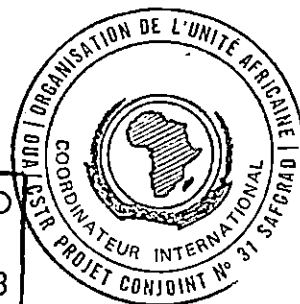


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ASSESSMENT OF AGRICULTURAL
RESEARCH RESOURCES
IN THE SAHEL

VOLUME I
REGIONAL ANALYSIS AND STRATEGY

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PERMANENT INTERSTATE COMMITTEE
FOR DROUGHT CONTROL IN THE SAHEL

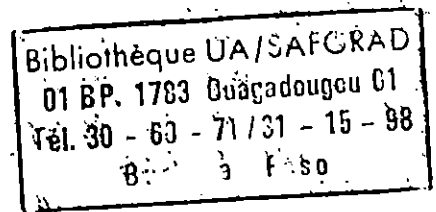
INSTITUT DU SAHEL
B.P. 1530
Bamako, Mali
Telephone: 22-21-78, 22-21-48
Telex: 432 INSAH

DEVRES, INC.
2426 Ontario Road, N.W.
Washington, D.C. 20009
Telephone: 202/797-9610
Telex: 440184
Cable: DEVRES

August 1984

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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 I of the DEVRES/INSAH project, Assessment of Agricultural Research Resources in the Sahel, analyzes the regional aspects of research in the eight Sahelian countries--Cape Verde, Chad, The Gambia, Mali, Mauritania, Niger, Senegal and Upper Volta--and presents a strategy to strengthen agricultural research in the region. Like the country summaries presented in Volume II 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 DEVRES, INSAH, 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.

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LIST OF SPECIALISTS, PERSONNEL, NATIONAL COORDINATORS AND
CONSULTANTS

1. DEVRES, Inc.

William H. Johnson
Project Director, October 1982 - April 1984
Project for Strengthening African
Agricultural Research

Dr. Rolland P. Poirier
Team Leader
Previous Dean of Agriculture
Laval University, Quebec, Canada
Retired Vice-President of the Canadian
International Development Agency

Vincent W. Brown
Project Director, April 1984 to present
Deputy Team Leader and Regional Coordinator
Development Programmer

Dr. Wilford H. M. Morris
Technical Consultant
Advisor to Coordinator-Mali
Agricultural Economist, Department of Agricultural
Economics, Purdue University

2. Institut du Sahel (INSAH)

Dr. Ousseini Sidibe
INSAH Representative
Director, Department of Research

Alioune Camara
INSAH Regional Coordinator
Coordinator, Sahelian Research and Documentation
Center (RESADOC)

3. Midwest Universities Consortium for International
Activities (MUCIA)

Dr. Kifle Negash
Sub-regional Coordinator (Chad, Niger and Upper Volta)
Agricultural Economist, Michigan State University

4. Institut d'Elevage et de Medicine Veterinaire des Pays
Tropicaux (IEMVT)

Bernard Peyre de Fabregues
Sub-regional Coordinator (Cape Verde, Gambia,
Mauritania and Senegal)
Range Management Specialist and Environmentalist

5. National Coordinators and their Consultants, by Country

a. Cape Verde

National Coordinator

Horacio Soares

Director, Center of Agrarian Studies

Consultants

Maria Luisa Lobo

Assistant Director General

Center of Agrarian Studies

(Agriculture/Extension Division)

Francisco Barbosa

Department Head

Forestry Division

Dr. Jose Antonio Monteiro

Director

Livestock Division

Santa Rita Viera

Biologist

Fishery Division

b. Chad

National Coordinator

Alladoumgue Nadingar

Director-General of Agriculture and Rural Development

Consultants

Mustapha Theophile Yehouessi

Resident Representative of ICRT

Phytophathologist

Ali Ngaram

Director

Fisheries Division

Ministry of Water and Forests

Water and Forestry Engineer

Dr. Dounia Daounaye

Veterinarian

Director, National Center for Poultry Production

Ngamada Maikata

Assistant Director of Education and

Professional Agricultural Training

Nonga Ndoasngir Gaingar
Assistant, Sub-division for the Sahel Region
National Office of Rural Development
Agricultural Engineer

c. The Gambia

National Coordinator

S. Sompo-Ceesay
Assistant Director of Agriculture

Consultants

Sankung Janneh
Director of Agriculture
(Extension System)

Thomas G. Senghore
Research Agronomist
Department of Agriculture
(Agronomy)

