most important languages are Hausa (56 percent) and Djerma (22 percent); however, the official language is French.

c. Education

A formal education system is highly emphasized, although a professional training component does exist. In most cases, the professional training tends to be short-term and responds to the on-the-job training needs, such as professional training and teacher training.

The formal education system is comprised of the primary, secondary, and university levels:

- o The primary level had 253,062 students in 1982. It receives 6-7 year olds for a six-year training. Those completing successfully are awarded a diploma-- Certificat de fin d'études du premier degree (CFEPD);
- o The secondary education is divided into two "cycles". The first "cycle" lasts four years, ending with the diploma Brevet d'études du premier cycle (BEPC). The second "cycle"

Table 19: Population Distribution, Niger, 1977

<u>Department</u>	<u>Population</u>	<u>Percent of Total</u>	<u>Population/km²</u>
Agadez	124,657	2.4	0.2
Diffa	166,741	3.3	1.2
Zinder	1,003,748	19.7	6.9
Tahoua	994,481	19.5	9.4
Niamey	1,171,701	23.0	13.0
Dosso	692,811	13.6	22.3
Maradi	944,288	18.5	24.5

Source: Bureau Central de Recensement, 1977.

lasts three years after the first, with the diploma Baccalaureat. The secondary level provides both technical and general education; and

- o The University level education is given at the University of Niamey or other institutions such as the Ecole nationale d'administration (ENA).

The University is comprised of the following faculties:

- o Agronomy;
- o Natural Sciences;
- o Health Sciences;
- o Literature and Social Sciences;
- o Economics and Law; and
- o Institute of Research and Math Studies.

From 1979 to 1982, 1,359 Nigerien students received a University degree. However, 66 percent were educated outside the country, in West Africa (Ivory Coast, Senegal, Togo) and Europe (mainly in France).

d. Government

Niger was proclaimed a republic on December 18, 1958. It became independent on August 3, 1960.

The last political change occurred on April 15, 1974 when the army came into power. The Conseil Militaire Supreme (CMS) is the highest political authority in the country. Its President is also the President of the State. The government is comprised of a Prime Minister and 20 Ministers and Secretaries of State (January, 1983).

The government has stressed its particular commitment to agricultural development with the general goal of attaining national food self-sufficiency and economic self-reliance.

e. Economic indicators

The total gross domestic product (GDP) was estimated at 650.4 billion FCFA in 1982. The rural sector contributed 47 percent of the GDP during the 1979 to 1982 period. This includes the combined output from the crop, livestock, fishery and forestry sectors. The overall growth pattern of GDP for the 1979 to 1982 period is shown in Table 20.

The major export items are uranium and livestock products, which accounted for about 90 percent of the exports in 1983.

Table 20: Growth Rate of GDP in Niger, 1979-1982

<u>Year</u>	<u>Growth Rate</u> (percent)
1979	13.6
1980	4.9
1981	1.1
1982	-0.7

Source: Ministère du plan, 1983.

The major imports are fuel oil, food, and industrial products. The most important trading partners are France, Nigeria, and the other members of the European Economic Community (EEC). The external trade for 1979 through 1983 had a deficit balance in each year. (See Table 21.)

f. Rural sector

In 1979, the area suitable for agricultural production was estimated at 15,000,000 ha. During the same year the area cultivated was estimated at 3,866,000 ha; in 1981 3,551,200 ha were cultivated. To date the irrigated area is estimated at 24,000 ha. Table 22 presents the most important crops in Niger, the area planted and the yield per ha for 1981.

The total area of pasture land was estimated at 9,700,000 ha in 1979. The magnitude of the pasture area indicates the extensive nature of livestock production in the country. The main livestock products and the amount and value of production for 1981 are shown in Table 23.

Fishery activities have not received great attention. As a result, neither the production systems nor the potential are well known.

The overall development strategy stresses the need to increase crop and livestock production, diversify the crops grown, and organize a better marketing system. Environmental protection, particularly soil conservation, is another important development component.

2. Field data analysis: agricultural research

a. Research institutions

There are four research institutions in Niger which are concerned with the agricultural sector. Three of these institutions are classified as national and the fourth as a regional/international organization:

(1) National institutions

The three national institutions are as follows:

- o National Agronomic Research Institute of Niger (INRAN--Institut national de recherche agronomique du Niger). It is under the auspices of the Ministry of Higher Education and Research (MES/R);
- o National Office of Solar Energy (ONERSOL--Office national de l'énergie solaire). The ministry responsible for the office is the MES/R; and

Table 21: External Trade Balance of Niger, 1979-1983
(Billion FCFA)

Designation	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>
Exports	103.1	124.9	126.3	119.0	133.6
Imports	<u>140.1</u>	<u>171.7</u>	<u>172.4</u>	<u>173.3</u>	<u>151.0</u>
Balance	-37.0 =====	-46.8 =====	-46.1 =====	-54.3 =====	-17.4 =====

Source: Ministère du plan, 1983.

Table 22: Major Crops Grown in Niger, 1981

Crops	<u>Area</u> (ha)	<u>Average Yield</u> (kg/ha)
Millet	3,100,000 ^a	360 - 450
Sorghum	982,000 ^a	300 - 500
Cowpea	1,140,000 ^a	240 - 320
Groundnuts	170,000 ^a	530 - 620
Rice	23,000	1,200 - 1,900
Maize	12,000	600 - 775

^aOften areas for millet, sorghum, cowpeas and groundnuts are intercropped.

Source: Plan Quinquennal, 1983.

- o Ecology Research (DRE--Departement de recherches ecologiques; and
- o Rural Economy Research (DRER--Departement de recherches en economie rurale).

The five research departments in turn are divided into sections. The major research programs, by Department, are the following:

(a) Crop research department

The department is divided into rainfed and irrigated farming research, with programs as follows:

- o Rainfed farming, including cereal crop improvement, particularly in sorghum and millet, and legume crop improvement, particularly in cowpeas and peanuts; and
- o Irrigated farming, including improvement of rice, fruits, and vegetables.

(b) Veterinary and Livestock Research Department

The two research programs are improvement in animal health and improvement of animal feed and nutrition.

(c) Forestry Research Department

The forestry department conducts a research program on the introduction and establishment of various tree species, (Eucalyptus, Neem, Cassia, etc.) in the Sahelian zone.

(d) Ecology Research Department

The two research programs are an inventory and classification of soils, and a program on soil chemistry.

(e) Rural Economy Department

This department conducts studies on farming systems, in both rainfed and irrigated sectors.

(2) ONERSOL

Its agricultural research program focuses on drying fresh onions and other agricultural products using solar energy. The activities are carried out in two sections: the research section, and the production section.

The research work at ONERSOL is carried out in collaboration with INRAN. However, ONERSOL has a production unit located in the industrial zone of Niamey.

(3) IRSH

The major research areas include geography, history, archeology, sociology, and linguistics. The research activities are usually carried out in connection with the thesis topic of the researcher.

Problem-oriented research programs are often undertaken in collaboration with other research and development institutions. IRSH also operates in various stations, most importantly those in Niamey and Agadez.

(4) ICRISAT

This was established in 1982 to serve as the regional coordinator for ICRISAT's millet research. The foci of its programs are millet improvement, peanut improvement and socioeconomic studies, particularly in farming systems associated with these two crops.

ICRISAT carries out its program in its own research center at Sadore, located 45 km south of Niamey. The station has an area of 500 ha. ICRISAT also undertakes other research activities at different sites, particularly in collaboration with national and international institutions (CIPEA, IFDC).

(5) Summary of the agricultural research programs

A comparative list of the major agricultural research programs of INRAN and the other institutions is presented in Table 24. As shown in the table, agricultural research in Niger is conducted under the umbrella of INRAN. Among its various activities, IRSH conducts research programs in rural sociology.

c. Human resources

As of late 1983, there were 633 personnel associated with the agricultural research institutions. The composition of the staff by institution is shown in Table 25.

d. Facilities and operating funds

(1) Infrastructure and equipment

The equipment and infrastructure possessed by the four research institutions are as follows.

For INRAN, at the Tarna station there are five laboratories in good condition but not fully equipped, and 22 offices for researchers and technicians. At the Kolo Station, INRAN has one laboratory in good condition, which is currently used as an office for agents, plus three other offices for researchers. The Tillabery Station has a laboratory for sugar cane analysis, but it is in poor condition and

unequipped; there are also two offices. At Agadez station there is one laboratory.

The Niamey station of ONERSOL has one laboratory. IRSH has one research laboratory in good condition for research, and 11 offices. ICRISAT's current facilities at Sadore are temporary. Offices and laboratories will be built in the near future.

(2) Documentation

Both INRAN and IRSH have libraries. At the Tarna Station of INRAN, there is a library with 2,500 books and six scientific journals, with an acquisition rate of 60 volumes per year. The most frequently consulted journals are Agronomie Tropicale and Journal des Sciences Oleagineux. At the Kolo Station, there are about 40 books and 260 journals in the Director's office. The most frequently-consulted journals are Agronomie-Tropicale and Afrique-Agriculture. A shelf of books exists in the Director's office of the Tillabery station but journals have not been received in recent years. The INRAN documentation center is in Niamey, and has 4,000 works.

IRSH has a library with 14,000 books and 14 journals.

(3) Financial Resources

The financial resources of INRAN and ONERSOL are known and are as follows. INRAN's median budget for the past three years has been FCFA 810 million, of which FCFA 400 million was State funds used as an operating budget, FCFA 150 million was national funds for investment (FNI-Fonds national d'investissements) and FCFA 260 million was from an external source.

ONERSOL has a total budget of FCFA 315 million, of which FCFA 287,000,000 comes from the national budget and FCFA 28,000,000 comes from an external source.

e. Comments

Prior to 1975, agricultural research in Niger was conducted by a multitude of institutions: IRAT, IEMVT, IRFA, IRHO, CTFT, IRSH, ONERSOL etc. A national council for research was set up in 1968 to develop policy and coordinate programs. It was dissolved in 1974. Beginning in late 1975, however, the principal responsibility for research and testing of agricultural innovations was transferred to INRAN. This change was effected with the hope of facilitating coordination of research programs, improving adaptability of the research output to local conditions and assuring effective transfer of technology to the farmer.

With the exception of ICRISAT's activities, all major agricultural research programs are currently conducted within INRAN. The activities of ICRISAT are based on a special memorandum of understanding signed between ICRISAT's headquarters and the Ministry of Higher Education in Niamey.

As of 1983, INRAN employed about 80 percent of the research personnel in the country. However, only 10 percent of the employees are in the research worker category.

As confirmed in the 1982 Zinder Conference on the role of agricultural research in Niger, the criterion by which INRAN's research is judged is the extent to which the research program reflects the farmers' needs. Procedurally, the list of priority research activities is generated in an annual conference of extension agents and researchers. Nonetheless, INRAN's attempt to identify location-specific agricultural techniques within diverse ecological zones of the country is constrained due to the shortage of well-trained and experienced research personnel. Other shortcomings affecting the performance of INRAN include the following:

- o Shortage of middle-level technicians;
- o Lack of status and incentives for researchers;
- o Inadequate operating budget;
- o Inadequate equipment and lab facilities; and
- o Absence and/or shortage of scientific documents.

3. Field data analysis: agricultural training

a. Training institutions

Niger: There are four agricultural training institutions in

- o School of Agronomy and Animal Husbandry (ESA--Ecole superieur d'agronomie). The school is a university-level institution. The ministry responsible for it is the MES/R;
- o Institute of Practical Training for Rural Development (IPDR--Institut pratique de developpement rural de Kolo). The ministry responsible for the institute is the Ministry of Rural Development (MDR);
- o School for Training Animal Husbandry Technicians (ECE--Ecole de formation des techniciens en elevage. The ministry responsible for the school is the MDR; and
- o Center for Training and Application of Agrometeorology and Hydrology (AGRHYMET--Centre regional de formation et d'application en agrometeorologie et hydrologie operationelles). The ministry responsible for the center is the MDR.

is as follows: 27 instructors are needed, 11 nationals are in training and eight instructors will require further training.

(2) IPDR

There were 61 instructors at IPDR. Twenty were full-time nationals, 23 full-time expatriates, 16 part-time nationals and two part-time expatriates. In addition, there were 18 administrative staff and 51 support personnel.

(3) ECE

The staff is composed of five national instructors, four expatriate instructors, two teachers' aides, five national administrative personnel and one administrator.

(4) AGRHYMET

There are 11 full-time instructors, eight expatriates and three expatriates from CILSS countries. In addition, the school uses about 11 consultants and other part-time professors.

d. Facilities and operating funds

(1) ESA

The school is mainly funded by the state. The average annual budget during the last three years was FCFA 13 million for investment and FCFA 23 million for operations.

(2) IPDR

The operating budget for the recent fiscal year (1983) was FCFA 215 million. The facilities of the school are in good condition and include school buildings, labs and a library. The school also has 24 ha of land for use in practical training.

(3) ECE

The operating budget for the school has been FCFA 45,915,000, which was spent on salaries and materials. In addition there has been an amount of FCFA 1,341,000,000 of which FCFA 1,307,170,000 was spent on construction of the school at Kolo. The remaining FCFA 33,830,000 was allocated for purchase of support materials for the school. The school library contains about 1,000 books and scientific journals.

(4) AGRHYMET

CILSS contributes FCFA 75 million to the operating budget of AGRHYMET, which also receives assistance from several other donors. The school facilities are in good condition: two classrooms

with average capacity of 40, three classrooms with average capacity of 80, and four adequately equipped laboratories.

e. Comments

The school of agronomy and animal husbandry (ESA) is the only institution in the country providing university-level training in agricultural fields. Many of the development officers in the extension services, a few of the research workers and some of the teachers in the other institutions are graduates of the ESA. Similarly, IPDR-Kolo and the ECE provide the necessary junior level manpower for the different service institutions. Both the university and the junior level training institutions suffer from inadequate human, financial and material resources. These include the following:

- o Shortage of well trained full-time instructors, particularly at IPDR-Kolo;
- o Lack of incentive for instructors, particularly for teachers at the ECE;
- o Inadequate operating budget to cover essential teaching facilities such as library materials, lab installation and equipment;
- o Inadequate field facilities for conducting practical training, particularly at the ESA; and
- o Weak institutional linkage between teaching and research institutions, particularly between the ESA and INRAN.

4. Field data analysis: agricultural extension

a. Extension institutions

Six institutions provide agricultural extension services in Niger:

- o Division of Agricultural Services (DSA--Direction de l'agriculture). The ministry responsible is MDR.
- o Division of Livestock and Animal Industries (DSEIA--Direction des services de l'élevage et des industries). The ministry responsible is the MDR.
- o Division of Forestry and Wildlife (DFW--Direction des forêts et de la faune). The ministry responsible is the Ministry of Water Use and Environment (MH/E).
- o National Office for Irrigation (ONAI--Direction de l'office national de l'aménagement hydro-agricole). The ministry responsible is the MDR.

- o Zinder "3M" Project;
- o Diffa Agricultural Project;
- o Dosso Rural Development Project;
- o Niamey Productivity Project;
- o Namanigoungou;
- o Konni Project; and
- o Diffa Agricultural Development Center, which administers the following projects:
 - Centre-Est Livestock Project;
 - Sud Tamesna Project;
 - Pasture Management Project;
 - Planning and Use of Soils and Forests Project;
 - IDA Forestry Project; and
 - Aquacultural Project.

e. Comments

Agricultural extension services in Niger are provided by six national institutions and 17 development projects, which constitute a basic structure reaching the majority of small farmers. The focus of the extension activity is on improving productivity in different parts of the country. The DSA is the institution concerned with crop production activities. It has about 1,500 employees of which about 2 percent have four years of training beyond the BAC level. The majority of the field agents have not reached the BAC level. With the human resources currently available to the national institutions, the projects primarily employ a farmer training model with donor funding to promote agricultural techniques related to specific crops. The results of the extension effort have not been encouraging. Some of the constraints which limit the effectiveness of the Nigerien extension network are:

- o Lack of agricultural technologies suited for the various ecological zones;
- o Inadequate number of well trained extension agents;
- o Insufficient logistical support for extension personnel;
- o Lack of a systematized working relationship between the national extension services and the development projects; and

- o Lack of constant and systematic interaction between farmers, extension workers and researchers in the process of transferring recommended agricultural technology.

5. Constraints to increased productivity

The following are the major technical and institutional constraints related to increasing productivity in Niger:

a. Technical constraints

The main technical constraints, including both the human and the environmental spheres, are the following:

- o Lack of soil conservation techniques for fragile soils;
- o Lack of appropriate water conservation practices for drought;
- o Lack of appropriate pest and disease control measures, especially Striga;
- o Shortage of experienced researchers;
- o Seasonal shortage of farm labor;
- o Shortage of adequately trained research personnel;
- o Low literacy level of the general population;
- o Lack of research and statistical data on some activities; and
- o Shortage of forage.

b. Institutional constraints

The major constraints to the efficient operation of Niger's agricultural institutions are inadequate infrastructure and equipment--stations without books, buildings in poor physical condition, and inadequate information exchange among institutions. As well, poor working conditions, personnel management practices devoid of any performance standard or reward for good work, and the untimely delivery, sheer unavailability, and high cost of production inputs are serious problems.

Other constraints include the frequent incidence of brushfires, the inaccessibility of livestock watering points, and the lack of security of land tenure, especially in the bas fonds rice production areas.

6. Outline of solutions and priority actions

In order to reduce some of the constraints, the National Report lists the following proposals for activities and projects:

a. Activity proposals for research

(1) Crop production

In the area of crop production, the National Report makes the following suggestions:

- o Develop crop varieties adapted to the different ecological zones, taking into account maturity, yield, quality and resistance traits;
- o Install an effective plant protection program;
- o Investigate the economics of intercropping;
- o Assist farmers in adopting improved agronomic practices;
- o Reinforce existing infrastructure in research stations and at sites of experiments:
 - Construct a new entomology laboratory at Kolo, and a physiology laboratory at Tarna;
 - Provide facilities for the research station at Tarna;
 - Fence research sites to protect them from animals;
 - Make the plant quarantine center at Tarna operational; and
 - Create a food technology institute.
- o Regionalize the crop research effort by identifying regional centers for low rainfall, high rainfall and river valley areas;
- o Create relevant research units in each department to network with INRAN, an essential link in conducting on-farm research;
- o Organize multi-disciplinary teams to work on problems in production of major crops. Base fund allocation of particular research on evaluation of past performance;
- o Allocate adequate funds for communications among researchers. Strengthen documentation, arrange seminars, facilitate conference attendance in and out of the country;

- o Promote training of high level researchers and junior level technicians; and
- o Implement a personnel policy conducive to promoting productivity.

(2) Animal production

In research and extension dealing with livestock, it is considered essential to encourage selection of better animals, modernize pasture management, intensify study of forage production to improve animal feed, and strengthen research on animal health and the economics of mixed farming.

It is also recommended to create a new station for animal husbandry research in order to promote selection of improved breeds of cattle, sheep, goats, and poultry, and to strengthen animal health protection activities; to establish a veterinary research unit in each department to coordinate with the activities of extension programs; and to promote high level research and junior level manpower training.

(3) Forestry production

The suggestions in the National Report are to promote training of high-level researchers, encourage farmers to participate in reforestation programs, and to select and promote good quality seeds.

(4) Fish production

The suggestions in the National Report are to increase availability of necessary fishing equipment, promote conservation methods to minimize the spoilage after catch, and to train high-level specialists.

b. Project proposals

The following are additional proposals outlined in the National Report:

- o Development of rainfed cereal crops;
- o Development of rice production;
- o Development of irrigated vegetable production;
- o Development of leguminous crops;
- o Strengthening animal health programs;
- o Establishment of two animal husbandry research stations;
- o Establishment of one well-equipped veterinary laboratory;

- o Promotion of the improvement of local tree varieties;
- o Establishment of a soil and water conservation research program;
- o Research on deficiency of essential mineral nutrients in agricultural soils;
- o Research on farm production systems;
- o Program of research on costs of production;
- o Establishment of a plant quarantine center at Tarna, near Maradi; and
- o Development of soil maps of the agricultural zones with a scale of 1/100,000.