Dr. Ebou Touray
Assistant Director
Department of Animal Health and Production (Livestock)

Dr. Seni S. Dabo
Project Manager, "Irrigated Rice Project"
(Constraints to Agricultural Productivity)

Bye Mass Taal
Director of Forests

Cherno Joof
Department of Fisheries

d. Mali

National Coordinator

Mamadou Ouattara
Assistant Director General, National Institute of
Research in Animal Husbandry, Forestry and
Hydrobiology (INRZFH)
Water and Forestry Engineer

Consultants

Cheick Oumar Diop
Chief, Division of Animal Husbandry, INRZFH
Chief Agricultural Engineer

Ousmane Sankare
Chief, Division of Forestry and Hydro-biological
Research, INRZFH
Applied Sciences Engineer

Dr. Zana Sanogo
Chief, Division of Agronomical Research
Rural Economic Institute, (IER)
Agronomist

Tiécouradié Diarra
Chief, Division of Production Systems Research, IER
Agronomical Engineer

e. Mauritania

National Coordinator

Bocar Soulé Ba
National Representative of CILSS; Director, Department
of Foreign Relations
Ministry of Rural Development
DEA, Agroeconomist

Consultants

Dr. Dramane Kamara
Technical Director of Agronomical Research
National Center for Agronomical Research and
Agricultural Development

Dr. Boubacar Diallo
Director
National Center of Livestock and Veterinary Research

Amadou Tidiane Ly
Director
Land Management Department
Ministry of Planning

Mohamed Mahmoud Vuld Jeilani
Director
Division of Commercial Fisheries

Ibrahima Thiam
Forestry Engineer

f. Niger

National Coordinator

Daouda Toukoua
Chief, Division of Planning and Programs
National Agronomic Research Institute of Niger (INRAN)

Consultants

Issaka M. Magah
Representative
Department of Agricultural Research, INRAN

Dr. Abdou Tahirou
Representative
Department of Veterinary and Animal Husbandry Research, INRAN
Veterinarian

Mamadou Ouattara
Representative
Department of Ecological Research, INRAN
Agricultural Engineer, Pedologist

Moussa Hassane
Representative
Department of Forestry Research, INRAN
Engineer of Forestry Techniques

Abdoulaye Samba Ly
Representative
Department of Research in Rural Economics, INRAN
Agroeconomist

g. Senegal

National Coordinator

Dr. Moctar Toure
Director of Agricultural and Agro-industrial Research
Ministry of Scientific and Technical Research
Agronomist

Consultants

Mamadou Sonko
Scientific Director
Senegalese Institute of Agricultural Research (ISRA)
Pedologist

Dr. Saydil Moukhtar Toure
Director
Department of Research on Animal Production and
Health, ISRA
Veterinarian

Dr. Jacqueline Lopez
Director
Oceanographic Research Center of Dakar-Thiaroge, ISRA
Oceanographic Biologist

Cheikhou Dieme
Chief, Division of Research on Fish and Fisheries
Department of Agricultural and Agro-industrial Research
Ministry of Scientific and Technical Research
Ichthyologist and Pisciculturist

Dr. Ousmane Kane
Director
Institute of Food-related Technology, ISRA
Physiologist

also assisted:

Dr. Mbaye Ndoye
Director
Agronomy Department, ISRA
Agronomist

Dr. Jacques Faye
Director
Farming Systems Research, ISRA
Rural Sociologist

h. Upper Volta

National Coordinator

Dr. Edouard Bonkoungou
Director
Institute of Research in Agronomy and Tropical Ecology,
Forester

Consultants

Dr. Michael Papaoba Sedogo
Director
Voltaic Institute for Research in Agronomy
and Animal Husbandry (IVRAZ)
Agronomist

Padga Celestin Belem
Division Chief, IVRAZ
Agricultural Economist

Urbain Poda
Director of Fish and Fisheries
Water and Forestry Engineer

Dr. Mathieu Malgoubri
Section Chief, Livestock and Animal Production
Veterinarian

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)
LEMVT	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
MUCLA	Midwestern Universities Consortium for International Activities
Mtere	Ministry
NAS	National Academy of Sciences
NGO	Non-Governmental Organization
OAU	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
MTAEFC	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
PRODES	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
DFF	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-Mann
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)
PDESO	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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ABOUT THIS ASSESSMENT

A. Background

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. (See Figure 1.) 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"¹:

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

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

¹World Bank, Sub-Saharan Africa: Progress Report on Development Prospects and Programs, (Washington, D.C., World Bank, September 1983), pp. 30-31.