7. Conclusions and recommendations

The picture that emerges from the preceding presentation suggests the following conclusions.

Rural Niger has diverse ecological zones that can support different agricultural activities. The rural sector is very important in the country's economy. As shown in the 1979-1982 period, the combined contribution to GDP from the crop, livestock, fishery and forestry sectors was 47 percent.

The population growth rate in Niger was 2.68 percent in the 1970-75 period. This rate is projected to rise to 2.97 percent during the 1985-90 period, making Niger's population growth rate the highest in the Sahel zone.

INRAN is the major agricultural research institution in Niger charged with developing technology and testing the potential of agricultural innovations prior to their dissemination to farmers.

INRAN and the major training and extension institutions are faced with manpower, financial, material and technical problems which hinder their effective performance.

The productivity of the four subsectors (crops, livestock, forestry, and fisheries) is also limited by a multitude of constraints. The major sources of the constraints include lack of suitable production technology and the absence of necessary physical, institutional and economic infrastructure to stimulate productivity.

In the light of these broad conclusions and the presentation in the text, the following recommendations and proposals are aimed at removing some of the constraints:

a. Off-station research

Although on track, INRAN should be further strengthened, emphasizing off-station research using both trial fields and on-farm trials. In accomplishing this, a multidisciplinary team approach must be employed, involving a balance between streamlined farming systems research, information gathering mechanisms, an appropriate varietal and agronomic technology testing mechanism, and an extension/demonstration mechanism in which agents test new technologies on the farmers' fields. The following are the major benefits of the approach:

- o It promotes greater farmer participation in the development and testing of inputs: seeds, fertilizers, pesticides and animal traction equipment;
- o It facilitates the identification of the principal factors which cause the "yield gap" between the research stations and the farmers' fields;
- o It promotes greater farm level technology adoption by tailoring package components (planting dates, seeding, weeding, thinning, fertilizing, replanting, etc.) to specific locations and enterprises;
- o It enhances effective field level interaction between farmers, extension agents and researchers; and
- o It promotes improved decision making and wise resource uses both at the local and higher level by accumulating scarce data for analysis and subsequent use by policy makers.

b. Improvement of incentives

Greater effort should be made to improve the level of incentives. Farmers should be given competitive prices for their products. This can be facilitated by first understanding the relevant costs of production, and at the same time putting greater reliance on both self-motivated local cooperatives and improved private trade structure for input and product marketing.

A new personnel management policy should be developed to improve working conditions of employees at the different institutions. This entails establishing acceptable salaries and other fringe benefits to attract and retain qualified researchers, teachers, and extension personnel in the profession. The main focus should be to institute accountability, rewards and correction provisions based on a clear set of performance standards.

c. Other recommendations

Other specific recommendations to increase food supply in Niger include:

- o Delineation of priority crops and enterprises such as millet and sorghum for intensive research and extension activities;
- o Selection and breeding of local varieties of sorghum and millet for the desired characteristics of yield, resistance, taste, etc.;
- o Development and encouragement of production of cash crops both for local and export markets, based on knowledge from the on-farm studies. Where credit is involved, development of a farm budget that reflects the loan repayment capacity of the household. Consideration of income generating activities must include the investigation of the possibilities and necessary arrangements for mobilizing savings in rural areas, and the development of cost and return figures on the most promising rural small-scale enterprises;
- o Search for feasible options to minimize the prevailing imbalance between the livestock population and feed availability;
- o Improvement of grain storage facilities in rural areas in order to minimize the incidence of seasonal hunger and storage loss;
- o Promotion of awareness on the part of policy makers and the population at large about the long-term ramifications of the effect of the actual level of population growth for the use of natural resources as well as on the demand for goods and services;
- o Institution of collaborative working agreements between the major research institutions such as INRAN, IRSH, and ICRISAT, as well as between the research training and extension institutions;
- o Organization of periodic meetings to exchange views between members of the various organizations, and the establishment of joint personnel appointments in appropriate institutions, to improve collaboration between them;
- o Streamlining of the relationship between the national services and the productivity projects, in order to enhance effective delivery of service; and
- o Upgrading of training institutions for extension agents. This may entail revising the curricula and strengthening the teaching and reference materials.

d. Proposals

The following proposals from the National Report deserve priority consideration. The first four of the following proposals should be undertaken within a farming systems framework.

(1) Development of rainfed cereal crops

The objective is to seek millet and sorghum varieties that can produce sustainable increased yields in the different ecological zones of the country. The project will require FCFA 700,000,000 over five years for research expenses, training, construction and acquisition of materials.

(2) Study of production systems

The purpose of this study is to characterize different ecological zones in order to facilitate the application of technological themes in specific locations. The study would require FCFA 170,000,000 for seven years. Funds should be allocated for organizing and operating a multidisciplinary research team.

(3) Study of costs of production

The objective is the collection of statistical data to determine the costs and returns of selected operations. The data can be used in price analysis. The project will need FCFA 69,000,000, for three years to establish a researcher and teams of enumerators in the various zones.

(4) Establishment of a water and soil conservation program

The objective is to study soil-water and fertility relationships; this would require FCFA 600,000,000 to finance technical assistance, training, and procurement of needed facilities.

(5) Development of irrigated vegetable farming

This project aims at increasing vegetable production, especially of onions, by producing improved seeds. This project would require FCFA 200,000,000 for training researchers, land preparation and equipment procurement.

An alternative to consider, however, is the feasibility of importing suitable seeds in adequate quantity from neighboring countries such as Nigeria and Cameroon.

(6) Establishment of an agricultural soil mapping operation

This project would enhance the work of soil mapping and analysis. It would require FCFA 640,000,000 (including expatriate salary), mainly to acquire laboratory facilities. The

focus of the proposal is to cater to the needs of the Nigerian agricultural sector, but does not exclude the possibility of strengthening the INRAN Soil Department as a regional training center.

(7) Establishment of a regional plant quarantine center at Maradi

The primary objective is disease prevention. The project would require FCFA 700,000,000 to operate for five years in strengthening infrastructure, training, technical assistance, and procurement of equipment.

G. Senegal

1. General information on Senegal

a. Geography

With 196,860 km², the Republic of Senegal is a middle size country of Western Africa.

Bordered by the Atlantic Ocean on the west (500 km of coast), by the Senegal River on the north and northeast (boundary with Mauritania and Mali) and the Faleme River on the east, Senegal has boundaries with the two Guineas (G. Conakry and G. Bissau) and it surrounds the Republic of Gambia.

Situated at a latitude from 18° to 24° north and a longitude from 11° west to 17° west, Senegal is predominantly a Sahelian country, although part of it, namely the Casamance Region, is situated in the Sudanian zone. On the basis of rainfall and soil types, six agricultural regions may be distinguished.

- o Central Groundnut Basin;
- o Casamance River Basin, in the south (subdivided into Upper-, Middle- and Lower Casamance);
- o Senegal-Oriental;
- o Niayes, on the northwest Atlantic Coast;
- o Ferlo, northern part of the central region; and
- o Senegal River Valley.

Four rivers cross Senegal flowing towards the Atlantic Ocean. These are the Senegal-Faleme, the Casamance, the Gambia and the Sine-Saloum (not permanent). There are significant variations of flow between higher waters (July-September) and lower waters (May-June).

The country is divided administratively into eight regions whose size is in inverse ratio to population density. They and their administrative seats are the Cap-Vert region (Dakar), the Casamance region (Ziguinchor), the Diourbel region (Diourbel), the River region (St. Louis), the Louga region (Louga), the Senegal-Oriental region (Tambacounda), the Sine-Saloum region (Kaolak) and the Thies region (Thies).

(1) Climate

The climate is Sahelian in the north, and Sudanian in the south (Casamance). Rainfall varies from 350 mm in the north to 1,600 mm in the south, and occurs within a two to five month period centering on July or August. The dry season lasts from seven to ten months (October-June) and is fairly "cool" during the first part (end

of rainfall to March) and then very hot (April to rainy season) in the continental part of the country. This pattern is tempered in the western coastal region by the Atlantic Ocean exhibiting:

- o High temperatures during the day and some cool nights (10° to 15°) in the dry season (January-February);
- o Significant range of temperatures between day and night;
- o Relative humidity as low as 15 percent at noon in February-March; and
- o Prevalence of harmattan winds during the dry season.

The climate in the continental part of Senegal is predominantly Sahelian. On the Atlantic coast, these features are influenced by lower temperatures and trade winds from the northwest.

(2) Soils

An extremely flat land, with the highest point below 500 m in the southeast, and covered by continental deposits, Senegal has uniform soils. There are eight soil types, including:

- o Three zonal soils, isohumic in the north (rainfalls below 500 mm), tropical ferruginous in the center (500-1,200 mm), and poorly ferralitic in the south (more than 1,200 mm); and
- o Five azonal soils, less extended than the above soils (vertisoils, hydromorphic soils, halomorphic soils, less developed soils and heavy mineral soils).

(3) Vegetation

Typical vegetation varies from pseudo-steppe with spiny shrubs in the north (annual grass layer and sparse thornbushes) to arboreous savanna in the south with dense forest and mangroves along the permanent rivers.

(4) Communications

Senegal has a well developed road network, with most of its main roads paved. It also has a railway system with two main lines: north-northeast between St. Louis, Linguère and Dakar, and an east-west international line between the Atlantic Ocean and the Niger River (Dakar-Bamako) via Diourbel and Tambacounda.

Two seaports (Dakar and St. Louis) and one important river port (Ziguinchor) allow a substantial trade with the rest of the world.

Fifteen permanent airports, most of which are regularly serviced by Air Senegal, and one international airport (Dakar-Yoff) handle a heavy flow of passenger traffic.

The telecommunication networks (telephone, telex, short wave), both external and internal, are satisfactory, at least between capitals.

b. Demography

The 1976 census estimated the population of Senegal at 5,068,000. Following investigation and adjustment, it was estimated at 6,200,000 in 1983. The annual growth rate is estimated at 2.8 percent (versus 2.3 percent between 1969 and 1970). A population of 7,300,000 is projected for 1990.

The Senegalese population is young (53 percent are less than 20 years of age while 6 percent are 60 or over) and is divided into seven ethnic groups:

- o Wolof and Lebou, 61 percent, located in the central and northern part of the Groundnut Basin and Cap-Vert area;
- o Sereres, 14 percent, located along the short coastline and in the Sine-Saloum region;
- o Peulhs, 13 percent, spread throughout the entire country;
- o Toucouleurs, 11 percent, located in the Senegal River valley;
- o Diola, Balante, and Manjacque, 7 percent, located in the Casamance region;
- o Mandingue, 5 percent, located in the Casamance region; and
- o Soninke, 2 percent, located in Senegal-Oriental.

The average population density is 29 inhabitants per km², but it varies from 2,310 inhabitants per km² in the Cap-Vert region to 115 per km² in the Thies region, to five inhabitants per km² in Senegal-Oriental, Louga and River regions.

Thirty-five percent of the total population lives in urban areas. This represents 27.6 percent of the labor force, 19.1 percent of which was unemployed in 1976. The rural population comprises 65 percent, indicating that the country is predominantly rural. The rural labor force of 1,650,000 is mostly gainfully employed and very mobile. Seasonal and permanent migrations between regions and rural exodus towards cities have increased as the drought persists, the motivation being the search for income and employment.

Islam is the chief religion (75 percent), while Christians comprise 5 percent of the population, and animists represent 20 percent.

The official language is French, but the most commonly used local languages are Wolof, Fulfulbe, Diola and Mandingue.

c. Education

The educational system, reformed in 1961, is comprehensive and includes:

- o Numerous pre-school education and special education (for the handicapped) institutions, 75 percent of which are private. They are concentrated in the Cap-Vert region;
- o Primary education, in which 392,000 children aged 6-11 were enrolled in 1980. This represents a national average of only 35.8 percent of total school-age population. Significant variations exist between regions, urban and rural areas (60 percent enrollment in urban centers and 15 percent in rural areas) and boys and girls (60 percent of primary school pupils are boys, and 40 percent are girls);
- o Intermediate education, in which a total of 70,000 students (age 12-15) are enrolled divided between the general education network (91 percent) and technical instruction (9 percent);
- o Secondary education, in which 17,000 students are enrolled including 20 percent in technical education and 80 percent in general education (53 percent in literature, 37 percent in science, 10 percent in technical subjects);
- o Professional education, which follows the intermediate cycle and includes 12 conventional establishments with 1,300 students, some of whom study agriculture or horticulture; four training schools for adults (with 3,000 trainees in 1979); and 29 regional technical training centers for women (2,000 trainees in 1979); and
- o Higher education, at the University of Dakar and several regional institutes. The University of Dakar has four faculties and six university colleges and institutes; a total of 11,664 students were enrolled in 1980. There are also eight specialized schools of higher education in Senegal, including two rural institutions--the National Institute of Rural Development and the National School for Rural Administrators. The total number of students in 1980 was 10,643.

d. Government

An independent republic since August 20, 1960, Senegal adopted a constitution providing for a multi-party system. Executive power is vested in the President of the Republic; legislative power is held by the National Assembly (120 members elected for five-year terms) assisted by the Economic and Social Council.

Senegal is divided into eight regions and 30 departments. Rural communes were established in 1972 to provide opportunities for rural participation in public affairs.

The government budget includes an operating budget which has maintained a positive balance since independence, and a national capital budget which has always been in deficit. The overall national deficit amounted to FCFA 12 billion in 1979-1980.

Major policy goals in agricultural production include improving rural living standards and the food distribution network, assuring sufficient agricultural production and preservation of the environment, and encouraging rural populations to participate in rural administration. In agricultural research, major policy goals include increasing the coordination of the current research approach by integrating a multidisciplinary focus and production systems studies with defined regional priorities. As well, efforts should be made to strengthen research linkages with extension and training, and between domestic and foreign research institutions, and to plan long-term training and advanced courses for researchers and technicians and improving personnel management.

On the international level, Senegal is a member of the UN (and its associated agencies), OAU, CEAO, ECOWAS, UMOA, CILSS, OMVS, and OMVG.

e. Economic indicators

Between 1959 and 1980, the GDP grew at an annual rate of 2.2 percent from FCFA 184.9 to FCFA 282.2 billion (in constant 1971 FCFA), and by 6.4 percent to FCFA 517 billion in 1980 (in current terms).

International trade has shown a rapid growth in imports and relative stagnation in exports. In 1980 the value of exports was less than 50 percent of the value of imports (FCFA 199.3 billion).

Senegal is part of the franc zone and the UMOA zone. The exchange rate of the FCFA (=0.02 FF) against the US dollar was FCFA 370-410 for US \$1 during the last trimester of 1983. The inflation rate was 16 percent in 1980, 21 percent in 1981, and 17 percent in 1982.

External aid was US\$ 245 million in 1980 (which represents a 15.6 percent increase from 1979), including US\$ 107 million in technical assistance of which 32.8 percent was for agriculture, forestry and fisheries. Food assistance amounted to approximately US\$ 11 million in 1980.

f. Rural sector

Estimates of cultivable land in Senegal are in the range of 3,730,000 ha, with a current utilization rate of approximately 72 percent in 1980. These lands are generally cultivated by small farmers, whose reference unit, based on the notions of family and farm, is the carré (compound).

Land ownership, which varies with the ethnic group, is generally dominated by the inalienable right to the land concept, based on old

tribal customs which are clarified in the Natural Environment Act (Loi sur le domaine naturel).

(1) Major crops

A list of the major crops cultivated in Senegal, with details on the average planted and production fields is given below:

Groundnuts account for 50 percent of export revenue and 40 percent of the national budget. Fifty percent of Senegal's cultivated land is in groundnuts. Production reached its highest point in the 1960's at 1,000,000 t, and then dropped to an average of 780,000 t between 1976 and 1982. The 1983 production is estimated at a very low 500,000 t as a result of drought and poor soil.

Millet and sorghum cover 1,000,000 ha, of which 850,000 are devoted to early millet. Annual production is estimated at 600,000 t, signifying a yield of 530 kg/ha. There appears to be a constant increase in the number of ha cultivated in these crops.

Unknown commercially before 1961, cotton is currently cultivated in the south, with an average yield of 1.1 tons/ha. The 1972 crop was 47,500 tons. Since 1967, production has exceeded the needs of the country.

Rice is cultivated in two very different regions. Irrigated rice is cultivated in the Senegal River valley and irrigated, rainfed and aquatic rice in the Casamance region. Annual production borders on 100,000 t of paddy rice; 25 to 50 percent, depending on rainfall, is produced along the river. Average yield of paddy rice is 1.3 t/ha. With a demand of 360,000 t, Senegal must import 25,000 t per month.

In 1979-1982, maize production averaged 43,000 t per annum, 75 percent of which was grown in the southeast. Average yields fall between 600 and 700 kg/ha.

Despite a high food value (protein) and outstanding hardiness, cowpea production remains at 17,000 t, 55 percent of which are cultivated in the Louga regions. Very low yields (300 kg/ha at the most) are attributed to poor growing conditions and insect infestation.

Crop yields in cassava have been decreasing ever since the invasion by the mealy bug. Production is centered in the Casamance region and does not exceed 50,000 t.

Because of the drought and a lack of organization, horticultural production has been decreasing for five years. In 1979-80, 81,500 tons of fresh vegetables were grown on a total of 5,785 ha. Consumption per capita has decreased to 19.6 kg per year.

In 1981, 50,000 t of sugar were produced from cane which satisfies 65 percent of the national demand (estimated at 80,000 t).

(2) Animal products

In 1980, production of meats and offal was about 69,000 t, representing a per capita consumption of 12 kg. Cattle accounted for 59 percent of this production, sheep and goats 18 percent, poultry 12 percent, and hogs and horses 11 percent.

Domestic milk production of 9.5 million liters, supplemented by six million liters of imported milk, provided a per capita consumption of 25 liters at an approximate cost of FCFA 100 per liter.

Egg production is 6,000 t, which is only 16 eggs per inhabitant per year.

(3) Forestry

This sector is dominated by the two main problems of desertification and domestic energy needs. Revenues from forestry operations in 1980 were estimated at FCFA 10.7 billion (50 percent from sales of firewood, 21 percent from charcoal, 11 percent from lumber and building material and 11 percent from products gathered by the rural people).

(4) Fisheries

This sector has experienced a spectacular growth rate since 1970. Catches in the Atlantic Ocean reached 236,700 tons in 1982, with a value of FCFA 42,971 million. Small-scale fishing accounts for 60 percent of production and provides about 2.5 percent of jobs.

The production of inland fisheries dropped from 25,000 t in 1965 to 11,000 t in 1980 (valued at FCFA 500 million) as a result of the drought. Aquaculture has not shown significant results so far.

(5) Main production systems

About 25 systems of production have been identified in Senegal. In crop production, these systems include the following:

- o Irrigated production, as in the Senegal River valley where farmers may also have rainfed or flood recession crops;
- o Rainfed production, a diversified system which includes semi-intensive crops in the groundnut basin, and which may be combined with livestock production; and
- o Upland and irrigated/marsh production, for rice and cotton, which is associated with diverse crops in the Casamance region and Senegal-Oriental.

In animal production, there is an extensive transhumant system in the Ferlo and River regions. Mixed crop and livestock production occurs in other areas. Livestock is predominant in the Delta, Ferlo-Boundou, Fouladou and Senegal-Oriental regions while crop production is predominant in the Groundnut Basin, and Lower and Middle Casamance.

(6) Marketing systems

Generally speaking, marketing networks have remained traditional or private. Only part of the production is handled by State corporations (SONAR with 125,000 t of groundnut seeds, the groundnuts for industrial processing and/or export formerly purchased by ONCAD, and SAED with one-fifth of the paddy rice in its irrigated perimeters). All the cotton is exclusively purchased by SODEFITEX.

Policy is limited to determining "official prices", which do not necessarily provide producers with adequate returns, thereby creating difficulties in the marketing system.