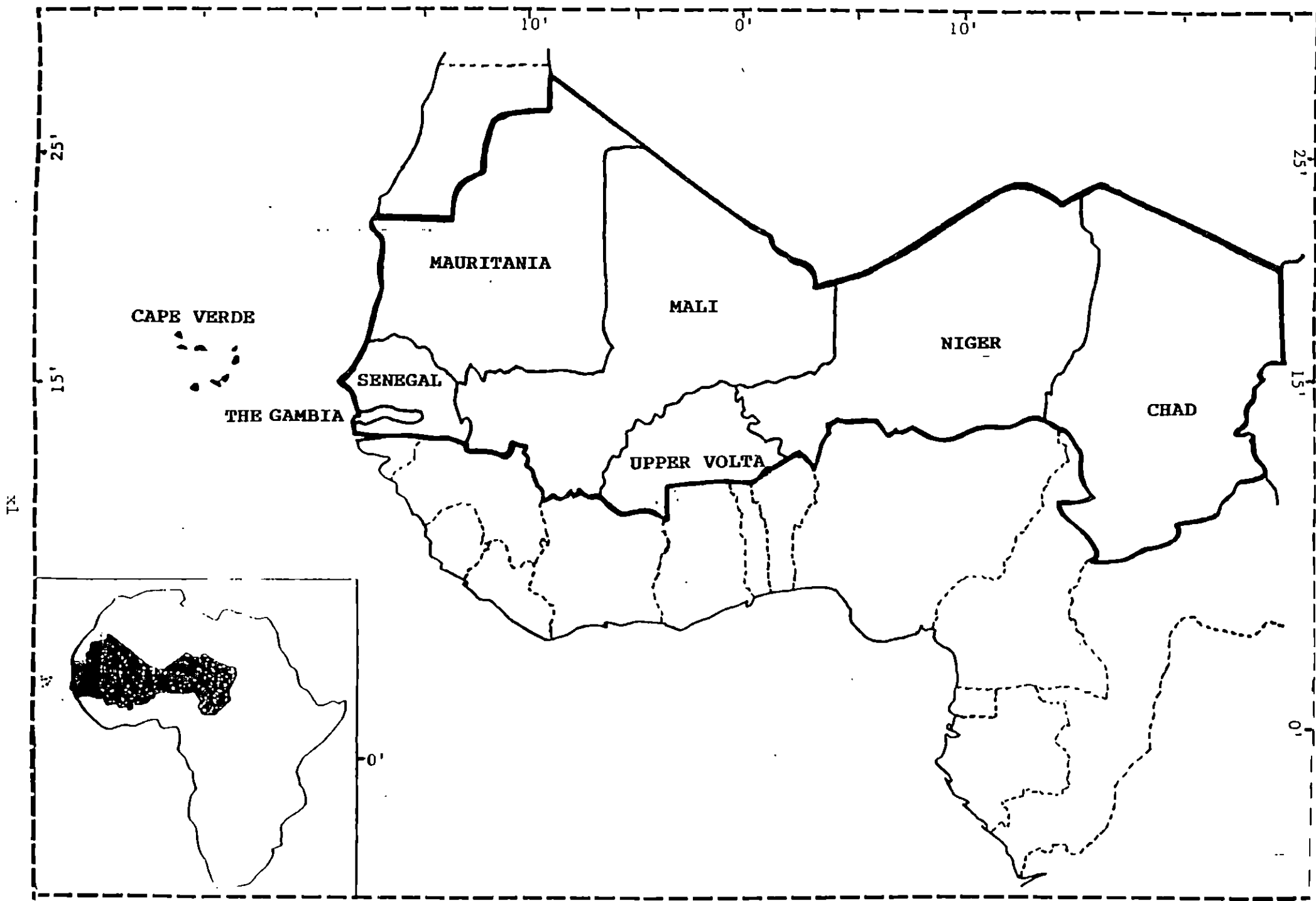


Figure 1: Map of the Sahel

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 their 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.

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. Annex 4 of this report contains detailed information on the contents and potential uses of this data bank.

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.