Of animal products, only the marketing of meat is well-organized, despite the numerous constraints. As prices are fixed at the beginning of the marketing chain, consumer prices can be very high.

Two private sector marketing systems exist for fish, namely sales to private consumers (at a 50 to 200 percent gross markup) and to industry. This latter system is very well organized.

(7) Production factors

Currently under reorganization, the input supply system is still in the hands of SONAR.

Sales of chemical fertilizers reached the highest level in 1980 with 98,000 tons. They have been dropping ever since to 30,000 tons in 1981-82 and 10,000 tons in 1982-83. Generally, quantities used are insufficient and they are inappropriately applied. In 1981 the fertilizer subsidy from the government amounted to FCFA 3.2 billion, enabling the farmer to pay FCFA 21 per kg instead of the real cost of FCFA 53.

Pesticides are only used on 3 to 6 percent of the planted area, except for that planted in cotton which is treated in its entirety.

Seed production is systematically carried out either by SONAR or by the CAA. The FMDR pays for the difference between the transfer and resale price to the farmers.

Given the lack of statistics concerning farm equipment, it can only be stated that demand is increasing. Moreover, the interruption in distribution of farm equipment which followed the dissolution of ONCAD, coupled with the need to replace the aged equipment found on most farms, has contributed significantly to the shortage of machinery.

(8) Rural sector administration

Rural development is controlled by several Ministries or State Secretariats--the Ministry of Rural Development, the Ministry of Environmental Protection, the Ministry of Rural Water Supply, the Ministry of Social Development, the State Secretariat for Ocean Fisheries. Rural development is administered through a large number of offices, projects, committees or state organizations with regional or national responsibility.

(9) Food balance

Average food consumption is estimated at 2,200 calories per capita/day (92 percent from vegetable products and 8 percent from animal products). The calories are provided by:

- o Cereals. National production meets only 45 to 80 percent of needs. Depending on the year, 250,000 to 750,000 t must be imported. Food aid represents 15 percent of imports;
- o Animal products. Imports are limited to 800 t of meat and 10-15,000 t of dairy products, eggs and honey;
- o Vegetable crops. 45,000 t of vegetables were imported in 1980 to supplement national production of 80,000 t; and
- o Fisheries. The small-scale catch covers all overall needs but there are strong regional differences in consumption because of the location of consumers in relation to the marketing networks.

(10) Farm credit

Before the August 1980 reform, which stopped the supply of credit (ONCAD) in order to reduce the debt burden, 95 percent of the BNDS credit allocated to and used by the rural sector went to organizations, 4.95 percent to cooperatives and only 0.045 percent to individual producers.

The accounting system has been reorganized and debt repayment rescheduled. From now on, credit advanced may not exceed 25 percent of expected average annual production. Repayment will be strengthened and implemented where the product is marketed. New credit for crop and animal production, fisheries and crafts will be extended at all stages of each production/marketing chain.

(11) Agricultural research institutions

The following is a list of institutions engaged in agricultural research:

- o Institute for Agricultural Research (ISRA--Institut senegalais de recherches agricoles);

- o Institute for Food Technology (ITA--Institut de technologie alimentaire);
- o National University College of Technology (ENSUT--Ecole nationale supérieure universitaire de technologie);
- o Research Center for Applied Economics (CREA--Centre de recherche en économie appliquée);
- o Science Faculty of Dakar University;
- o Food and Applied Nutrition Service (SANAS--Service de l'alimentation et de la nutrition appliquée-au Senegal);
- o Office of Overseas Scientific and Technical Research (ORSTOM--Office de recherche scientifique et technique d'outre-mer);
- o Organization for Research for African Food and Nutrition (ORAWA--Organisation de recherche sur l'alimentation et la nutrition africaines);
- o Organization for the Control of Insect and Bird Pests (OCLAVA--Organisation commune pour la lutte anti-acridienne et la lutte anti-aviare);
- o African Institute for Economic Development and Planning (IDEP/CEA--Institut africain de développement économique et planification); and
- o Inter-State School for Science and Veterinary Medicine (EISMV--Ecole inter-états des sciences et médecine vétérinaire).

(12) Women and agriculture

As is the case in most Sahelian countries, Senegalese women, who were traditionally responsible for specific and sometimes numerous agricultural activities, are becoming increasingly responsible for the farm work. In some areas, for example in Lower Casamance, if the female rice workers leave the rural area, the land is left untilled.

This situation results from the drought which caused an overall drop in agricultural production, and consequently returns. These returns have declined still further on a per capita basis because of population growth. The crisis has caused increasing numbers of men and, in certain cases women, to go to the cities to find jobs and secure incomes, leaving the villages to older people, women and children.

2. Field data analysis: agricultural research

Institutions conducting agricultural research include ISRA-- Institut sénégalais de recherche agricole, ITA, ORSTROM, and ORANA.

a. Institute for Agricultural Research (ISRA--Institut sénégalais de recherche agricole)

The mission of this organization is to develop and undertake research on crop production, animal health and production, forestry and fisheries. The development of these agricultural products is vital to economic and social development in Senegal.

(1) Goals

Short and medium term goals have been adjusted and reformulated as follows:

- o Prevention of desertification and promotion of land conservation;
- o Rational water management, intensification and diversification of agricultural production (both crop and livestock);
- o Knowledge and rational management of physical, biological and human environments; and
- o Contribution to improved nutrition and higher earnings for rural populations.

(2) Organization

ISRA is composed of six research departments: crop production, forestry, fisheries, animal health and production, production systems and transfer of technologies to rural areas, and support to research services.

In addition, there are ten centers or research stations:

(a) Agricultural Research Center of Richard Toll/Fanaye (CRA-RT--Centre de recherche agricole de Richard Toll/Fanaye)

The Center was established in 1949, and currently operates three substations in Guede, M'Dial and St. Louis. The research programs include applied research in animal and crop production (particularly rice) and in the agricultural production systems of the River Valley, with a goal of improving productivity.

- (b) Animal Husbandry Research Center of Dahra
(CRZ-D--Centre de recherche zootechnique
de Dahra)

The research programs of the Dahra station include applied research on reproduction, nutrition, breeding of cattle, sheep and horses, and livestock production systems in the Sahelian zone.

- (c) Agricultural Research Center of Bambey
(CRA-B--Centre de recherche agricole
de Bambey)

The Bambey station was established in 1921, and currently operates a substation in Louga. The applied research program focuses on crop production (millet, groundnuts, cowpeas, and vegetables) and livestock production in the northern part of the groundnut basin. Research on the primary production systems is also underway.

- (d) Forestry Research Center of Dakar-Hann
(CRF-D--Centre de recherche forestière
de Dakar-Hann)

The Dakar-Hann station was established in 1965, and operates substations in Manga, M'Biddi, Bandia, Keur-Mactar, and Djibélor. The station also uses numerous trial grounds in its country-wide research on reforestation and ecosystems.

- (e) Oceanographic Research Center of Dakar-Thiaroye
(CRO-DT--Centre de recherche océanographique
de Dakar Thiaroye)

The center was established in 1961 and operates a substation in Ziguinchor. The research focus is on the potential of fisheries and rational management methods.

- (f) Horticultural Development Center of Camberene
(CDH-C--Centre de developpement horticole
de Camberene)

In 1979, the research activities in the area were integrated into the Camberene station which operates a substation at "km 15". The Center conducts research on vegetable production and intensification techniques.

- (g) National Livestock and Veterinary Research
Laboratory (LNERV-- Laboratoire nationale
d'élevage et de recherche vétérinaire)

The Laboratory was established in 1935 and operates a substation in Sangalkam (1953). The research program includes applied research in virology, bacteriology, parasitology, physiology, the nutrition of cattle, sheep, and pigs, and vaccine production.

(h) Agricultural Research Center of Kaolak
(CRA-K--Centre de recherche agricole
de Kaolak)

The Center was established in 1978 and operates substations in Nioro-du-Rip, Sinthiou-Malème, Darou, as well as numerous other trial grounds. The Center's program includes applied research on all crop and livestock production, and production systems in the region.

(i) Animal Husbandry Research Center of Kolda
(CRZ-K--Centre de recherche zootechnique
de Kolda)

The Center was established in 1972. Its research focuses on reproduction, nutrition, cattle and sheep breeding, and production systems in the Sudano-Guinean zone.

(j) Agricultural Research Center of Djibelor
(CRA-D--Centre de recherche agricole de
Djibélor)

Established in 1967, the Center has one substation in Sefa and numerous trial grounds. Applied research is conducted on agricultural production and production systems in Lower and Middle Casamance.

(3) Human and financial resources

In 1983, ISRA had a staff of 1,300, including 174 researchers. Of these researchers, 126 were Senegalese having the BAC and at least six years of additional training.

The 1983 budget for ISRA was FCFA 6,060 million including 942 million for civil engineering. Of the total budget, 57.7 percent was provided by external sources. Half of the budget was used in support of the research centers.

Table 26 provides a detailed comparison of the personnel and budget for each of ISRA's research centers.

(4) Infrastructure and equipment

The amount and quality of equipment in each research station varies greatly. A detailed comparison is provided in Table 27. In general, the facilities at the Richard Toll, Bambey, Louga, Dakar-Hann and Kaolak stations are old and need renovation.

(5) Resources in scientific and technical information

ISRA holds 60,000 documents and about 500 or 600 magazines. This collection of documents is intrinsically valuable and extends back over a long period. However, problems include:

Table 26: Human Resources and Budget
of ISRA Centers

<u>Center</u>	<u>Researchers</u>	<u>Technicians</u>	<u>Others</u>	<u>Total</u>	<u>Budget</u>	
					<u>(millions FCFA)</u>	
					<u>1982</u>	<u>1983</u>
CRA Richard Toll	12	NA	NA	80	128	244
CRZ Dahra	7	12	19	38	89	185
CRA Bambey	39	15	396	450	509	107
CRF Dakar-Hann	15	NA	NA	50	70	172
CRO Dakar-Thiaroye	17	12	60	89	182	263
CRH Cambéréne	13	12	75	100	NA	286
LNERV	25	38	31	98	392	528
CRA Kaolak	8	NA	NA	100	135	313
CRZ Kolda	5	6	19	30	60	71
CRA Djibélor	17	7	76	100	182	255

Source: DEVRES/INSAH Agricultural Research Resource Assessment, 1983.
See National Report on Senegal for more detail.

Table 27: Infrastructure and Equipment in ISRA's Research Centers

<u>IRSA Center</u>	<u>Infrastructure and Equipment</u>
CRA Richard Toll	3 laboratories (soils, plant protection, physiology) 1 greenhouse 7 storerooms 2 workshops 23 offices (including 16 in the center) 16 houses (including 11 in the center) 1 reception center 4 experimental stations covering 200 ha, including 120 ha of irrigated land 1 micro-computer 1 library
CRZ Dahra	1 laboratory (artificial insemination) 1 sheep pen 1 cattle pen 1 garage, workshop, several storerooms, several generators, 3 offices 4 houses 1 reception center 7,000 ha of land 600 cattle 200 small ruminants
CRA Bambey and Louga	4 laboratories (soils, microbiology, plant protection) 2 greenhouses 1 cold storage room 1 cattle pen 1 workshop 1 well organized documentation center 650 ha of land, including 4 ha of irrigated land 38 houses 1 reception center 1 IBM 5120 computer
CRF Dakar-Hann	1 analytical laboratory 1 greenhouse for micro-cuttings 14 offices (7 in Dakar, 3 in Djibelor) 2 garage/workshops (Bandia, M'Biddi) 1 cold storage room 4 storerooms 1 poorly equipped library, little modern equipment 700 ha under cultivation in 5 stations (50 ha of irrigated land)
CRO	1 laboratory complex (physics, ecology, biology)

Source: DEVRES/INSAH Agricultural Research Resource Assessment, 1983.
See National Report on Senegal for more detail.

Table 27: Infrastructure and Equipment in ISRA's Research Centers (cont.)

<u>IRSA Center</u>	<u>Infrastructure and Equipment</u>
Dakar-Thiaroye and Ziguinchor	1 multidisciplinary laboratory in Ziguinchor 6 offices including 1 in Dakar port 1 research ship 1 radioactive materials storage 3 storehouses and 1 workshop high-capacity data processing facilities (IBM 4331, HP 9845) 1 well-equipped and organized documentation center
CRH Dakar Camberene	4 laboratories (pathology, entomology, genetics) 1 phytotron and 1 cold storage room 25 offices 1 documentation center storerooms and garage/workshop 40 ha of irrigated land (including 33 in the CRH)
LNERV	1 laboratory complex of 0.2ha 3 animal houses 20 offices, including 2 in Sangalkam 1 garage 2 workshops 1 well-equipped documentation center 50 ha of partly-irrigated land high capacity data processing facilities (IBM 5120)
CRA Kaolak	3 laboratories (soil, biochemistry, plant protection) 27 offices, including 18 in Kaolak 2 workshops and storerooms few data processing facilities poorly structured data center experimental area of 200 ha (80 in Nioro-du-Rip, 60 in Sinthiou Maleme, 62 in Darou)
CRZ Kolda	1 laboratory for artificial insemination 4 offices 1 garage/workshop 1 cattle pen, 1 sheep pen few data processing facilities poorly structured documentation center 2000 ha of land (25 ha cultivated) essentially grazing grounds 400 cattle and 300 sheep (average)
CRA Djibelor and Sefa	6 laboratories (soil, plant protection, agronomy) 2 greenhouses, 1 shelter, 1 cold storage room 34 offices including 3 in Sefa 2 cattle pens 4 workshops 9 houses good capacity for data processing (IBM 5120) well equipped documentation center area of Djibelor 70 ha, of Sefa 410 ha

Source: Devres/INSAH Agricultural Research Resource Assessment, 1983.
See National Report on Senegal for more detail.

- o Lack of a documentation network within ISRA (lack of contacts and information exchange between centers, archivists and researchers);
- o Lack of qualified personnel and insufficient budget for procurement of documents; and
- o A distribution network which makes it difficult for researchers to access the available documents.

The new organization of ISRA, however, provides a division responsible for documenting, publishing and distributing research results.

b. Institute for Food Technology (ITA-Institut de technologie alimentaire)

(1) Mission

Established in 1966, the institution became an Etablissement public autonome on February 5, 1983. Its mission includes:

- o Undertaking and coordinating research, studies and activities on food processing, consumption, and storage with a view to setting up food industries;
- o Developing new local food resources;
- o Developing and distributing varied foods with high nutritional value which are compatible with local food habits and incomes; and
- o Assisting in the quality control of distributed, imported or exported food products.

(2) Organization

The ITA is divided into four technical departments:

- o Crop products, with two divisions--one for cereals and vegetables, the other for horticultural products;
- o Livestock products, with three divisions--milk and dairy products, fish and fish products, and meat and meat products;
- o Analysis, with one laboratory (chemistry, microbiology and taste tests) and one division (nutrition and dietetics); and
- o Research support, with five divisions--maintenance, socio-economics, packing and conditioning, standardization and a documentation center.

(3) Human resources

The ITA employs about 100 workers, all of whom are Senegalese. They include senior researchers with a Masters degree or a Ph.D., senior technicians (DUT or BTS equivalent), technicians (BAC and BT) and technical assistants (BEI, CAP). ITA has many student interns or trainees.

(4) Budget

The last year of FAO aid to the ITA was 1974. After that, funding was provided by a national grant maintained at FCFA 185,000,000 since 1980.

(5) Infrastructure and equipment

The ITA has one administration building and one technical building (built in 1967-68) which includes laboratories and pilot-workshops. These facilities are not large enough and need to be expanded. The first expansion was completed in 1983.

Most of the machinery was purchased between 1966 and 1974 with FAO assistance and it is now obsolete or broken. Lack of spare parts prevents it from being repaired.

c. Office of Overseas Scientific and Technical Research (ORSTOM--Office de recherche scientifique et technique d'outre-mer)

The ORSTOM is a French institution which operates in Senegal under the direction of the French Ministry of Scientific and Technical Research.

(1) Mission

The tasks of ORSTOM include:

- o Promoting scientific and technological research that contributes to the cultural, social and economic development of the country;
- o Implementing a scientific and technical information policy;
- o Contributing to the implementation and utilization of the results of its studies;
- o Providing practical training; and
- o Promoting, in a contractual framework, common actions by all institutions involved in similar research.

(2) Organization

The Dakar-Hann center is the ORSTOM headquarters in Senegal and has divisions responsible for pedology, geology, hydrogeology and geophysics. The center possesses 1,000 m² of laboratories, six offices and the main documentation center. The Dakar-Bel-Air center has sections responsible for microbiology, nematology and physical oceanography. The center possesses 2,000 m² of laboratories and offices, specialized libraries, and one phytotron. The geography center in M'Bour, has ORSTOM's seismography facilities, and 600 m² of laboratories and offices. The Richard Toll station, specializes in ornithology and consists of 300 m² of laboratories and offices.

(3) Human resources

ORSTOM employs 227 workers, including two administrators, 42 researchers (representing 17 scientific areas), five trainees, eight volunteers of the National Service and research fellows, 68 laboratory technicians, 32 technicians, and 60 workers.

In addition to this, ORSTOM annually provides for a two-year training of eight senior executives (three foreigners and five Senegalese); the placement of Senegalese researchers within ORSTOM teams for two to four years; the practical training (stages) of 25 people (especially people from the sub-region) for a variable period; and the post-university and university-level training for about ten researchers.

(4) Budget

ORSTOM's financial resources have been FCFA 375,000,000 for operating expenses and FCFA 27,000,000 for investment expenses (average of 1981-82-83). This budget does not take into account salaries of technical assistance personnel and certain specific expenses incurred outside Senegal.

(5) Information resources

ORSTOM has about 5,000 books and annually purchases 100 books and 200 magazines.

Internal production is estimated at 70 publications, essentially based on social sciences and soil biology.

ORSTOM is in regular contact with ISRA, ITA, Dakar University, development corporations (SAED, SOMIVAC, SENPRIM), inter-state and international institutions, and several public services (MDR, Directeur Statistique, Institut Pasteur, IFAN, BRGM, ASECNA and national parks).

d. Organization for Research on Food and Nutrition in Africa (ORANA/SANAS--Organisation de recherche pour l'alimentation et la nutrition africaines)

ORANA/SANAS is a regionally-oriented institution established in 1956. In 1961, it was attached to the Organization for Cooperation and Coordination of the Control of Major Endemic Diseases.

(1) Mission

The research program includes:

- o Studies on food consumption and the nutritional condition of populations;
- o Food analysis and studies on the influence of nutrition on human biology; and
- o Lectures at the Department of Medicine and Pharmacology and in several specialized centers.

ORANA has a Senegalese counterpart called the Food and Applied Nutrition Service (SANAS--Service pour l'alimentation et la nutrition appliquée au Senegal) which is part of the Ministry of Public Health.

(2) Human resources

ORANA employs 13 researchers, one specialized technician, three technicians and temporary survey workers.

(3) Budget

ORANA operations are funded by quotas from member countries, by grants from associated states and bi- or multilateral organizations.

e. Comments

The main strengths of Senegalese research institutions lie in their scope, which seems to be all-encompassing. The high level of competence of the personnel, especially the researchers, and the number and capacity of facilities and equipment are additional strengths.

Weaknesses include the usual budget problems which result in obsolete infrastructure and lack of appropriate work facilities. In addition, due to the extreme complexity of the system and insufficient dissemination of information, there is a risk of duplication in the programs.

3. Field data analysis: agricultural training

a. Training institutions

(1) Senior staff

- (a) Inter-State School for Sciences and Veterinary Medicine (EISMV--Ecole inter-Etats de science et medicine vétérinaire)

Within a regional framework, the school provides for the training of veterinarians in six years after completion of the BAC. The size of the classes is about 40 students. The school also organizes a regional post-university course (UNESCO-INSAH) on agro-pastoral development which is funded by UNDP.

- (b) National Institute of Rural Development (INDR--Institut national de développement rural)

Now in its starting phase (having been established in January 1983), the Institute will offer classes for about 40 people to train technicians in agricultural research and development, animal husbandry, water and forestry in five years after completion of the BAC. Twenty places will be reserved for foreigners.

(2) Middle level implementation staff

- (a) National School for Professional Rural Training of Bambe (ENCR--Ecole nationale des cadres ruraux de Bambe)

The course requires three years of training after the BAC. Since 1960, 666 ingénieurs have been trained in agriculture (58 percent), animal husbandry (81 percent), water and forestry (18 percent), agricultural technology (2.5 percent) and fisheries (1.5 percent). A special course for junior executives was started (by UNESCO-INSAH) in 1983.

- (b) National School for Applied Economics (ENEA--Ecole nationale d'économie appliquée)

This school specializes in rural extension. Since 1983, 819 students have graduated. Programs consist of three years for supervisors, inspectors, ingénieurs and monitors and two years for technical agents. Trainees are either professionals undergoing in-service training or students with the BAC or DFEM (Diplôme de fin d'études moyennes). Divided into six colleges, the school enrolls 180 students every year and has three centers for practical work.

(c) National University College of Technology
(ENSUT--Ecole nationale supérieure
universitaire de technologie)

The two-year program provides a university degree in technology. The curriculum can be adapted on request. Topics of study have included agricultural business, plant protection, water resources and agricultural technology, and meteorology. For ten years, ENSUT has been training senior technicians and technological ingénieurs. For four years, it has also trained technical school teachers. Its capacity is limited to 15 ingénieurs and 12 university level technology students a year.

(3) Lower level implementation staff

Schools for technical agents (Ecoles des agents techniques) exist for various disciplines. There is the School for Technical Agents in Agriculture (EATA) in Ziguinchor, the School for Technical Agents in Livestock (EATE) in St. Louis, and the School for Water and Forestry (EATEF) in Djibélor. Applicants to these schools must have the DFEM. The course is for three years, with class size varying between 20 and 30 students.

Another institute is the National Horticultural School of Camberene (ENHC). Its classes consist of 80 students who are divided into three horticultural programs: CAP (Certificat d'aptitude professionnelle), BP (Brevet professionnel), and BT (Brevet de technicien) that are organized within the same structure and which include numerous on-site training sessions.

The CAP and BP training take three years to complete. Recruitment begins after the fifth grade or in the last year at the Centre d'initiation horticole. The program for the BT degree lasts three years. Recruitment occurs by means of entrance examination given after the DEFM.

Agricultural centers are open to all members of rural communities (men, women, and children). These institutions address all aspects of rural activities. They include five centers for agriculture, one center for vegetable production, one center for irrigated crop production; centers for fisheries, centers for craftsmen, and centers for extension worker training and in-service courses.

The efficiency of these institutions is limited by the availability of human and financial resources. Most centers are currently being reorganized due to the shortage of competent instructors.

(4) Training institutions for the fishing industry

(a) National School for Marine Training
(ENFM--Ecole nationale de formation maritime)

ENFM provides for the training of all sea-going personnel, but lacks trainers in some specialized fields such as

refrigeration, electronics and radio operation. Senior personnel must still be trained outside of the country, because there is no school in Senegal.

- (b) School for Technical Agents in Oceanography and Marine Fisheries of Thiaroye (EATOPM--Ecole des agents techniques de l'oceanographie et des peches maritimes de Thiaroye)

EATOPM provides for the training of middle and lower level staff for research and extension in marine deep-sea fisheries.

- (c) School for Technical Agents in Water and Forestry (EATEF--Ecole des agents techniques des eaux et forêts)

EATEF provides for the training of technical agents in aquaculture.

- (d) National School for Professional Rural Training of Bambey (ENCR--Ecole nationale des cadres ruraux de Bambey)

This institution provides for the training of inland fisheries technicians at the ingenieur level. The curriculum includes nine months of training in Bouake (Ivory Coast).

- (e) Training Center for Fishermen in Joal

Instructors teach fishermen how to apply fishing techniques. The Training and Extension Center for Inland Fisheries in Goudomp and M'Bour is responsible for training fishermen in modern inland fishing techniques.

b. Human resources and equipment

(1) Senior level

- (a) EISMV

The number of teachers is adequate. Africans represent 65 percent of the permanent faculty and 25 percent of the temporary teachers. Several courses, however, do not have permanent teachers. Enrollment is too high for the size of the classrooms (80 instead of 60 as planned) so the facilities are too small.

- (b) INDR

Currently in its first year of operation, the institution has only nine students. It should become fully operational by the end of 1984. There is a shortage of competent teachers and financial resources. The institute also needs a practical training center. Teachers are predominantly from foreign countries.

(2) Middle-level implementation staff

(a) ENCR

Senegalese teachers comprise 35 percent of the permanent staff and 100 percent of the temporary staff. The number of teachers has remained static because of poor working conditions and insufficient training for teachers.

Infrastructure and facilities are old and insufficient. The school needs a practical training center.

(b) ENEA

The number of teachers (65 percent Senegalese) has not increased because there are insufficient training facilities for teachers, and they have a low status. Limited grants, obsolete facilities, absence of trainers' programs and poor definition of some programs have resulted in bad working conditions.

(c) ENSUT

Teachers (30 percent Senegalese) have good working conditions and have a motivating salary structure. Business leaders and senior executives participate in the teaching. Deficiencies include the slow replacement of equipment, insufficient technical training for teachers, and scarcity of scholarships to remedy the problem.

(3) Lower-level implementation staff

EATA, EATE, EATEF and ENHC have the same employment conditions. Swiss assistance provides for their operation and the necessary investments for training the teachers. Nonetheless, teachers are insufficient in number, due in part, perhaps, to a lack of incentives in the salary structure. Senegalese agriculturists comprise 60 to 90 percent of the teachers.

The service personnel is plethoric. EATA, EATE and EATEF have appropriate facilities and practical training.

c. Comments

To the credit of its 14 agricultural training institutions, Senegal has a large number of qualified agricultural agents. There is one agent for 1,124 rural workers (or 628 ha). They are all paid by the government; that is, there are no private extension activities at present.

All these institutions are characterized by a high level of competence among teachers, well-adapted training facilities as well as an efficiently operating system for teacher training, resulting in a continuous improvement of the teaching quality.

The absence of a specialized training institution for extension agents must be stressed.

Relations between training and research institutions seem very loose. Training structures for research personnel are insufficient. Most researchers are trained abroad, except for those in animal husbandry.

Researchers do not participate actively enough in the training programs, probably because of the absence of organizational links that allow switching from research to training and vice-versa.

As is the case with other structures, budget difficulties, disparate (sometimes precarious) salary structures, and unfavorable working conditions can be disincentives to staff.

4. Field data analysis: agricultural extension

Extension activities in rural areas of Senegal are carried out by numerous and sometimes very disparate structures including services in Ministries, institutions, corporations, intervention or development centers, or projects, each having different conditions of service.

a. Agriculture

The six institutions which provide for extension activities are SODEVA, SOMIVAC, SODEFITEX, SAED, SODAGRI, and STN.

(1) Agricultural Extension and Development Institution (SODEVA--Société de développement et de vulgarisation agricole)

Established in 1968, SODEVA aims at improving crop and livestock production and forestry in the groundnut basin. Its work encompasses 66 percent of the Senegalese farming lands and 200,000 farmers. Since 1981, the government has been approving its action plan annually.

SODEVA personnel number 1,361 agents, including 42 senior supervisors (20 agronomists, one agricultural engineer, four animal scientists, one veterinarian, three horticulturists, and 13 economists), nine administrators, 343 senior technicians and technicians, and 967 implementation agents.

Financial resources originate from three projects directed by SODEVA:

- o The rural development project in the Louga area and M'Bour department--FCFA 4,289,000,000 over four years from IFAD and Islamic Development Bank (IDB);
- o The Thies-Diourbel project (phase II)--FCFA 2,753,000,000 over four years (USAID); and

- o The redesigned Sine-Saloum Project--FCFA 1,602,000,000 over four years (IDB-CCCE).

(2) Casamance Agricultural Development (SOMIVAC--
Société de mise en valeur agricole de
la Casamance)

Established in 1976, SOMIVAC operates in Casamance on rainfed and irrigated farm areas. Its extension work covers 25 percent of the cultivated lands in Casamance which produce about 30 percent of the regional output.

Personnel number 611 agents, including 87 technical supervisors, 16 administrators, 34 senior technicians, 326 extension agents, and 150 implementation agents.

Financial resources originate from three projects directed by SOMIVAC: Project for the Sedhiou Department (PRS 1 and 2 phase), Integrated Development Project for Lower Casamance (PIDAC/USAID), and Chinese Agricultural Mission (MAC).

This amounts to a total of FCFA 2,577,494,000 for 1983-84, including FCFA 1,082,377,000 from the national budget and FCFA 1,485,117,000 from external sources.

(3) SODEFITEX

Established in 1974 to develop cotton production, SODEFITEX extended its scope to other sectors. The Government annually defines its program in a "letter of mission". It operates in the southeast part of the Sine-Saloum, Senegal-Oriental and Upper Casamance. Its main focus is on cotton, rice, maize, and groundnut production and animal husbandry.

Personnel number 680 agents, including ten senior technical supervisors (ingeneurs), 80 ingenieurs in agricultural works, 30 administrators, 300 extension agents, and 280 implementation agents.

Financial resources originate from the intensive cereal production in Senegal-Oriental. This includes EDF's contribution of FCFA 1,400,000,000 for 1982-83, and FAC's contribution of 200,000,000 for 1982-84 and FCFA 200,000,000 for 1983-84 (national budget) for a total resource base of FCFA 1.8 billion.

(4) Senegal Delta Development Organization
(SAED--Societe d'amenagement et
d'exploitation du delta Senegal)

Established in 1961, the SAED covers the river delta, the left bank of the Senegal River and the Faleme valley (since 1980), or about 250,000 ha of irrigated land. It supports irrigation activities and provides for extension and supervision.

Personnel include 1,033 agents: 98 senior supervisors (six agronomists, six agricultural ingénieurs, one animal scientist, 75 horticulturists, six economists/sociologists), 40 administrators, 150 senior technicians and technicians, 238 extension agents, and 507 implementation agents.

Financial resources originate from the national budget and several external funding sources (IBRD, CCCE, FAC, EDF) and amounted to a total of FCFA 8,371,000,000 for 1983-84.

(5) Industrial and Agricultural Development Organization (SODAGRI--Société de développement agricole et industriel)

Established in 1974, SODAGRI operates in Upper Casamance and focuses primarily on rice but also on groundnut, millet, sorghum and maize production. Its scope currently encompasses 14,600 ha of rainfed land but is expected to expand to 16,250 ha of irrigated land when the dam on the Anambe River is built. Finally, it processes and sells its own rice.

Personnel include 68 agents: ten senior technical supervisors (six agronomists, one agricultural ingénieurs, one specialist in plant protection, two economists), ten administrators, eight senior technicians, and 40 technicians and implementation agents.

Financial resources are divided into operating and investment budgets. The SODAGRI operating budget is supported from the national budget and from the proceeds from marketing its rice production.

The investment budget (dams, irrigation facilities, rice mills) is provided by external sources.

(6) Operation for the Development of New Land (STN--Société des terres neuves)

STN was established in 1971 with the objective of organizing the migration and settlement of farmers from the Groundnut Basin in East Senegal and for developing the necessary infrastructure. It eventually became responsible for extension of the vegetable and fruit sectors of the entire country.

Personnel number 306 agents including ten senior technical supervisors (ingénieurs), 37 administrators, 34 senior technicians and technicians, 195 extension agents, and 28 implementation agents.

The national budget provided FCFA 221,875,000 of STN's budget for 1983/84. External funding amounted to FCFA 516,439,000. STN's total current budget is FCFA 738,714,000, including FCFA 442,480,000 for investments and FCFA 295,834,000 for operating expenses.

b. Livestock production

Under the Direction of Animal Health and Production of the MDR, two organizations are in charge of extension and supervision activities--SODESP and PDES0.

(1) Organization for the Development of Livestock in the Sylvo-Pastoral Zone (SODESP--Societe de developpement de l'elevage dans la zone sylvo-pastoral)

Established in 1975, SODESP is responsible for the development of livestock production in the sylvo-pastoral zone (600,000 ha in the Ferlo area).

Personnel include the following 139 agents: ten senior supervisors (one animal scientist, eight veterinarians, one economist), 21 administrators, and 108 extension and implementation agents.

Financial resources of SODESP originate from three sources and amounted to FCFA 2,350,000,000 in 1982/83 (FCFA 1,120,000,000 for investment and FCFA 1,230,000,000 for operating expenses). The national budget provided FCFA 590,000,000 of SODESP's budget, external sources (EDF, FAG, USAID) provided 840,000,000 and 530,000,000 came from SODESP's own resources.

(2) Senegal-Oriental Livestock Development Project (PDES0--Projet de developpement de l'elevage au Senegal-Oriental)

Operational since 1977, PDES0 is charged with improving livestock production in Senegal-Oriental. Its scope covers 1,300,000 ha in this region.

Personnel include 64 agents of which five are senior technical supervisors (one agronomist, one agricultural ingénieur, three veterinarians), eight are administrators, seven are technicians in animal husbandry, 34 are junior technicians in animal husbandry and ten are implementation agents.

Financial resources exclusively for operations amounted to FCFA 215,924,000 in 1982-83. One-fourth of these funds originated in the national budget and 75 percent were contributed by IDA.

c. Water and forestry, hunting and inland fisheries

Supervision and extension operations in this sector are the responsibility of the Department of Water, Forestry and Hunting of the Ministry of Environmental Protection.

The Department's scope of operation is 6,000,000 ha of forest, and its main activities are forestry and ecosystem protection, including wild animals, hunting and inland fisheries.

Personnel are composed of 680 agents including: 11 senior supervisors (ten water and forestry ingénieurs, and one economist), 34 administrators, 376 technicians and equivalent (ITEF, etc.), 11 technicians in horticulture, one technician in animal husbandry, and 249 implementation agents.

The National Report does not include information on financial resources.

d. Fisheries

This sub-sector is the responsibility of two different ministries--the Ministry for the Protection of Nature (Ministère de la protection de la nature) for inland fisheries, and the State Secretariat for Marine Fisheries (Secrétariat d'Etat à la pêche maritime), which in July 1980 had a staff of 300 within the MDR for marine fisheries.

Small scale marine fisheries are supervised by the Center for Assistance to Small-Scale Fishing in Senegal (CAPAS--Centre d'assistance a la peche artisanale au Senegal) which is funded by Canada.

CAPAS operations include equipment (engines for pirogues, equipment, material), marketing (infrastructure and processing), and training (knowledge of the products, mechanics, storage, and refrigeration). For a summary of the personnel of the extension institutions, see Table 28 on the following page.

e. Comments

Supervision and extension structures in Senegal are generally well staffed. For sectors such as agriculture, animal production, water, forestry and inland fisheries, these organizations employ 4,940 people, including 283 high level senior staff. This represents an average of one agent for 334 rural workers (or 755 ha of cultivated land) which is an appropriate density. This is a favorable situation, especially when personnel qualifications and motivation are good.

The national budgetary contribution to the funding of supervision and extension activities of these organizations testifies to the government's interest in them.

Other favorable factors include the institutions' good relations with the research sector, as is sometimes embodied in a contractual agreement (SODEVA, SODEFITEX), and the relative frequency of applied research accompanying extension projects.

Surveys in nine development agencies covering the different sectors (excluding marine fisheries) show the following weaknesses:

Table 28 : Extension Institution Personnel

	SOEVA	SOEFITEX	SOMIVAC	SAED	SODAGRI	STN	SODESP	PDESO	Water, Forestry, Inland Fisheries	Marine Fisheries
Administrators (All levels)	9	30	16	40	10	37	21	8	34	
Senior staff	42	10	87	98	10	10	10	5	11	
Senior technicians	343	80	34	150	8	34		7	386	
Technicians										
Extension workers	967	300	324	238	40	195	108	34		
Implementation agents		280	150	507		28		10	249	
Total by institution	1361	680	611	1033	68	304	139	64	680	
TOTAL by sector	4057						203		680	300
Senior staff by sector	257						15		11	

Source: DEVRES/INSAH Agricultural Research Resource Assessment, 1983.
See National Report on Senegal for more detail.

- o Financial difficulties (mentioned five times) arise from administrative lag in appropriation and from termination of funding by external donors. Insufficient funding was mentioned only once (SODAGRI);
- o Delays in the delivery of inputs, such as fertilizers, chemicals, or seeds (mentioned four times) or excessive prices (mentioned once, by PDES0), which results from a lack of financial resources or poor management;
- o Difficulties in the marketing of the products (mentioned three times) reflect both low prices and a poor distribution system;
- o Difficulty in access (mentioned twice, by SODAGRI and SOMIVAC), which occurs in specific remote sectors of Casamance and portions of the "Trans-Gambian" road;
- o The linkage of extension and research activities is poor, despite frequent claims to the contrary. Since insufficient consideration is accorded to the observations made by the farmers, the applied research needed by the extension service is inhibited;
- o Insufficient personnel (mentioned three times) and extreme diversification (mentioned once) refer to the number of workers as compared to the number of tasks. This requires a redefinition of objectives in a few organizations;
- o Drought (mentioned twice), poor quality of products (mentioned once), difficulties of equipment maintenance (mentioned once) and excessive centralization in Dakar (mentioned by SODAGRI) are common constraints; and
- o The final constraint, is the new, though growing, phenomenon among African farmers of relinquishing their responsibilities (cited three times). This results from two main factors: first, the increased financial difficulties resulting from the drought causes farmers to "give up" when confronted with the uselessness of their efforts; and secondly, excessive pressure from extension agents to "impose" instead of "advise" and the tendency to disregard the farmers' experience, leads the farmer to abandon his responsibilities.

5. Constraints to increased productivity

a. General constraints

The National Report shows that some of the constraints which affect agricultural production apply to the entire sector in general. They vary in intensity from one subsector to the other, but not in nature. They are:

(1) Physical constraints

A major physical constraint is the drought. It affects all subsectors (except marine fisheries) and, while it may be possible to reduce its effects, there is no way to control it.

(2) Financial, structural or legal constraints

Financial, structural or legal constraints which reduce the effectiveness of research, training and agricultural extension institutions indirectly affect the development of the entire sector. The specific constraints are listed in the institutional analysis. They vary in importance but are seldom completely absent. In summary, they are as follows:

- o Financial constraints. These include insufficient investment and operating budgets, uneven or slow implementation of these budgets, resulting cash flow problems, structural distortion between internal and external funds and the resulting consequences which include lack of financial control. The country's inability to plan external financing, and the increasing share of operating funds going towards salaries compound the problems;
- o Infrastructure and equipment constraints. They are mostly related to financial problems and are reflected in the age and general lack of materials and buildings and in the lack of maintenance and inoperative equipment;
- o Human resources. The constraints vary from one field to another, the most common being the absence of long-term and short-term personnel training policies, and of a specific mechanism for research training, the lack of senior staff and obstacles to their training, and the lack of emphasis on training agents who should have on-the-job training opportunities. In addition, technicians generally lack the practical experience and knowledge necessary to acquire general maintenance skills;
- o Scientific and technical information. The major constraints are irregularity and difficulty of contact between institutions and between researchers. This results in a lack of information and communication. There are too few librarians, and they are sometimes involved in other tasks. The slowness and the difficulties encountered by the National Scientific and Technical Documentation Center in reaching full implementation have already been mentioned; and
- o Structural constraints. The lack of uniform status of research personnel creates an unfavorable climate. The legal framework in the institutions is often considered inappropriate. Some personnel, especially field personnel, are excessively preoccupied with career advancement to the

detriment of field work. Agents working in the most remote stations are not satisfied with the social environment.

(3) Socioeconomic constraints

The major socio-economic constraints are outlined below in order of priority.