EXECUTIVE SUMMARY

A. Purpose and Procedure

1. Purpose

The purpose of the Agricultural Research Resource Inventory and Assessment carried out in eight countries of the Sahel was to conduct a country-specific, regionally-sensitive analysis of existing resources and to develop a 20-year regional agricultural research strategy to strengthen existing national and regional activities. It was carried out within the framework of the high priority accorded by the member countries of CILSS (Permanent Interstate Committee for Drought Control in the Sahel) and the CDA (Cooperation for Development in Africa) countries¹ to the need to develop and strengthen agricultural research capability in the region.

2. Procedure

The inventory, assessment and preparation of the strategy were carried out by DEVRES, a U.S.-based private contractor located in Washington, D.C., assisted by two subcontractors, the Institute du Sahel (INSAH) located in Bamako, Mali and the Midwest Universities Consortium for International Activities (MUCIA), headquartered at Ohio State University. The project was financed by the U.S. Agency for International Development (AID), acting on behalf of all the CDA donors in the area of agricultural research for the Sahel and the southern African regions.

The assessment of agricultural research resources in the Sahel involved over 50 African agricultural researchers, developers, extensions advisors and educators from eight countries (Cape Verde, Chad, The Gambia, Mali, Mauritania, Niger, Senegal, and Upper Volta), a regional research organization, INSAH, and DEVRES staff of experienced agricultural researchers and development specialists. The inventory was based on a detailed questionnaire developed by DEVRES, INSAH and MUCIA in consultation with agricultural researchers in the Sahel. It covered research, extension and training activities. Senior researchers from each of the Sahelian countries were hired to conduct the inventory and prepare the national reports for their respective countries based on the results of the questionnaire. The bulk of the data collection and the writing of the national reports were carried out from September to December 1983. INSAH, because of its regional responsibilities for coordination of agricultural research and dissemination of their results, became the repository of the results of the questionnaire in the form of a comprehensive computerized data bank.

¹The CDA is an informal association of donor countries comprised of Belgium, Canada, France, Germany, Italy, United Kingdom and the United States.

The regional analysis and research strategy were developed by the DEVRES staff in consultation with INSAH in light of the national reports and other data available. From January to April 1984, the DEVRES/INSAH staff collaboratively designed the proposed programs and activities to carry out the strategy elements. Particular attention was given to seeking ways to strengthen existing national and regional research activities.

B. Conclusions

1. Food deficits in the Sahel are increasing

Food production in the Sahel is failing to keep pace with population growth. While the traditional food production systems that have evolved over time are well-adapted to the physical characteristics and resource limitations of the region, they are inadequate in the face of rapidly expanding rural and urban populations. This is demonstrated by the growing imbalance between domestic cereal production and consumption. For example, from 1970 to 1982, domestic cereal production increased 27.8 percent (an annual compound rate of only 2.07 percent); during the same period, population increased 35 percent (an annual compound rate of 2.6 percent). In less than 70 years (by the year 2050), unless a rapid decline in fertility occurs, the population in the region will quadruple to 136 million. Without dramatic advances in agricultural productivity in the next 10-20 years, the gap between domestic food supply and demand will continue to widen.

Similarly, while all of the countries in the Sahel have individually and collectively adopted a priority objective of achieving food self-sufficiency, they have, in the short term, had to rely on increasing their commercial and concessional imports of cereals to meet the food needs of their people, especially in the urban areas. In the last five years (1978-1982), regional cereal imports reached an average of one million metric tons (MT)--more than double the amount in 1970. On a per capita basis, imports have more than doubled to meet consumption needs.

2. Agricultural productivity is seriously constrained

There are a number of serious constraints to increasing agricultural productivity in the Sahel. These affect the production of crops, livestock, agro-forestry, and artisanal fisheries. The constraints are both direct (those which constrain production and productivity directly such as low soil fertility, deficient and poorly distributed rainfall, lack of appropriate technology for controlling plant diseases and pests, etc.), and indirect (those which impede the development and application of solutions to the direct constraints such as institutional and policy weaknesses--e.g., inappropriate institutional structure, poor project administration, insufficient understanding of socioeconomic factors).

These constraints are complex and interrelated, involving political, technical, physical, social and economic factors. They must be reduced to increase agricultural productivity and move toward a situation of increasing food security. To reduce these constraints it is vital to strengthen both national and regional research capacity to: 1) plan and establish research priorities, 2) finance and carry out effective agricultural research programs, and 3) disseminate successfully to farmers the results of this work.