Incentives in agricultural production prices are inadequate. National price policy is confronted with the problem of importing foodstuffs at the low world price (rice) and exporting produce at variable or unprofitable prices (groundnuts). The impact of import policy on producer incomes, especially in the case of poor harvest, or in the case of a surplus in food crops, seems to be inadequately considered.

Secondly, the organization of agricultural input and product markets, especially for vegetable production is also inadequate. Farmers do not consider the present system secure enough and they modify their production accordingly. It is sometimes difficult to evaluate the advantages resulting from the use of certain inputs (for example pesticides on groundnuts) as the monetary value of the advantage cannot be calculated.

Other constraints in the same category are the lack of information on the impact of assistance to farmers and on the national system of production. Identification of levels of profitability for different crops grown by different classes of farmers is also necessary information. The National Report mentions the division of land into small parcels, but this factor varies according to farming system and region.

b. Crop production constraints

Among the numerous constraints listed in the National Report are the following:

(1) Environmental constraints

Frequent rainfall deficits of varying degrees have substantially affected rainfed crop production and, to a lesser extent, irrigated crops over the past few years. In rainfed crops, irregular rainfall makes it difficult to determine the appropriate planting date, which becomes a major constraint.

A major limitation is declining soil fertility, which has resulted from extended periods of farming without mineral replenishment, from a curtailed fallow period (for example in the groundnut basin), and from soil fragility. Soil fragility is worsened by drought since the wind is more likely to carry away the fine elements on very dry soils without plant cover.

(2) Technical constraints

For rainfed crops, the major constraints mentioned are the lack of information and availability of locally adapted varieties, the appearance of new diseases (as on maize), poor weed control, and the poor adaptation of varieties to weather and soil conditions, and to pests. Other constraints relate to seed quality and availability, and in horticulture, to the imbalance between various areas of research, and the insufficient research on varietal improvement of local vegetables, such as okra and peppers.

For irrigated crops, the report indicates that declining river flood levels result in smaller areas becoming available for flood recession farming along the rivers and behind dams. This decline exacerbates the irrigation problems.

Lack of maintenance has resulted in deficient mechanized and manual irrigation systems, and poor levelling of rice paddies has resulted in uneven irrigation structures.

In animal traction, the weakness of draft animals at the beginning of the growing season is a major problem.

(3) Constraints in agricultural research

In the past, agricultural research was concentrated in Bambey where the potential for increased productivity was limited. Research operations are now being decentralized and spread throughout the country.

The isolation of the various research disciplines, aggravated by a lack of coordination at the national level, led to a technical approach to problem-solving rather than one adapted to actual systems of production.

Researchers have lacked experience in multidisciplinary team work, an approach which is now more frequently undertaken.

(4) Extension constraints

The most frequently mentioned constraint is the extension system's inability to disseminate research-based technical information to users. Another is the lack of information on the actual and practical needs of farmers, which results in poor application of research results. Farmers' needs and problems should be made a part of those programs that do not sufficiently correspond to the difficulties and questions which affect the farmer.

Until now, the research sector did not have enough stations to adequately ascertain or understand the farmer's point of view, nor to disseminate suitable results.

(5) Technological constraints

The National Report emphasizes the importance of pre- and post-harvest losses (of millet, vegetables and cowpeas) from insects and birds. It also discusses the lack of conservation methods for vegetables, particularly storage of potatoes and onions which are currently imported in considerable quantities.

(6). Economic constraints

The National Report mentions as economic constraints inadequate agricultural credit, steadily increasing input prices and unpredictable date of delivery and the relatively steady decline in producer prices with the consequent loss of incentives, aggravated by marketing difficulties.

c. Animal production constraints

In the livestock sector many constraints arise from the increasing gap between traditional structures and methods of animal husbandry and the irreversible modernization of the economic environment. Many traditional methods are now undermined or obsolete but the farmers' transition towards the adoption of modern methods is slow. Abandoning the security of traditional techniques that were well-adapted to the physical environment and to traditional socio-economic conditions upsets too many traditions and values to be done easily. Modernization remains an urgent necessity, however, since a delay will only make changes increasingly difficult to implement.

The current animal husbandry systems tend to be "subsistence" systems. Profound modifications are necessary to achieve a "productive" animal husbandry sector. These changes include producers' motivations, customs, and needs. Research is being conducted in these areas but too little attention has been directed to the production constraints faced by producers.

The report emphasizes the lack of information on the part of the producers and the lack of qualified personnel able to disseminate information in the field, especially about technical innovations, input utility and availability, forage management and herd management.

The modernization process is slowed by the absence of a pricing policy (i.e, sales' prices based on animal weight), and by neglect of methods for improving the marketing networks for animal products.

(2) At the ecological and nutritional level

The dominant constraints are the decline in natural forage due to reduced and uncertain rainfall and the reduction in fallow lands as a consequence of stagnant agricultural yields and population growth. Constraints also arise from the difficulty of reconciling management and use of grazing lands, from the lack of intensification and from the limited access to purchase commercial

forage because of availability and price considerations that arise from high transportation costs.

The extensive transhumanant livestock system which is predominant in Senegal has its limitations. Rational management of pasture lands by the cattle herders themselves has become an urgent necessity. It is therefore necessary to rationalize and generalize management of the grazing lands by their users, and to encourage them to organize and become more responsible.

In forage production and animal nutrition, research is needed on natural forage production, its substitutes, improvement of cultivated forage, nutritional values and especially on nitrogen deficiency in the diet.

(3) Animal and genetic health

The continuing heavy incidence of disease, the insufficient means of control (i.e. of brucellosis and trypanosomiasis) and the poor performance of local breeds affect productivity levels. However, their excellent adaptation to the environment, particularly to natural forage or to forage currently available, is a major positive factor.

The National Report emphasizes that excessive attention has been directed to research in animal health (the area of concentration of research at LNERV) in comparison to research on animal science and nutrition. It recommends extension of the scope of work at Dhara and Kolda stations, intensification of genetic selection for milk production, and the development of poultry programs.

d. Agro-forestry constraints

The major constraints in this subsector, both intensified by the drought, are the prevailing gap between human demand for wood and animal demand for forage, and the limited potential for ligneous plant production. The imbalance is particularly evident for the Sahelian thornbush steppe (where the biomass may have declined by more than 30 percent) and results from drought, fires, overgrazing, and human consumption.

The two major methods of forest production development are discussed below. These methods have been unevenly explored.

(1) Rational development, protection, restoration

The option of rational development-protection-restoration of trees, is rarely followed, since it necessitates massive re-education of the population. Generating awareness among wood users of controlled forest management and development methods and of the importance of trees to the environment requires levels of control and education which have not yet been attained, even though these problems are generally recognized. Usually daily needs prevail.

(2) Planting and reforestation

The option of planting and reforestation has been widely followed, although with uneven success. Reforestation methods relying heavily on exotic species are difficult to implement because the resulting product rarely has the positive qualities of the local product. Physical constraints are numerous, plant material is difficult to select, and tests are extremely expensive and impact on very limited, if not marginal, areas. Moreover, the available land area is constantly decreasing under pressure from farming needs. Forestation efforts are also continually undermined by fire and wandering animals. Finally, the heavy recurrent costs of forestry projects are not always considered before engaging in a study or a planting program.

Since forestry research in Senegal was so recently initiated (in 1968) experience is lacking, and this is a serious limitation since the study of change in forest formations, whether spontaneous or not, is a lengthy process.

As in other sectors, the report emphasizes the following problems:

- o Lack of financial resources (only six percent of the research budget goes to agroforestry), and their irregularity;
- o Lack of human resources (few experienced specialists) and of equipment, especially for field work; and
- o Lack of information among the rural population on the treatment and use of the plantings and inadequate extension services to promote the application of results.

e. Fisheries constraints

(1) Inland fisheries

The production of inland fisheries has substantially declined in the last few years from 23,000 t in 1980 to 15,000 t in 1982. The decline is attributed to the effects of drought (the flood area in Senegal went from 380,000 ha in 1980 to 220,000 ha in 1982) which resulted in reduced breeding by the fish population and encouraged some fishermen to give up fishing for agriculture.

The field teams are too few to reverse this trend, and lack the data to identify the nature and amount of effort necessary to improve it.

At the "post-catch" level, marketing facilities are limited and losses from pests can be enormous (up to 40 percent of the products which have been semi-preserved by drying or smoking). This loss is not due to deficient techniques but to inadequate means such as firewood.

Fish breeding was abandoned because of a drop in inland fish production over the past few years. ISRA does no research in the area and has no specialist or researchers in fish breeding. Moreover, the costs of ponds and of transporting fish-feed from the west where they are manufactured are quite high.

(2) Small-scale marine fishing

Senegal's marine fisheries have developed considerably in the last few years. However, major constraints still exist.

Development is impeded by the remoteness of the unloading points, and the lack of incentive in prices offered by the processing units, combined with the absence of an organized structure for transferring innovations to fishermen.

In the area of applied research, the report mentions problems in monitoring the uniformity of compliance (mesh size of nets), the need to develop a regional structure for managing marine areas and stocks, the lack of a specially equipped boat to monitor fish stocks, and the absence of national training for research staff in the sector. At the financial level, the report emphasizes budget inadequacy, the unreliability of external financing, and above all, the insufficient financial contribution of national fisheries to meet research needs.

f. Production system constraints

In this subsector, the constraints identified in the National Report deal only with the related research.

As this subsector was recently identified and is still "young", the main constraints on research development come from the fact that research is still in the phase of identifying concepts and strategies.

The agents surveyed mentioned these constraints:

- o The lack of standard methods for research on production systems and the lack of experience of researchers, who are generally young;
- o The lack of a "critical mass" of baseline data on this subsector; and
- o The lack of logistical and budgetary means, as well as computer capabilities.

6. Definition of solutions and priority actions

a. Policy aspects of the propositions

The National Report, after explaining the country's main features and analyzing the institutions and problems in the

production subsectors, proposes a very complete set of recommendations or action options.

A summary of this list is presented below.

(1) General recommendations

(a) Direct interest for research

Based on consideration of the characteristics and constraints within agricultural research, the National Report proposes the following recommendations for an immediate impact on the research sector:

- o Transform the current legal framework of research institutes into public scientific and technological institutions;
- o Establish a dissemination structure to promote and transfer research results;
- o Improve mechanisms to evaluate and define scientific and technical policy;
- o Create a motivating salary structure that provides research personnel with adequate incentives;
- o Increase and secure operating and investment credits;
- o Reinforce and standardize equipment;
- o Improve administrative and financial management capabilities;
- o Reinforce scientific and technical cooperation between research institutes;
- o Improve senior staff recruiting policy, in order to reach a level of 75 percent nationals in the positions;
- o Promote and develop the information circuit at the national level; and
- o Improve the social and cultural environment of research agents.

(b) Indirect interest for research

A more broadly-based set of recommendations that will also affect research are the following:

- o Encourage communication and cooperation between all institutions working for agricultural development;

- o Increase research responsibility in training rural development agents;
- o Improve the potential to benefit rural communities by implementing:
 - A consistent national agrarian reform policy;
 - A price incentive policy for producers;
 - Reorganization of marketing networks;
 - Alleviation of some production tasks;
 - A development and diversification policy for energy sources;
 - Reorganization of producer groups on the basis of increased responsibilities; and
- o Encourage the establishment of small- and medium-size companies involved in local product processing.

(2) Scientific and technical recommendations

In order to increase knowledge on ecological problems and the development of the natural environment, the following recommendations were made:

- o Inventory and study the evolution of the main ecosystems;
- o Study climatic modifications and forecast drought periods;
- o Use state-of-the-art technologies in order to inventory mineral and live ecological resources;
- o Establish a cohesive development policy for irrigated crops, including improved irrigation techniques, integrated systems, and the agricultural development of arid and semi-arid areas;
- o Promote a water drawing and water conservation policy;
- o Create a national soil service with qualified personnel, laboratory analysis and soil mapping equipment;
- o Improve and preserve the environment, especially in terms of soil erosion and restoration problems; and
- o Continue the study of soil regeneration and fertility conservation.

In the area of plant production, some general recommendations were made to improve the entire sector:

- o Accelerate creation at the national level of a gene bank, a pesticide control lab, a plant quarantine station, a national commission responsible for preparing an official catalog of plant material resources, and a forage seed production center;
- o Establish a promotion network for plant protection; and
- o Intensify studies on the possibility of manufacturing tools and machines, and participate in the training of artisans in agricultural equipment maintenance.

For food crops the primary recommendation is to continue selection work on species which are adapted to ecological conditions, disease and pest resistant, and which taste good. Other recommendations for food crops include the following:

- o Develop work on fonio, pigeon pea and cassava;
- o Reinforce research methods to meet the need for foundation seeds;
- o Improve knowledge on the ecology and the dynamics of major pests;
- o Continue work on food crop processing (small-scale and industrial); and
- o Continue the study of socioeconomic aspects of food crop production.

A number of recommendations relate specifically to groundnut production. Specifically, groundnut varietal improvement should be oriented towards increasing resistance to disease, tolerance to drought and nitrogen fixation. Groundnut-related entomology should be studied in order to protect the plant before and after the harvest, evaluate the economic importance of pests on groundnut-seed, evaluate the effect of pesticides on the increase of yields and on reducing stock losses, and to encourage moderate use of pesticides.

For fruit and vegetable crops, the following recommendations are made:

- o Balance research on locally grown vegetables, including their processing and conservation; and
- o Restore the dynamism of the fruit research organization.

In forestry, priority should be given to research on local tree species and to research on forestry by-products. Other recommendations are to improve fruit tree species, study the bio-

ecological effect of major public works (dams, mines) on forest areas and to study wildlife (protection, introduction and utilization).

The following research in animal production should be continued or developed:

- o Local cattle and sheep breed selection;
- o Artificial insemination;
- o Meat product conservation;
- o Crossbreeding of local pig varieties and breed improvement; and
- o Milk production from productive imported or local cows.

In animal health and nutrition, the following research should be continued or developed:

- o Natural pasture evaluation, development and management;
- o Cultivation of forage crops and their integration in farm systems;
- o Development of agro-sylva-pastoral system (fallow, forage rotation and introduction of forage varieties);
- o Study of domestic animal physiology and behavior during the July food shortage and by ecological area;
- o Research on ruminant finishing ratios and on factors affecting the finishing of small numbers of animals on the farm; and
- o Poultry pathology, including trematodes and mollusks.

In the sector of fish production, the following research should be continued or developed:

- o Study of main migratory species (sub-regional collaboration);
- o Improvement in fishing equipment and on-board fish conservation in artisanal fishing;
- o Study of the coastal ecosystem;
- o Utilization of hydrophytes (biogaz, compost);
- o Socio-economics of industrial fisheries, inland fishing industries and markets;
- o Stratification of the freshwater environment for rational exploitation;

- o Wildlife dynamics at the sub-regional level (endemic character and availability of species);
- o Creation, for aquaculture, of functional research and development facilities;
- o Biology and feeding mechanisms of species in their natural environment;
- o Development of production systems taking into account the hardiness of fish, the food systems and complementarity with other activities; and
- o Development of structures to evaluate technical and economic operating standards.

b. Technical proposals and priorities

Planned operational programs are appended to the report, under the following titles:

- o Millet. Pathology and parasite resistance mechanisms, genetic diversity of Bambey millet;
- o Maize. Extension dissemination of maize "opaque 2" in Senegal, agronomy, growing techniques, physiology;
- o Groundnuts. Pathology, protection against millepedes, drought adaptation;
- o Sorghum. Development of local genetic resources;
- o Vegetable and food crops. Virus and mycoplasma infections;
- o Forage crops. Strengthen and diversify research;
- o Seeds. Production of foundation seeds;
- o Cultivars. Conservation of plant resources in Senegal.
- o Livestock. Milk production management in Niayes. Strengthen research in animal parasitology and immunity and antigens in African swine fever. Inventory and surveillance of Sahelian pasture ecosystems (phase 2);
- o Machines. Create a National Center for Agricultural Machinery. Build a light threshing machines for soybean;
- o Forestry. Management, conservation and development of Senegalese forests. Reintroduction and utilization of trees in the farming system. Forestry research in Casamance;

- o Fisheries. Macrobrachium shrimp biology in Guiers Lane and Lower Senegal River. Impact of the anti-salt dams on fisheries in Casamance. Aquaculture and fish breeding in Diama dam. Fish production of temporary river ponds;
- o Environment. Establish a monitoring laboratory and study forest products with pharmaceutical value. Research on the use of mangroves;
- o Technology. Physical grain storage conditions in rural areas; and
- o Human food supply. Create a data bank on Senegalese water quality. Research on pesticides and mycotoxins contaminating food products. Standardize new products developed by the ITA. Study bacterial contamination of meats in Senegal. Modernize artisanal fish processing. Weaning food and peanut-based high energy foods. Soybean utilization in traditional diet. Development of a regional food composition table. Nutritional monitoring in Senegal. Diet and nutritional status of children around the urban areas.

7. Conclusions and recommendations

The constraints identified and the solutions proposed in the National Report and summarized above suggest that all important production problems have been considered and included in a program project.

Conversely, a certain number of structural difficulties and agricultural policy problems mentioned in the report require attention and evaluation, study or research. The most important among them are the following.

a. General recommendations

(1) Rainfall

Rain is the major factor in agricultural production and development, especially in the Sahel. Agro-climatologists have been concerned about rainfall for a long time. However, the new climatic conditions resulting from the drought require fresh study, especially with respect to identifying a favorable time for planting, anticipated total rainfall, and short- and medium-term agricultural planning.

The project, which goes beyond the scope of a single country, should be based on the study of weather data collected since the beginning of weather data collection and processing in West Africa. Since this corresponds to a supra-regional approach, it is included with regional projects.

(2) Statistics

The need for numerous and reliable data, particularly for a continuous analysis of agricultural policy efforts and development projects, is expressed at all levels.

In order to meet this need, it is necessary to improve the means of collecting and processing statistical data by strengthening monitoring and evaluation components of the project, training qualified agents for that activity and developing the possibility to centralize data, combined with a capacity to process them and distribute them to potential users.

(3) Agricultural policy

There is an urgent need to develop an incentive system for the farmers. Promises given to the producers should be kept and maintained. It is also necessary to avoid excessive transfer of responsibilities to agents or public structures, which may be too abstract or insufficiently involved, from the farmer's standpoint, in the consequences of their initiatives.

A system should be developed to restore all possible incentives to agricultural production. It is particularly necessary to carry out a complete evaluation of the low price policy applied to imported cereals which compete with or are substituted for national products. This generally favors urban populations and the consequences are interpreted by the farmers as a punishment, which aggravates the gap between urban and rural groups. By the same token, farm gate prices should be revised as they are a source of general dissatisfaction.

Those directly responsible should ensure continuity and manage the related research programs and financing instruments for some time, with appropriate flexibility so that the necessary orientation can be implemented without restricting the effectiveness and success of operations.

b. Recommendations on inputs

(1) For all subsectors

(a) Agricultural credit and marketing

Accelerate the implementation of an agricultural credit system available to all producers (limited and automatically recoverable loans) including a "bonus-malus" system to encourage serious borrowers and discourage the others. In particular, serious and non-serious borrowers should receive different treatment if a grace period is extended, for example, because of a regional disaster.

(b) Post-harvest technology

Major efforts should be made to identify and develop post-harvest conservation methods so that individual farmers

can use them. Research should be oriented towards simple systems and adapted to a rural environment, even if their effectiveness does not compare with modern techniques, which are well known but too sophisticated to be implemented at the village level.

(c) Irrigated cultivation

The National Report considers the possibility of reaching food self-sufficiency in the year 2000 through irrigated crop development. The irrigation option should be carefully studied to ascertain how realistic an approach it is for reaching this goal. Rainfed crops are essential for accomplishing this objective, and dryland farming is currently stagnating. It is necessary to determine the improvements required for the most common farming systems in order to develop them on the basis of real constraints experienced by the farmers and their aptitude to adopt new techniques.

(2) Agricultural production

Study practical and efficient methods to increase the reliability of structures developed to economically make local phosphate fertilizers and other inputs available to farmers. Likewise, it is necessary to reorganize the timely supply of seeds and develop structures to produce them locally.

(3) Animal husbandry

(a) Pastoral resources and animal husbandry practices

Strengthen studies on preservation and restoration of pastoral resources in order to define and promote very quickly, as a replacement for traditional methods, a rational pastoral management system placed under the responsibility of cattle breeders instead of state or parastatal structures.

(b) Socioeconomics of traditional animal husbandry

Study the socioeconomics of traditional animal husbandry, determine the needs and motivations of cattle breeders and their current means of satisfaction in order to define the direction for modernizing this sector. Production constraints in traditional animal husbandry should be identified and quantified in order to determine methods to eliminate them.

(4) Fisheries

(a) Fish price and unloading

After revising the price offered to fishermen, it is suggested that fish unloading points be multiplied through creation of secondary points (Djifféne, Kaffountine) and intermediate facilities on beaches.

(b) Research

Study the profitability of an oceanographic research boat specializing in fish stock follow-up. This project would present a regional interest, with Mauritania, The Gambia, Cape Verde and Guinea-Bissau as possible partners.

Train Senegalese researchers specializing in fisheries and encourage competent and motivated extension workers.

Stimulate research on inland fisheries and fish breeding at ISRA.

(c) Small-scale fish processing

Contribute to an improvement of the fish processing done by women by giving these women the opportunity to learn new techniques and by making available to them materials and necessary products.

(5) Forestry

Within the context of the protection and restoration of the natural environment, it is urgently required to:

- o Develop awareness programs for the rural population on protection methods for trees and on various wood substitutes to satisfy their needs. It is also necessary to provide them with such substitutes;
- o Accelerate research on firewood substitutes and controlled wood-processing techniques, particularly for pasture lands; and
- o Disseminate production techniques to grow local species in tree nurseries, transplant them and protect them.

c. Recommendations for institutions

(1) General recommendations for all institutions

(a) Agent motivation and careers

Develop a continuing individual evaluation system for agents which, combined with advantages and sanctions, encourages them to increase their productivity and does not allow them to keep their position on the sole basis of title or credentials. Too much importance is placed on recognized diplomas, even when the agent does not perform well.

Develop internal promotion structures capable of motivating agents to improve their performance, whether by acquiring a new diploma or by other means.

(b) Agent status

Accelerate the revision of those legal structures which are deemed inappropriate, in order to develop a single structure which places more emphasis on research and allows the agents (especially executives and senior technicians) not to be excessively preoccupied with future career prospects.

(c) Management and administration

In the past, executives were promoted without adequate preparation to higher functions with managerial or supervisory responsibilities. The problem is often aggravated by the ineffectiveness of the administrative services. It is necessary to develop training facilities to prepare staff for new responsibilities.

The training should include methods of personnel management, development programs and general administration. It should be organized in a fashion which is not disruptive to their career and should be flexible enough to be provided on an "a la carte" basis, adapted to the trainee's profile and new responsibilities.

(d) Maintenance

Since equipment deterioration is a major problem, training should be given for maintenance personnel. The organization of practical training structures for agents after they graduate from a vocational school should be determined. For example, they could specialize in materials specific to their work environment.

(e) Information

There is a permanent lack of information among researchers, trainers and extension workers. It results from the lack of communication between agents, both between and within the institutions.

We recommend studying the possibility of creating a system of organized dialogue between agents and enabling them to share their experience and have meaningful discussions. For example, financing of these meetings could be included in projects or programs.

(f) Documentation

Faced with the shortage of qualified librarians and the lack of equipment and acquisition opportunities, Senegal created the National Scientific and Technical Documentation Center. The Center is not yet completely operational.

An evaluation is necessary to define needs, to improve relations between researchers and librarians, to improve communication of scientific results, to reorganize scientific and technical documentation facilities, and to define a genuine information and documentation policy.

(2) Research institutions

(a) Multidisciplinary approach

A multidisciplinary approach should be emphasized in research by facilitating the grouping of researchers in teams whose activities would be geared towards a production system. ISRA's new strategy is to follow this approach but as yet the researchers are not completely prepared for the new method. They should be given the opportunity to learn more about the advantages of multidisciplinary work. Information courses could be organized for that purpose.

(b) Evaluation of research effectiveness

Noting the difficulties encountered in modifying ongoing programs to address a changing economic situation, we recommend studying a system of objective critical review of services provided by research institutes relative to the amount of finance provided. It is necessary to determine program modifications required through reevaluation of objectives and in relation to cost/benefit studies, personnel and financing of research effort.

On a different level, a study of the reasons why recommendations and scientific results have such limited application in the field might prove quite constructive for redefining research and extension policy.

(c) Conditions of service

By nature, agricultural research is carried out in the field. There is, however, a lack of interest among researchers for field station assignments, especially the most remote ones. In order to reverse that trend, it is necessary to find means for improving the social environment and the relative advantages offered to agents posted in the field. This must include financial advantages, career opportunities, cultural, social, health and material aspects.

(3) Training institutions

Although there are many training institutions at all levels, inadequate training and employment of agents is frequently cited. It seems to result from a lack of an overall training policy. In particular, field workers are hardly ever trained at the highest levels. Many workers need practical training, and all of them want training and improved opportunities.

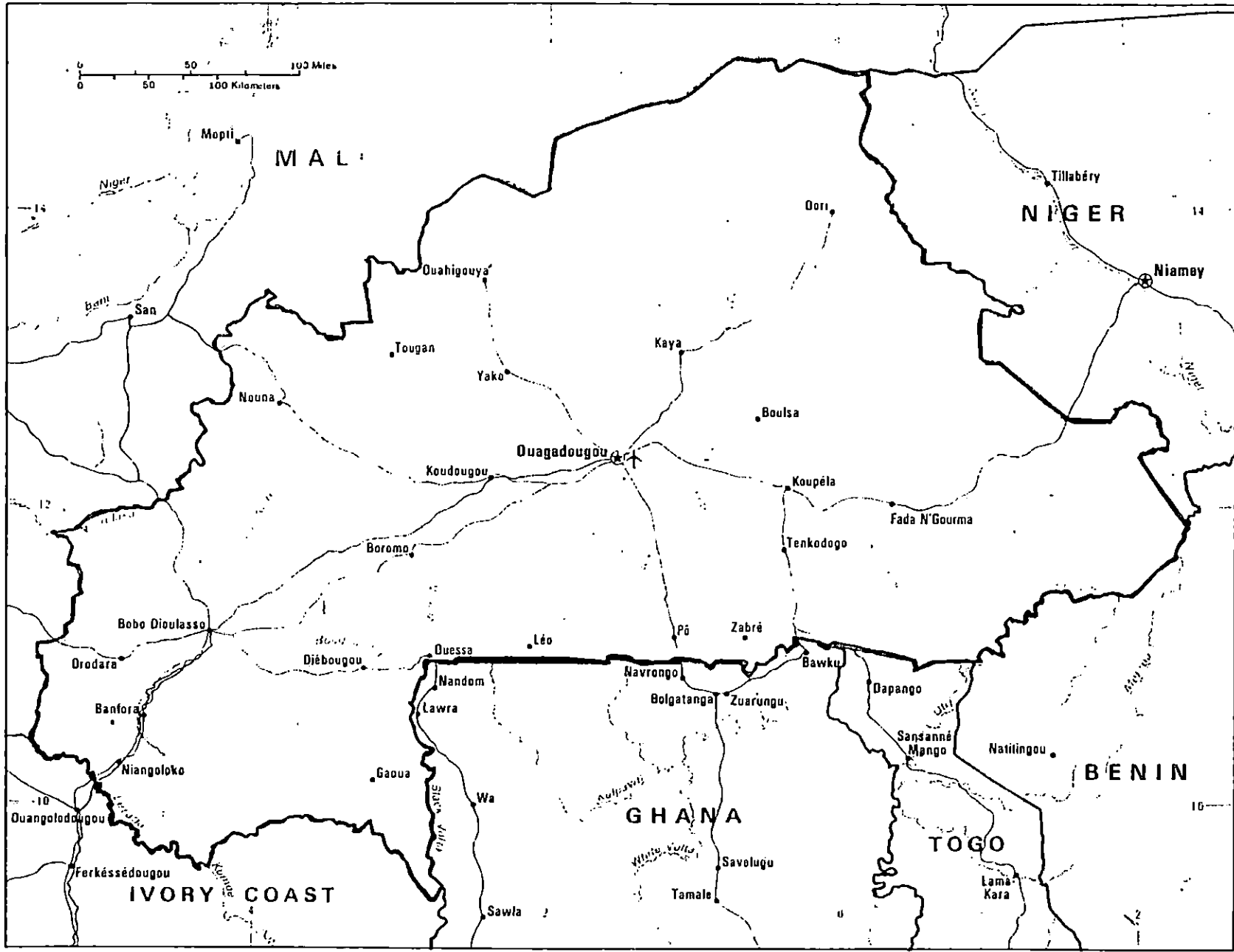
Another recommendation is to investigate the possibility of having projects organize field training for their agents and asking qualified researchers to train researchers and extension workers.

Extension tasks receive little attention, so that extension workers generally get insufficient training. The recommendation is to upgrade their job by providing them with better and more diversified skills emphasizing the pedagogical aspect of their job. It is necessary to investigate the possibility of having high level extension workers who do not look down upon their jobs because of their diploma. It is also necessary to make extension capabilities more uniform; this capability currently varies widely from one institution to another.

(4) Extension institutions

The major problem seems to result from insufficient linkages between researchers, extension workers and producers. In order to improve these linkages, the National Report offers many suggestions which are summarized below:

- o Establish an extension coordination centre which could define a strategy for assembling and supervising the supply of inputs and recovery of costs, and which could organize producer participation in the definition of needs and in contact with research;
- o Promote farmers' associations which would be responsible and operational, provide them with training and seek their advice on development programs so that they may become active participants instead of passive recipients of development. They should be able to make their own decisions with regard to production, processing and marketing; and
- o Provide financing for an adequate number of official research fields to enable definition of the actual needs of farmers within a broad experimental spectrum, and to collect the observations of those involved in the research process.



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 Lambert Conformal Projection
 Standard parallels 8° and 32°
 Scale 1:4 000 000
 Boundary representation is
 not necessarily authoritative

Figure 9: Map of Upper Volta

— Railroad
 - - - Road
 ↑ Airport

H. Upper Volta¹

1. General information on Upper Volta

a. Geography

(1) Location and boundaries

Upper Volta is one of the four land-locked Sahelian countries. It has a land area of about 274,000 km². The country is bordered by Mali to the north and west, by Niger to the east, and by Ivory Coast, Ghana, Benin, and Togo to the south. Ouagadougou, the capital of Upper Volta, lies at a great distance from the closest seaports, which are Abidjan in Ivory Coast (1,200 km) and Tema in Ghana (900 km).

(2) Climate and ecological zones

Upper Volta is a relatively flat country with few contrasting topographic features. The average elevation is less than 400 meters, and the highest elevation does not exceed 600 meters. Several different types of soil are found in Upper Volta, most of which are characterized as poor and have limited potential for expanding dryland farming. The surface water system is made up of three main river basins--the Volta, the Comoe and the Niger. The Volta river basin is located in the central part of the country (164,000 km²) and is comprised of Black Volta, White Volta, Red Volta and Penjari rivers. The Niger basin covers only 72,000 km² in the northern and eastern regions. The Comoe basin is made up of several permanent water streams: the Comoe, Yanon and Leraba.

Upper Volta is generally considered to be a Sahelian country, but the physical geography varies from a strict Sahelian zone in the north to a Sudano-guinean zone in the southwest. This variation is also reflected in the rainfall pattern which varies from 300 mm in the north to 1,230 mm in the south (sub-Saharan zone). The rainfall and climatic variation determine the following seasons:

- o A dry season, from mid-November to mid-April;
- o A transition period, from mid-April to mid-June;
- o A rainy season, from mid-June to mid-September; and
- o Another transition period, from mid-September to mid-November.

The rainy season is the main cropping season and may vary from about 30 days in the north to 90 days in the southwest.

¹As this report was going to press, the Government announced that it had changed the name of "Upper Volta" to "Burkina Faso."

(3) Transportation

Roads and the railway are the primary means of surface transportation. In early 1980, the road system included 8,214 km of categorized roads and 2,437 km of non-categorized roads. The classified roads are sub-divided into 4,606 km of national roads, 1,244 km of departmental roads and 2,364 km of regional roads. A relatively good roadway system in the south connects Upper Volta with both Ghana and Togo. On the other hand, 95 percent of the surface transport to the Ivory Coast is by railroad. Until the present time, this 1,146 km rail line between Ouagadougou and Abidjan has been the principal route of access to the sea.

Air traffic is quite limited. The two major international airports are located at Bobo-Dioulasso and Ouagadougou.

b. Demography

The latest census in 1975 estimated the total population at 6,147,508 inhabitants--3,157,483 men and 2,990,025 women. A substantial flow of out-migration had reduced the resident population to an estimated 5,630,203 inhabitants in 1975. The Ivory Coast is the primary destination for emigrants.

The population distribution shows a high concentration in the central plateau area and relatively sparsely populated areas elsewhere, notably in the south and east.

Age-related data indicate a predominantly young population. According to the 1975 census, more than 50 percent of the population was under 21 years of age. Given a natural increase of 2.1 percent per annum, the population is expected to double every 27 years.

Important to note on the subject of agricultural development is that 93.6 percent of the population live in rural areas and depend on agriculture for living. According to the classification of the 1975 census, Upper Volta has five cities: Ouagadougou (172,661 inhabitants), Bobo-Dioulasso (115,063 inhabitants), Koudougou (36,838 inhabitants), Ouahigouya (29,690 inhabitants), and Banfora (12,358 inhabitants).

Upper Volta is a mosaic of about 60 ethnic groups. These are generally classified in the literature as extended families or affinitive groups. The Mossi group is the largest, constituting about 50 percent of the population. The second most numerous group is the Peul, which is about 10.4 percent of the population. Other groups are the Lobi-Dagari, which is 7 percent of the population, the Bobo, with 6.7 percent, and the Senoufo, with 5.5 percent.

The native languages are almost as varied as the ethnic composition. The official language is French which is spoken by about 10 percent of the population. There are three main religious affiliations: Animists (56 percent of the population), Moslems (33 percent), and Christians (11 percent, of which 10 percent are Catholics and 1 percent Protestants).

c. Education

There are two educational systems in Upper Volta, one is the informal, adult education and the other a standard educational system which is divided into primary, secondary and university-level education.

School attendance is extremely low. In 1982, for example, only 16.5 percent of the school-age population actually went to school. In addition, approximately 90 percent of the adult population was illiterate in any language. Since 1966 the adult education program has been expanded in order to reduce illiteracy. As of 1981, an adult education course had been established in 1,684 centers throughout the country, and was reaching 50,680 students.

Primary education begins at age six or seven, and lasts for six years. At the end of the program, students receive a diploma, le Certificat d'études primaires elementaires (CEPE). In 1982, there were 1,176 primary schools (1,088 public schools and 88 private schools) with a total of 251,269 students.

Secondary school includes both general and technical tracks. Both courses are divided into two "cycles" or levels. The first "cycle" lasts for four years after primary school, and upon successful completion of the final exam, students receive le Brevet d'études du premier cycle (BEPC). The second "cycle" lasts for three years, and immediately follows receipt of the BEPC. Upon successful completion of the second "cycle" students are awarded the Baccalaureat (BAC). The secondary schools are largely geared towards general education; in 1983, of the 93 secondary schools in the country, 72 had a general curriculum and only 21 were technical schools.

There is one university, located in Ouagadougou. As of the academic year 1983-84, the University had 3,685 students divided among eight faculties. This represents a 19.4 percent increase from the previous academic year.

d. Government

Upper Volta was proclaimed a republic on December 11, 1958, and obtained its political independence on August 5, 1960. A number of political changes have since occurred. The latest change, on August 4, 1983, brought into power the Conseil national de la revolution (CNR) which is the highest political authority in the country. The current government is composed of a President (also the President of CNR), and 19 Ministers. Five ministries are concerned to some extent with agricultural development:

- o Ministry of Rural Development;
- o Ministry of Higher Education and Scientific Research;
- o Ministry of Environment and Tourism;

- o Ministry of Planning and Cooperation; and
- o Ministry of State Enterprises.

As of September 1983, the country is divided into 25 provinces which function as regional administrative units, replacing the previous division of ten departements.

e. Economic indicators

In 1980, the gross domestic product (GDP) was estimated at FCFA 270 billion. Almost all of the export products are agricultural--cotton, oil seeds, and livestock. During the past 20 years, the contribution of cotton production to exports has risen from 2 percent to 37 percent. The primary imports are oil products, machinery, food, and transport and construction equipment. Upper Volta's principal trading partners are Belgium, China, France, West Germany, Canada, Italy, Ivory Coast, Japan, Great Britain, and the United States. These countries figure in both the export and import sectors of Upper Volta's trade. Table 29 presents the external trade balance, which constitutes a deficit level of 20 percent of GDP.

f. Rural sector

The potential land resources and their current allocation by use are summarized in Table 30.

Sixty-two percent of the national territory is considered suitable for agriculture. It is estimated, however, that out of the 88,290 square kilometers fit for rainfed agriculture, only 24,000 to 25,000 km² are actually cultivated in any single year.

Crop production is the main agricultural activity, occupying about 90 percent of the total population and making the largest sectoral contribution to GDP. The main staple food crops are millet and sorghum; other important crops are maize, rice, peanuts, and sesame. The area planted, total production and yield per ha for the major crops are shown in Table 31.

Livestock production is one of the most important economic activities in Upper Volta. Table 32 shows the annual contribution of livestock, fisheries and hunting to GDP. Fisheries and hunting make a small contribution in relation to that of livestock. Livestock production is extensive, and is found predominantly in the northern part of the country.

Fishing is of course a less important activity due to the limited water resources. There has been some official interest in developing this sector but it currently remains a secondary activity.

One goal expressed by all the successive governments in Upper Volta has been the achievement of national self-sufficiency in food. The last four development plans (the plan cadre 1967-70, the intermediate plan 1971, the five-year plan 1972-76, and the 1977-81

Table 29: External Trade of Upper Volta: 1976-1978
 (\$US million)

	<u>1976</u>	<u>1977</u>	<u>1978</u>
Products exported	83.1	94.8	107.8
Products imported	<u>-167.4</u>	<u>-220.8</u>	<u>-255.4</u>
Products deficit	<u>-84.3</u>	<u>-126.0</u>	<u>-147.6</u>
Services exported	23.4	23.7	28.5
Services imported	<u>- 93.3</u>	<u>-121.7</u>	<u>-151.0</u>
Services deficit	<u>- 69.9</u>	<u>- 98.0</u>	<u>-122.5</u>
Products and Services deficit	<u>-154.2</u>	<u>-224.0</u>	<u>-270.1</u>
	=====	=====	=====

Source: World Bank Report, 1982.

Table 30: Land Use, Upper Volta, 1980

<u>Area (km²)</u>	<u>Use</u>	<u>Percentage of Total</u>
88,290	Rainfed Agriculture	32.2
874	Irrigated Agriculture	.3
129,570	Pasture Land	47.3
34,760	Forestry & Reserves	12.7
21,380	Other	7.5

Source: DEVRES/INSAH Agricultural Research Resource Assessment, 1983. See National Report on Upper Volta for more detail.