3. Agricultural research can help reduce constraints to increased productivity if an adequate "critical mass" is assured

The establishment of a Sahelian capacity to create, manage, and utilize research results over the next 20 years is a sine qua non to achieving increased per capita agricultural output in the Sahel. Currently, agricultural research, extension and training programs in the Sahelian countries differ substantially in terms of focus, number of personnel, funding and institutional support. However, there may not be the requisite "critical mass" of research institutions, trained professionals, material or financial resources to undertake the research which will significantly increase productivity in the region. In 1983, there were 289 agricultural research programs/projects in the Sahel of which 223 were ongoing, 12 were "new starts" and 54 were proposed for implementation. Over half of the continuing activities focused on crops research; 26 percent focused on livestock. The remainder included research on forestry and ecology, fisheries and technology. The number of activities per country varies widely from six (in The Gambia) to 31 (in Mali) as does their size and scope. There are presently about 80 research stations and substations in use across the Sahel.

The number of personnel involved in agricultural research, extension and training is also a useful indicator of the level of effort. In most Sahelian countries today there are still inadequate numbers of national agricultural researchers available to meet research needs. For example, in 1983 the total number of professional research personnel in the Sahel, including expatriates, was only 634. Approximately one-third of these are agronomists. In certain critical research disciplines, especially the social sciences, gaps of qualified professionals working on agricultural research are particularly noticeable. Similarly, the technical range of capabilities among the 1,261 professional Sahelian and expatriate extension personnel is limited with plant and animal scientists, engineers and economists in shortest supply. Also in short supply are instructors who are qualified to train graduate level agriculturalists—as a result only five of 40 national agricultural training centers in the Sahel offer advanced training.

Severe financial constraints also impact directly on agricultural research, extension and training efforts in the Sahel. For example, research institutions often face operational difficulties caused by delays in the release of funds and the inadequacy of funds for follow-

up on field trials. Extension services report difficulties in obtaining adequate funds for field work, training and upgrading staff. Training institutions report difficulty in funding adequate teaching staff. Researchers and technicians note their low salaries and lack of career opportunities.

Although CDA donors currently sponsor over 130 agricultural research programs/projects of varying scope and duration, many of the Sahelian countries believe the resources are inadequate, short-sighted and sometimes improperly focused. Yet, given their own financial difficulties, initial and subsequent country contributions to research and related projects are likely to be modest, consisting mainly of personnel and facilities. Thus, more sharply focused projects of high priority, carefully designed budgets and improved project management must be pursued vigorously by each country.

Also, donors must bear a major portion of the recurrent costs for both national and regional research projects. For example, donors must be certain that complete financing is available for long- and medium-term projects; if such projects are to be viable and successful. Unless donors are prepared to cover recurrent costs fully--in addition to the usual equipment and other start-up and training costs--attempts to increase the priority given to agricultural research in the region will fail.

4. A regional approach for agricultural research is needed to strengthen national institutions and to achieve a "critical mass"

Given the limited number of qualified personnel and funds in the individual Sahelian countries and the fact that many of the problems they face are the same, or very similar, collaboration among institutions in a regional framework can help to overcome certain gaps at the national level and to ensure that adequate resources are brought to bear on key problems. A regional approach could help to rationalize the effective and efficient use of scarce human, financial, technical and administrative resources.

Fruitful regional collaboration, however, will require an established and agreed-upon agricultural research policy framework at both the national and regional levels for carrying out specific projects and programs. Agricultural research policy in the Sahel should be designed at both national and regional levels, to:

- o Ensure sharply focused projects;
- o Encourage the establishment of clear research priorities;
- o Support careful evaluation of existing work;
- o Sustain that ongoing work most likely to produce the results desired and expected;

- o Account realistically for the timeframe or range of time in which concrete results can expect to be achieved; and
- o Ensure the availability of finances required.

In addition, policies are needed to encourage the development of management skills in the administration of research institutions and in the establishment of priorities for the careful use of limited human and financial resources.

While the successful execution of regional projects is difficult, because of administrative and financial difficulties, in some circumstances such projects offer significant advantages, particularly as complements to national programs. Some of these are: the synergistic effect of exchanging information and combining the collective experience of professionals; the provision of better developed and more specialized educational opportunities within the region; the achievement of economies of scale and efficiency; the avoidance of duplication; and the possibility of working in areas that might be politically sensitive at the national level. Moreover, a number of agricultural problems facing the region such as meteorology, plant and animal diseases, weeds and predators, are not bound by political frontiers and need to be dealt with at a regional level.