Table 31: Evolution of Major Crop Production in Upper Volta, 1961-79

Year	Sorghum			Millet			Maize			Rice			Peanut			Sesame			Cotton		
	1000ha	1000T	Kg/ha	1000ha	1000T	Kg/ha	1000ha	1000T	Kg/ha	1000ha	1000T	Kg/ha	1000ha	1000T	Kg/ha	1000ha	1000T	Kg/ha	1000ha	1000T	Kg/ha
1961	908	411	453	615	195	317	149	75	502	54	30	560	n.d	n.d	n.d	n.d	n.d	n.d	22.9	2.3	111
1962	1042	508	488	597	261	438	160	78	487	67	45	677	277	113	501	15	5.7	380	36	6.6	180
1963	908	460	507	823	116	383	160	109	689	33	25	762	100	50	500	21	4.1	197	45.8	8	190
1964	1173	660	563	1817	378	449	167	127	761	35	34	977	127	70	551	30	6	200	52.5	8.8	170
1965	964	530	550	800	150	438	164	110	667	35	34	986	130	73	562	25	6	260	49.7	7.5	140
1966	1018	540	530	800	150	438	165	124	752	35	34	980	136	76	559	25	6	260	52.4	16.3	310
1967	1312	604	460	700	310	429	225	124	530	36	44	1215	142	80	563	25	6	260	65.4	17.3	260
1968	831	530	638	612	188	601	228	137	600	46	40	871	150	85	567	20	7.9	379	71.6	32	450
1969	1094	547	500	867	382	440	100	60	600	40	34	836	137	71	519	22	3.7	171	84.1	36.2	430
1970	1041	563	541	851	378	444	85	55	645	40	34	850	140	68	484	26	6.3	238	80.6	23.5	290
1971	1070	576	538	672	197	591	90	55	655	41	36	891	144	66	458	21	4	182	74.1	28.1	380
1972	1051	512	488	711	440	373	81	59	725	32	30	941	105	60	577	34	5.6	166	70.1	32.6	470
1973	1037	481	464	720	253	351	89	58	658	39	31	799	167	63	376	35	5.2	143	66.6	26.7	410
1974	1200	705	588	850	370	435	90	62	683	40	36	906	120	65	382	30	8	150	61.5	30.6	500
1975	1200	650	542	850	350	412	90	62	683	42	40	952	180	80	444	40	8	175	68	50.7	750
1976	1138	717	630	911	406	370	90	46	511	45	41	911	164	87	533	40	7	179	79.2	55.3	700
1977	1000	610	610	900	350	350	90	50	556	42	23	548	165	85	515	40	6	150	68.9	38	550
1978	1100	621	565	910	404	404	150	101	673	40	32	748	170	70	412	40	7	175	71.7	60	840
1979	n.d	610	n.d	n.d	430.5	n.d	n.d	104.5	n.d	n.d	47.2	n.d	144.6	69.9	480	27.1	5.4	200	77.8	75.1	960

Source: Rapport Mission Conjointe Banque Mondiale/FNU/ISVOR sur la Recherche Agronomique en Haute-Volta, 1983.

Table 32: Livestock Contribution to GDP, 1964-75

<u>Designation</u>	<u>1964</u>	<u>1965</u>	<u>1968</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1974</u>	<u>1975</u>
Primary sector	29289	19448	34327	36360	37360	40061	45074	47324
Livestock, fishery, & hunting	6248	5913	8645	8350	8690	10808	12606	10402
% Primary sector contribution	21.3	20	25.2	23	23.3	26.6	28	22
GDP	50385	51670	70727	78790	82980	85508	100508	106844
Livestock contribution GDP	12.4	11.4	12.2	10.6	10.5	12.6	12.5	9.7

Source: Deuxieme Conference des Cadres du Ministere du Developpement Rural, Juillet 1981.

plan) have all stressed national self-sufficiency in food as a focal point of the development strategy. As in many developing countries, however, the plans have been "top down" proposals, relying heavily on short-term external financing. An economic plan to direct Upper Volta's development activities is under discussion as this report goes to print.

2. Field data analysis: agricultural research

a. Research institutions

There are eight agricultural research institutions in Upper Volta. Five of these institutions are considered national institutions and the other three are regional or international institutions.

(1) National institutions

(a) Institute for Biological and Tropical Ecology Research (IRBET--Institut de recherche biologique et d'ecologie tropicale)

The ministry responsible is the Ministry of Higher Education and Research (MESRS--Ministere d'enseignement supérieure et de la recherche scientifique). IRBET was established in 1981 to undertake research in the following areas--botany, zoology, ecology and forestry and natural history.

(b) Voltaic Institute for Crop and Animal Husbandry Research (IVRAZ--Institut voltaïque de recherche agronomique et zootechnique)

The ministry responsible is also the MESRS. IVRAZ was established in 1981 to coordinate agricultural research in Upper Volta. It is divided into five research departments--food crops, commercial crops, horticulture, irrigated crops and livestock.

The research programs of the following institutions also fall under the rubric of IVRAZ: the Institute for Research in Tropical Agronomy and Food Crops (IRAT--Institut de recherches agronomique tropicales et des cultures vivrières); the Institute for Research on Cotton and Textiles (IRCT--the Institut de recherche sur le coton et les textiles); the Institute of Research on Oils and Oil-Producing Plants (IRHO--Institut de recherche sur les huiles et les oléagineux); and the Center for Experimentation on Rice and Irrigated Crops (CERCI--Centre d'experimentation sur le riz et les cultures irriguées).

(c) Division of Agricultural Services (DSA--Direction des services agricoles)

The ministry responsible is the Ministry of Rural Development (MDR--Ministère de développement rural). The DSA is composed of many service departments:

- o Administration and Accounting;
- o Documentation, Statistics and Programming;
- o Agricultural Production;
- o Seeds;
- o Quality Control;
- o Plant Protection;
- o Experimentation and accompanying studies;
- o Soil Services; and
- o Training and Extension.

(d) Overseas Office of Scientific and Technical Research (ORSTOM—Office de recherche scientifique et technique d'outre mer).

The ministry responsible is the MESRS. ORSTOM is a French research institute, which undertakes research in the following areas--social sciences, biological sciences, hydrology and geology.

(e) Agrometeorological service: climate study

The ministry responsible is the Ministry of Equipment and Communication (MEC--Ministere de l'équipement et des communications). The institution was established to facilitate food production by identifying weather-related risks to productivity. The institution collaborates with many institutions nationally, such as IVRAZ, the DSA and the ISP. It also has a long-standing relationship with AGRHYMET of Niamey.

(2) Regional and international institutions

(a) ICRISAT

The ministry responsible is the MESRS. ICRISAT established a program in Upper Volta in 1975 with the assistance of UNDP. Its major objective is to develop improved varieties of sorghum and millet, in order to assist farmers in obtaining productivity increases. ICRISAT also has activities funded by SAFGRAD.

(b) IITA/SAFGRAD

The ministry responsible is the MESRS. The research program of the International Institute of Tropical Agriculture was established in Upper Volta in 1977, with funding from SAFGRAD. The objective of IITA/SAFGRAD is to develop approved

varieties of maize and cowpeas in the semi-arid zone for the 27 SAFGRAD-member countries.

(c) FSU/SAFGRAD

The ministry responsible is the MESRS. The Farming Systems Unit was created in 1979, when Purdue University was commissioned, under the SAFGRAD project, to study agricultural production systems.

b. Research programs

Table 33 presents a list of the major agricultural research programs in Upper Volta. Only the major program headings of each institution are presented in order to indicate the similarities and differences among the objectives of the research institutions. A more detailed account of the research activities comprising each program is outlined below by institution.

(1) IRBET

IRBET's programs are the following:

- o Biology, ecology and economy of forestry resources;
- o Introduction of eucalyptus in the Sudano-sahelian zone;
- o Water and soil conservation research; and
- o Studies of local and imported tree varieties (other than eucalyptus).

(2) IVRAZ

The research projects concerned with rainfed food crop research are conducted with assistance from IRAT, INSAH, SAFGRAD, ICRISAT, and IITA. The other research projects of IVRAZ are the following:

- o Cotton research, carried out with the assistance of IRCT;
- o Oil-producing crops; in particular, peanuts, sesame and karite, with the assistance of IRHO;
- o Horticulture, with the assistance of IRAT, and UNDP/FAO;...
- o Rice and irrigated crop research, with the assistance of UNDP/FAO in CERCI; and
- o Forage crops, with the assistance of UNDP/FAO.

Table 33: Agricultural Research Programs in
Upper Volta, 1983

<u>Program Title</u>	<u>Name of Institution</u>							
	<u>IRBET</u>	<u>IVRAZ</u>	<u>DSA</u>	<u>Agro- Meteo</u>	<u>ORSTOM</u>	<u>ICRISAT</u>	<u>IITA</u>	<u>FSU</u>
Rainfed Food Crops		X						X
Sorghum						X		
Millet						X		
Maize							X	
Cowpeas							X	
Cotton		X						
Oil Seeds		X						
Horticultural Crops		X						
Rice and Irrigated Crops		X						
Forage Crops		X						
Soil and Water Conservation	X	X	X					
Crop Protection/ Entomology		X	X					
Forestry	X							
Agropastoral System					X			
Animal Health		X						
Study of Rodents					X			
Climate Study				X				
Production Systems		X	X			X	X	

Source: DEVRES/INSAH Agricultural Research Resource Assessment, 1983.
See National Report on Upper Volta for more detail.

(3) DSA

The DSA's various programs include the following:

- o Study of soil fertility, conservation of soil and water;
- o Study of principal pests and diseases affecting food crops;
- o Updating of systems integrating growing practices with pest control to reduce the usage of pesticides as much as possible; and
- o Production and control of improved seeds.

(4) Agrometeorological Service

The research of the Service centers on the study of climate-related risk and the reduction of its impact on agricultural production.

(5) ORSTOM

Activities concentrate on the study of agro-pastoral systems and harmful rodents in Upper Volta.

(6) ICRISAT

ICRISAT's research programs are focused on the improvement of sorghum and millet; an increase in resistance to Striga; soil and water management; and various socioeconomic studies.

(7) IITA/SAFGRAD

IITA's research projects concern the improvement of the selection of maize and cowpeas, the improvement of crop cultural practices of maize and cowpeas and of storage of cowpeas and entomological studies related to these two crops.

(8) FSU/SAFGRAD

The FSU carries out socioeconomic and agronomic studies on farming systems.

In addition to the four stations detailed in Table 34, the PAPEM (Point d'appui de vulgarisation et d'experimentation multilocale: trial fields for pre-extension experiments) are used for agronomic testing. A PAPEM generally consists of ten to 15 ha of land and is managed by a regional development organization--ORD¹.

¹ORDs (Organisme régional de développement) are extension institutions. Additional information on ORDs is presented in in subsection 4 entitled Agricultural Extension.

Table 34: Major Agricultural Research Stations,
Upper Volta, 1983

<u>Name of Station</u>	<u>Land Area (ha)</u>	<u>Ecological Zone</u>	<u>Average Annual Rainfall (mm)</u>	<u>Focus of Research Activity</u>
Kamboinsé	170	Sudano-Sahelian	775	sorghum, millet, maize, cowpeas, groundnuts, soybeans
Sariz	400	Sudano-Sahelian	775	sorghum, millet, maize, cowpeas, groundnuts, sesame, soybeans
Farakoba	475	Sudanian	1,050	maize, rice, fodder, root crops, irrigated crops, vegetables, sorghum and millet
Niangoloko	NA	Sudanian	1,200	groundnuts, sesame, soybean

Source: DEVRES/INSAH Agricultural Research Resource Assessment, 1983. See National Report on Upper Volta for more detail.

Other research sites which are less well-developed include:

- o Gampela station, which is owned and operated by the University of Ouagadougou and operated mainly for training purposes;
- o Gonse, Denderesso, Sapone and Oursi stations which are used for forestry and ecology-related study; and
- o Samandeni and Markoye livestock stations, where a herd is maintained but no current research activity is underway.

c. Human resources

At the end of 1983 there were 615 personnel associated with Upper Volta's research institutions. The composition of the personnel by institution is given in Table 35.

d. Facilities and operating funds

The availability of infrastructure, equipment and documents, as well as the level of financial resources, varies greatly from institution to institution. The information given below gives an idea of the general situation:

(1) Infrastructure

The availability of the necessary infrastructure for each of the research institutions is as follows:

(a) IRBET

At the Oursi station, IRBET has six houses, a kitchen and eating facility, six offices and a garage, with a water and electric system. This property is owned jointly with ORSTOM.

(b) ORSTOM

In addition to the facilities shared with IRBET, ORSTOM owns additional property in Ouagadougou, which consists of four large well-equipped laboratories, one administrative office, a workshop, and a library.

(c) IVRAZ

The Kamboinse station, administered by IVRAZ, has well-equipped laboratories and offices. ICRISAT and IITA/SAFGRAD are located here. Saria station, also administered by IVRAZ, has 13 houses, nine offices and three laboratories, all furnished by IRAT.

The Farako-Ba station has well-equipped offices, laboratories, hangars, and workshops for the 25 researchers; its proximity to Bobo-Dioulasso allows its workers to live there. Nianogoloko station, on the other hand, does not have enough offices or laboratories.

Table 35: Personnel Composition of Research Institutions

	<u>IRBET</u>	<u>IVRAZ</u>	<u>DSA</u>	<u>ORSTOM</u>	<u>AGRO- METEO</u>	<u>ICRISAT</u>	<u>IITA</u>	<u>FSU</u>
Voltaic Researchers	8a	35	19	NA	10a	1	1	3a
Expatriate Researchers	--	20	4		--	6	5	--
Technicians	7	19	40	30	20	30	12	15
Technical Assistants	33	NA	5	20	40	7	NA	NA
Administrative	3	191b	NA	NA	NA	NA	10	10

^aThese figures indicate the total number of researchers in these institutions, not divided between Voltaic and expatriate.

^bThis figure includes administrative personnel, contractual technicians and other employees.

Source: DEVRES/INSAH Agricultural Research Resource Assessment, 1983
See National Report on Upper Volta for more detail.

The research center on trypanosomiasis at Bobo has well-equipped laboratories.

(d) FSU

FSU has an office at Ouagadougou but works out of five village laboratories.

(2) Documentation

The availability of research documents for each institution is as follows:

(a) IRBET

The documentation center of IRBET is not yet developed, but nonetheless possesses about 270 books donated by CTFT.

(b) IVRAZ

Except for a few collections at the various stations, there is no well-developed information system within IVRAZ.

(c) DSA

Each section of the DSA has about 200 books, but there is no organized system to facilitate the flow of information.

(d) ORSTOM

ORSTOM has a collection of 1,850 books with 100 new acquisitions per year. There are about 128 scientific journals.

(e) Agrometeorological Service

The Service obtains documents and information from AGRHYMET of Niger as well as from the World Meteorological Organization's central documentation.

(f) ICRISAT

ICRISAT has about 300 books and over 12 scientific journals, mostly furnished from the head office in India.

(g) IITA

IITA has about 100 books, and about four scientific journals.

(3) Budget

The level of financing and the sources of funding also vary from institution to institution. Table 36 provides a

Table 36: Operating Budgets of Research Institutions
in Upper Volta, 1983
(million FCFA)

<u>Institution</u>	<u>Source</u>		<u>Total</u>	<u>Percentage External</u>
	<u>National Budget</u>	<u>External</u>		
IRBET.	4.80	0	4.80	0
IVRAZ	321.85	238.15	560.00	43
DSA	34.70	681.90	716.60	95
ORSTOM	0	161.75	161.75	100
Agrometeo	88.20	52.35	140.55	37
ICRISAT	0	272.00	272.00	100
IITA	0	240.00	240.00	100
FSU	0	90.00	90.00	100

Source: DEVRES/INSAH Agricultural Research Resource Assessment, 1983. See National Report on Upper Volta for more detail.

comparative overview of the average annual operating budget along with the sources of funding.

e. Comments

The existence of eight agricultural research institutions in Upper Volta indicates the positive attitude of Voltaic policy makers towards expanding agricultural research activities. The expansion has been assisted by the inflow of funds and personnel from external sources. In 1983, for instance, there were 605 employees associated with the research institutions. About 112 of the total personnel were high level researchers, among which 34 were expatriates. During the same period, the operating budget for all research institutions was over FCFA two billion. About 80 percent of this operating budget was generated from external sources. The research activities of both the national and regional/international organizations have focused on crop improvement programs.

A major problem in the Voltaic research program has been its lack of coordination. Because each institution has customarily defined and conducted its own program somewhat in isolation, some duplication of effort has occurred. Furthermore, research results have frequently been inapplicable to the solution of the multidimensional farm problems. Although annual research review meetings have been held, they have not resolved the problem. In most cases the research results and practices recommended were based on experiment station trials, and as a result the recommendations were often inconsistent with farmers' conditions. Fortunately, the coordination issue is recognized by the Voltaic policy makers, and by many of the research institutions. The creation of IVRAZ, as well as the recent joint seminar arranged in Ouagadougou by ICRISAT, FSU and IRAT, attest to the determination of both the government and the major research institutions to resolve the current coordination problem.

Other shortcomings which hinder effective performance of the research institutions are as follows:

- o Relatively few researchers, and among them few have a post-graduate specialization. Most of the well-trained national researchers are young, with limited research experience.
- o The existing personnel management policy is not conducive to attracting and retaining qualified researchers and technicians.
- o Operating budgets are inadequate. The national allocation for research is meager, and there are complicated disbursement procedures. Large proportions of the funds come from external sources, mostly specified as short term.
- o Resources at the disposal of researchers, particularly at the national institutions, are inadequate. This

includes documents, laboratory facilities, equipment and facilities for data analysis.

- o The four major national research stations are all found in the Sudano-sahelian or Sudanian zone, and have an annual average rainfall above 750 mm.
- o There is no advisory council in place to guide IVRAZ in its coordination role.
- o The coordinating role of IVRAZ in relation to the other institutions, including those of regional or international focus, remains ambiguous.

3. Field data analysis: agricultural training

a. Training institutions

There are five agricultural training institutions in Upper Volta:

- o Polytechnical Institute (ISP--Institut superieur polytechnique. The ministry responsible is the MESRS.
- o Agricultural Training Center at Matourkou (CAP--Centre agricole polyvalent de Matourkou). The ministry responsible is the MDR.
- o National School for Animal Husbandry and Animal Health (ENESA--Ecole nationale d'el'evage et de sante animale). The ministry responsible is the MDR.
- o Anti Tsetse Fly Training School (ELAT--Ecole de lutte anti-tsetse). The ministry responsible is the MDR.
- o National Forestry School of Dinderesso (ENFD--Ecole nationale de forestiere de Dinderesso). The ministry responsible is the Ministry of Environment and Tourism (MET).

b. Curricula

The curricula of the training institutes in Upper Volta are detailed below:

(1) ISP

The ISP is the only university-level agricultural training institution in Upper Volta. Admission is granted to students who have received the Baccalaureat (signifying secondary school completion). Training is provided at two levels:

(a) Basic level

This level requires three years of training with a total 12 weeks practical field training during the last two years. Upon completion, students are awarded a diploma called Ingénieur des techniques du développement rural.

(b) Advanced level

This level extends two years beyond the basic level. One year is devoted to field work in preparation for the thesis. Students completing this level are awarded a diploma of Ingénieur du développement rural.

In the 1982-83 school year, there were 471 students. Enrollment has risen to 560 for 1983-84.

(2) Other institutions

The other four institutions (CAP, ENESA, ELAT and ENFD), provide certificate-level training in various areas. Table 37 presents the program areas and actual levels of training available at the five institutions.

As shown in Table 37, the admission requirements for the CAP and ENFD are set at the BEPC and CEPE levels, respectively. The BEPC is the certificate awarded after four years of secondary school, and the CEPE is awarded after successful completion of primary school. The current enrollment capacity is 90 students for the CAP and 70 for ENFD.

c. Human resources

The personnel in the various institutions are as follows:

(1) ISP

The staff of the ISP is composed of 35 national and 15 expatriate full-time instructors.

(2) CAP

In addition to two administrators, the CAP has 23 national full-time teachers, ten national part-time teachers, 13 visiting teachers, seven teaching assistants and three teachers in training.

The CAP plans to obtain additional training for teachers in the next ten years in the following subjects: chemistry, physics, mathematics, French, English, and soils.

Table 37: Areas of Specialization and Levels of Agricultural Training
by Institution, Upper Volta, 1983

Specialization	ISP ¹		CAP ¹		ENESA		ELAT	ENFD
	BAC + 5	BAC + 3	BEPC + 5	4eme + 4	1e - c+3	2e + 2	recyclage	CEPE + 2
Agronomy	X	X						
Animal Husbandry	X	X						
Water and Forest	X	X						X
General Agriculture			X	X				
Veterinary Medicine					X	X	X	
Livestock					X	X	X	

¹ Entails field level training:
of the BAC + 5 : 1 yr field work for thesis
of the BAC + 3 : 6 weeks field training in 2nd and 3rd years
of the BEPC + 5 : 2 yr field training.

Source: DEVRES/INSAH Agricultural Research Resource Assessment, 1983. See National Report on Upper Volta for more detail.

(3) ENESA

The staff of ENESA is comprised of one full-time director/teacher; and visiting teachers are obtained from other institutes.

(4) ENFD

The staff of ENFD is comprised of five permanent teachers, three assistant teachers, four visiting teachers and one teacher in training.

ENFD plans to train seven teachers in the next ten years.

d. Operating funds and libraries

The 1983 budget for agricultural training had the following composition:

- o The ISP received FCFA 35,000,000 from national sources for its operating budget;
- o The CAP received FCFA 125,000,000 from national sources for its operating budget, and FCFA 125,000,000 for investment from external sources; and
- o ENFD received FCFA 3,027,444 from national sources and 4,939,515 from external sources for its operating budget. ENFD also received 199,815,000 for investment from external sources.

The ISP and the CAP are the only two institutions with libraries; the ISP has 1,647 books and 15 journals and the CAP has 500 books and about ten journals.

e. Comments

In order to increase the practical relevance of the instruction, both the ISP and the junior level training institutions include practical field training in their programs in addition to formal classroom teaching. The Gampela Station, which currently serves as a training ground for ISP students, is a viable mechanism for linking the teaching effort with research activity. The normal practice of assigning students to work in the ORD exposes students to practical extension problems. If, however, the assignment was done systematically rather than on the prevailing ad hoc basis, greater benefit for the participants could be attained. Other issues requiring priority consideration for improving effectiveness of the training performance include:

- o Formalizing linkages between the teaching, research and extension institutions using mechanisms such as joint staff appointments;

- o Implementing standardization procedures to minimize degree equivalency problems; and
- o Developing a personnel management policy that can improve personnel productivity.

4. Field data analysis: agricultural extension

a. Extension institutions

Presently, there are fifteen institutions in Upper Volta that provide agricultural extension:

- o Regional Development Organizations (ORD--Organismes regional de développement). There are a total of 11 ORDs covering all of Upper Volta. The ministry responsible is the MDR;
- o Volta Valley Development Authority (AVV--Autorité pour l'aménagement des vallées des Voltas). The ministry responsible is the MDR;
- o Division of Fisheries and Aquaculture (DPP--Division pêche et pisciculture). The ministry responsible is the MET;
- o Division of Forest Development and Reforestation (DAFR--Division de l'aménagement forestier et de reboisement). The ministry responsible is the MET; and
- o Division of Livestock Production and Industries (DSET--Division de l'élevage et de l'industrie animale). The ministry responsible is the MDR.

b. Nature of activities

The extension institutions, particularly the AVV and the ORDs, have the following responsibilities:

- o Introducing new technology to the producers;
- o Providing a mechanism for the supply of inputs and credit; and
- o Promoting marketing of products.

The first ORD was created in Ouagadougou in 1965. Others were subsequently established in each of the ten départements. Although it was created with a broader mandate, the focus of its activity is providing an extension service to crop farmers. The AVV was created in 1972 to operate in the three Volta river zones (Volta Noire, Volta Blanche and Volta Rouge). Selected characteristics of the extension institutions, including the specific focus of their activities, are shown in Table 38.

Table 38: Extension Program Focus, Upper Volta, 1983

Extension Institution	Ecological Zone	Focus of Extension Effort	Farm Family/Ext. Agent Ratio ¹
1. AVV	* Sudano-Sahelian Sudanian * Sudano-Guinean	- Aimed at cereals (sorghum, millet, corn) cotton - Production system (FS) - Water management (rice and vegetable products)	—
2. ORD - Black Volta (Delougou)	* Sudanian * Sudano-Sahelian	- Aimed at cereals (sorghum, millet, rice) cotton - Ground nuts and vegetable production	344
3. ORD - Upper Basins (Bobo-Dioulasso)	* Sudanian	- Aimed at cereals (corn, rice, sorghum, millet) cotton - Vegetable, fruits and root crop production	236
4. ORD - West Central (Koudougou)		- Aimed at cereals (sorghum, millet) cotton - Vegetable and ground nuts	475
5. ORD - North Central (Kaya)	* Sudano-Sahelian	- Cereals (sorghum, millet) - Mabe, vegetables	711
6. ORD - Sahel (Dori)	* Sahelian	- Livestock production - Millet, sorghum	1072
7. ORD - North Yatenga (Ouahigouya)	* Sahelo-Sudanian	- Aimed at cereals (sorghum, millet) - Small ruminants	827
8. ORD - Central (Ouagadougou)	* Sudano-Sahelian	- Aimed at cereals (sorghum, millet) cotton - Ground nuts	577
9. ORD - Comoe (Banfora)	* Sudano-Guinean	- Cereals (rice, corn, sorghum) cotton, root crops, groundnut, livestock and poultry	236

Source: DEVRES/INSAH Agricultural Research Resource Assessment, 1983. See National Report on Upper Volta for more detail.

Table 38: Extension Program Focus, Upper Volta, 1983 (continued)

Extension Institution	Ecological Zone	Focus of Extension Effort	Farm Family/Ext. Agent Ratio ¹
10. ORD - Fada	* Sudanian Sudano Sahelian	- Aimed at cereals (sorghum, millet, rice) cotton, groundnuts	256
11. ORD - Koupeles East Central	* Sudano-Sahelian	- Aimed at cereals (sorghum, millet, rice) cotton, groundnuts - Vegetable production	526
12. ORD - (Diebougou) Bougouriba	* Sudano-Sahelian * Sudanian * Sudano-Guinean	- Cereals (sorghum, millet) cotton, groundnuts, rootcrop (ignames), grain legumes, vegetable	20 ⁰
13. DPP	All zones	Fisheries	
14. DAFR	All zones	Forestry	
15. DSEIA	All zones	Cattle, sheep, goats, poultry and pigs	

¹ Ratio Adopted from World Bank Report, 1982

Source: DEVRES/INSAH Agricultural Research Resource Assessment, 1983. See National Report on Upper Volta for more detail.

c. Human resources

There are 2,922 employees in the extension system. About 12 percent have a minimum level of training of a BAC plus four years additional training; over 75 percent of the personnel have less training than high school graduation. The latter category comprises the majority of the extension field staff. There are 98 women employed in the extension system, 3 percent of the total. The level of academic qualification, sex and institutional affiliation of the extension personnel are presented in Table 39.

d. Facilities and operating funds

As seen in the averages of the 1983 funding, the total operating budget of all extension institutions amounts to FCFA 8,203.9 million. Over 70 percent of the operating budget of the extension institutions is generated from external sources. AVV has the largest proportion of external funding with a 98 percent contribution, followed by 96 percent for DAFR. The details of the operating budget by source of each institution are shown in Table 40.

e. Comments

A well-developed agricultural extension system is in place in Upper Volta, and it has already produced appreciable results, particularly in cotton production. However, with other crops the system has been less successful in assisting farmers to adopt improved production practices, or in providing constant interaction and feedback between the farmers, researchers and planning authorities. The constraints limiting the effectiveness of the agricultural extension network include the following:

(1) Shortage of viable technological packages

As stated in the subsection concerning research, the technical packages given to farmers are generally based on research results which have not taken into account farmers' objectives, farmers' resource endowments and other constraints that are prevalent in the micro-ecological areas for which the packages are intended.

(2) Unfavorable effects of a one-way extension framework

The existing extension strategy in Upper Volta (known as encadrement) concentrates heavily on a "top down" approach and neglects any horizontal communication. Technical recommendations, derived from research stations are sent to the target environment as prescribed extension themes. Extension agents are directed to explain and disseminate these themes, and to guide and supervise their application. There is no provision for a give-and-take exchange between the agents and the farmers. An interactive role is critical in maintaining a successful extension network and it requires two-way communication between farmers and planners/researchers, through the channel of the extension agent.

Table 39: Extension Personnel by Academic Qualification, Sex,
and Type of Institution, Upper Volta, 1983

Academic Qualification	AVV		ORDS		DPP		DAFR		DSEIA.		Grand Total
	Nat.	Exp.	Nat.	Exp.	Nat.	Exp.	Nat.	Exp.	Nat.	Exp.	
Greater or equal to BAC + 4:											
Male	25	NA	72	55	9	0	38	0	78	22	349
Female	0	0	0	0	1	0	2	0	0	0	3
Less or equal to BAC + 3:											
CTAS = BEP + 3											
ATAS = CEPE + 4											
Encadreur = CEPE + 9ms											
Male	71	0	1839	0	28	0	273	0	264	0	2475
Female	5	0	90	0	0	0	0	0	0	0	95
Total	101	0	2001	55	38	0	363	0	342	22	2922

Source: DEVRES/INSAH Agricultural Research Resource Assessment, 1983. See National Report on Upper Volta for more detail.

Table 40: Operating Budgets of Extension Institutions,

Upper Volta, 1983

(in million FCFA)

Institution	Source		Total	Percent External
	National Budget	External		
AVV	50.0	2500.0	2,550.0	98
ORD Ouagadougou	100.0	70.0	170.0	41
ORD Koudougou	33.6	66.4	100.0	66
ORD Koupela	28.0	37.0	65.0	57
ORD Kaya	150.0	NA	150.0	NA
ORD Fada	1,030.0		1,030.0	NA
ORD Bobo-Dioulasso	700.0	800.0	1,500.0	53
ORD Banfora	23.5	46.5	70.0	66
ORD Bougouriba	571.0		571.0	NA
ORD Dedougou	112.0	672.0	784.0	86
ORD Ouahigouxa	25.0	112.95	137.95	82
ORD Sahel	52.0	64.5	116.5	55
DPP	5.45	NA	5.45	NA
DAFR	17.5	412.0	429.5	96
DSEIA	524.5	NA	524.5	NA

Source: DEVRES/INSAH Agricultural Research Resource Assessment, 1983. See National Report on Upper Volta for more detail.

(3) Lack of coordination

Due to the lack of coordination between central services and extension services (such as ORD), the dispatch and delivery of important agricultural inputs is slow and deliveries arrive late. In addition, coordination at the national level is also weak. As an example of non-communication between institutions, the MET forestry agents have not defined a field-level working relationship with the livestock and crop production extension agents of MDR.

(4) Low motivation and morale among extension personnel

The major sources of discontent among the extension agents are inadequate basic training, lack of opportunity for in-service training, employment insecurity, insufficient logistical support, inadequate compensation, and the frequent transfer of personnel.

5. Constraints to increased productivity

There are numerous constraints hindering the productivity of the rural sector in Upper Volta. The nature of the constraints and the intensity of the effect varies from one institution to the other and from sector to sector. Among the most frequently cited constraints are:

a. Technical constraints

The technical constraints to increasing productivity are the following:

- o Lack of improved production technology, especially in the below 700 mm rainfall zone;
- o Low literacy level of the general population;
- o Shortage of adequately trained extension personnel;
- o Lack of experienced researchers;
- o Poor soil;
- o Lack of rainfall, in terms of both frequency and distribution, mostly in the Sahelian zone; ...
- o Livestock feed shortage; ...
- o Prevalence of pests and diseases including parasitic weed such as striga; and
- o Lack of statistical data.

b. Institutional constraints

Among the major institutional constraints to productivity are the following:

- o Lack of a national research strategy--particularly prioritizing the research programs, using adaptive and applied research methodology;
- o Lack of coordination and weak institutional linkages, hence inadequate information exchange among institutions;
- o Inadequate financial resources both for investment and operations. The national allocation for research is meager and is obstructed by complicated disbursement procedures. Additionally, a large proportion of the financial resources come from external sources and are typically specified for a short period, usually three to five years;
- o Inadequate infrastructure and equipment. There are stations without essential laboratories or equipment, libraries without books, buildings in poor physical condition, etc.;
- o Poor working conditions and management practices, lack of performance standards as well as rewards for good work;
- o Unavailability, untimely delivery and high cost of inputs, mostly due to the inefficiency of some parastatals, that at times exclude better-prepared private sector participants from the market; and
- o Production objectives oriented towards immediate output gains without due regard to long-term production or resource conservation.

6. Suggested solutions and priority actions

Although committees have been organized and conferences are underway to investigate means of improving the performance of existing institutions, the country report has also provided suggestions to eliminate or reduce some of the constraints outlined in the previous section. The report also has several proposals.

a. Crop production

Suggestions in the crop production area include the following:

- o Creating a planning and programming unit within IVRAZ;

- o Establishing research and extension linkage;
- o Building networks between research stations;
- o Strengthening relationship between IVRAZ and the ISP in order to promote improved working relationships between researchers and professors;
- o Undertaking more multidisciplinary research to resolve the priority problems, such as:
 - Study of the physical environment;
 - Study of soil-water and plant relationships;
 - Study of soil fertility;
 - Inventory of natural resources;
 - Genetic studies to improve crop adaptability and resistance to disease; and
 - Research programs to counteract serious plant diseases, such as groundnut rust.

b. Livestock production

Suggestions for improving the output of the livestock sector include:

- o Providing improved extension service to herders, especially during the livestock marketing season;
- o Using audio-visual facilities for training herders;
- o Improving training for livestock extension agents;
- o Using better animal feed including industrial by-products; and
- o Planning periodic meetings between researchers, instructors and extension personnel in order to facilitate institutional collaboration.

c. Forestry and fish production

In the area of forestry and fisheries, policy suggestions are the following:

- o Encouraging farmers to participate in reforestation programs, particularly in planting well-adapted local varieties;

- o Specifying legal and technical solutions to minimize the incidence of forest fires;
- o Minimizing the loss to fishermen from deterioration of fish during the marketing process; and
- o Reducing the over-exploitation of some fishing areas.

d. Additional proposals from the National Report

The following are additional proposals outlined in the National Report:

- o Establishing a research program to study groundnut rust disease;
- o Researching the biological fixation of nitrogen;
- o Developing production of "short-cycle" animals, i.e. goats and sheep;
- o Establishing a research program on animal husbandry and for improving different breeds;
- o Strengthening the food grain research program;
- o Promoting improved marketing of animal feeds;
- o Planning short seminars for fishermen and their extension agents;
- o Establishing two agricultural research stations, one in northern and one in eastern Upper Volta;
- o Strengthening the existing research stations of Saria, Farakoba, Niangoloko and Kamboinse;
- o Strengthening the fishery extension program; and
- o Strengthening the infrastructure and programs of Mare d'Oursi Station for conducting a regional study on Sahelian ecosystems.

7. Conclusions and recommendations

While optimistic about the possibility of strengthening the capacity of Upper Volta's research, training, and extension institutions, the National Report clearly outlines the prevailing constraints which limit these institutions from significantly increasing productivity. The report, however, places high hopes on the committees and conferences which have been established to find solutions to many of the priority constraints. Subsequently, the various suggestions contained in the report are at best considered

tentatively. Final solutions are to emerge from future discussions in committee and/or conference meetings.

While useful results can reasonably be anticipated from the meetings, it should also be recognized that the task of reducing existing constraints in Upper Volta will require not only a one-time discussion but a continued commitment to invest in agricultural training and research and a willingness to make significant changes in conception and approach. The following are some factors involved in effecting a long-term sustainable improvement in productivity:

a. Off-station research

An important factor in effecting long term sustainable productivity entails emphasizing off-station research using both PAPEMs and on-farm trials. A multidisciplinary team approach must be employed in accomplishing these tasks, involving a balance between a streamlined, farming systems information-gathering mechanism, an appropriate varietal and agronomic technology testing mechanism and an extension/demonstration mechanism in which agents put new technologies into farmers' fields. The following are the major benefits of the approach:

- o Promotes greater farmer participation in the development and testing of technology;
- o Facilitates the identification of principal factors causing the "yield gap" between the research stations and farmers' fields;
- o Enables modification of on-station research objectives and methods;
- o Promotes greater farm level technology adaptation;
- o Enhances effective field level interaction among farmers, extension agents and researchers; and
- o Promotes improved decision making and wise resource use, even at higher levels, by accumulating scarce data for analysis and use by decision makers.

b. Improvement in levels of incentives

Greater effort should be made to improve incentives. Farmers should be given competitive prices for their products. This can be facilitated by greater reliance on both self-motivated local cooperatives and on improved private trade structure. The over-extended role of the marketing parastatals (e.g., OFNACER) must be redefined.

A new personnel management policy should be developed to improve working conditions of employees of the different institutions. The main focus should be to institute accountability and rewards, based on

a clear set of performance standards. Steps should also be taken to minimize the degree-equivalency problem constantly faced at the ISP.

c. Other recommendations

Other specific recommendations to increase food supply in Upper Volta include:

- o Delineating priority crops such as sorghum and millet, and other enterprises for intensive research and extension activities;
- o Selecting and breeding local varieties of sorghum and millet for desired characteristics of yield, resistance, taste etc.;
- o Streamlining the central agricultural extension service and reducing the number of functions it has to perform. Strictly observed performance standards and use of new computer technology can keep costs down. Increased road development and improved radio communication will also help;
- o Devising and instituting close collaborative working relationships between national and international research institutions, as well as between research, extension and training institutions. Organizing periodic meetings to exchange views between members of various organizations, and instituting joint personnel appointments in appropriate institutions would improve collaboration among the participants;
- o Upgrading the training institutions for extension agents, upon which the quality of extension service depends heavily;
- o Improving grain storage facilities in rural areas to minimize incidence of seasonal hunger and storage losses. In addition to improving the transport and market information system, some of the well-managed cereal banks in rural Upper Volta deserve assistance in expanding their storage capacity; and
- o Based on knowledge from the on-farm studies, developing and encouraging farmers to produce cash crops both for local and export markets. Where credit is involved, developing a farm budget that reflects the loan repayment capacity of households. In Upper Volta, consideration of income-generating activities must also include investigation of the possibilities and necessary arrangements for mobilizing savings in rural areas and the development of cost return figures for the most promising rural small-scale enterprises.

d. Proposals from the National Report

The following proposals from the National Report deserve priority consideration:

- o Establishing a research program to study groundnut rust disease, seeking short term treatment as well as long-run genetic solutions. Perhaps this research may be appropriately considered in a regional context as an element of a broader plant protection program;
- o Researching biological fixation of nitrogen. The project is aimed at minimizing expenditure on purchase of commercial fertilizer. However, given this project objective as well as the prevailing regional interest on rock phosphates (Upper Volta, Niger, Mali), it seems more appropriate and timely to make a concerted research effort to assess the economics of mineral phosphates prior to launching the suggested nitrogen fixation program;
- o Strengthening the food crop research program. The project is aimed at increasing output and improving storage facilities, as well as improving soil and water management techniques in the production of sorghum, millet, maize, root crops, etc. It is an important proposal, but the program is very broad and should be refined;
- o Promoting improved marketing of animal feeds. The purpose of this proposal is to promote improved feed for different classes of animals. The proposal requires a market study to ascertain feasibility;
- o Strengthening the infrastructure and programs of Mare d'Oursi station. The proposal aims at strengthening the forestry research on a regional basis. As previously indicated, the station could render greater service if it could jointly support crop and animal husbandry activities in addition to forestry programs; and
- o Strengthening the infrastructure of the existing research stations at Saria, Farakoba, Niangoloko and Kamboinse. The specific requests include: more living quarters, laboratories, offices, and electricity in the case of Saria and Niangoloko. It is essential to upgrade the stations, provided that the facility and equipment requested appear consistent with the needs of the priority research agenda. Some current needs include strengthening the documentation in each station, facilitating information exchange among researchers and furnishing facilities that enhance the capability of data analysis.

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1984-08

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