C. Recommendation: Establish a Regional Agricultural Research Strategy for the Sahel

The objective of the 20-year agricultural research strategy is to achieve a significant increase in per capita agricultural output greater than the rate of population increase to enhance national food security in the Sahel. X

The strategy to achieve this objective consists of ten elements which together will help agricultural research play an important role in overcoming the constraints to increasing agricultural productivity in the region and to achieve the goal of production output increases equal to or greater than the population growth. These strategy elements are briefly described below:

1. Develop the potential of Sahelian institutions

The absence of a sufficient, indigenous capacity to train research personnel in technical disciplines or management is a serious impediment to improved research and to agricultural productivity generally. Strong research and training institutions with the ability to carry out needed agricultural research and to deliver the results effectively to farmers are essential for improved agricultural productivity. In addition to training in the technical disciplines, training in the management of research institutions, policy analysis, database use outreach, and the establishment of research priorities is essential to achieve the potential of the research institutions in the Sahel.

2. Develop new technologies

The lack of appropriate and effective technologies is one of the major problems in increasing per capita agricultural productivity in the Sahel. To remedy this lack, national efforts to provide appropriate technological packages require stepped-up regional and international support. Some of the national research activities which seem of high priority when viewed from a regional perspective are listed by sub-sector below:

- o Crops: The relationship between soil, water, and plants, particularly rainfed production; ecological effect of agricultural change--different fertilizers, cropping systems, soil erosion, etc.; development of technology packages for irrigated agriculture;
- o Livestock: Animal health, improved breeding and pasture and fodder development with the objective of increased production of both meat and milk;
- o Forestry/ecology: Fast-growing species; firewood substitutes; protection and development of natural forests; the conservation and restoration of soils; natural vegetation patterns, and combatting desertification; and
- o Fisheries: Inland fisheries; biology of different species and fish population dynamics; technologies to improve the profitability of commercial fish production.

3. Provide protection and restoration of the ecosystem

Important environmental problems have been shown to constrain agricultural productivity and output in the Sahel such as the Sahel's dwindling firewood supply with the attendant destruction of forest and brush land, over-grazing by a cattle population too large for the natural resource base of many areas and over-utilization of fragile agricultural soils in both irrigated and dryland cropping. If more research work is not done to resolve these problems now, they may even turn out to be the ultimate constraints to increasing agricultural productivity in the Sahel during the next 20 years.

4. Increase capacity to undertake agricultural policy research

There is an urgent need to increase the capacity of institutions in the Sahel to carry out agricultural policy research to provide information on which to base national and regional decisions affecting aggregate and per capita agricultural productivity. For example, certain aspects of agricultural policy pose serious constraints to increased agricultural production. These include: farm prices set too low, input costs too high, official crop prices announced too late, agricultural credit unavailable, low investment priority for research, etc. The ability to develop and combine effective policy responses appropriate for these and many other intertwined issues is critical to agricultural development in the

Sahel. While most research on such issues is done at the national level, there is a need for more multi-country or regional activity on some policy issues to enable individual countries to benefit from the experience of their neighbors and to resolve issues with regional import.

5. Provide administrative and management training

The lack of administrative and management capability in the field of agricultural research has been one of the serious constraints to designing and carrying out research programs and projects in the Sahel. In addition, support skills, such as those in finance, budget and personnel management, are also very limited in the region. Another kind of management research is the planning and establishment of research priorities. With limited human, material, and financial resources, training in the techniques and methods of establishing research priorities has become very important. Actions need to be taken now to ensure that during the next 20 years the Sahelian countries will have an indigenous capacity to provide administrative and management training.

6. Strengthen multidisciplinary approach to agricultural research

The compartmentalized single discipline approach to agricultural research in the Sahel is an important constraint to the development of widely useful agricultural technologies and thus to increasing production. Traditionally, research has been conducted in a single discipline (e.g., plant breeding, livestock, or soil fertility, etc.) and has ignored other aspects of agricultural production (e.g., socioeconomic aspects) which would enable the results of the research to be applied more effectively and thus make an appreciable difference in agricultural productivity. The use of a multidisciplinary approach as well as more multidisciplinary teams in agricultural research is just beginning in the Sahel and will require specific action by donors and country governments. In addition, given the complexity of, and interrelationships among, technical, social and economic factors and the interdisciplinary requirements of much of the research concerning them, it is likely that the increased availability of inexpensive microcomputers will be useful.

7. Strengthen linkages between the researcher and the farmer

A major constraint is posed by poor linkages between researchers, extension services, and farmers. The development of the essential two-way interaction between the agricultural researcher and the farmer by strengthening the functional capability of the public and private entities which link the two is a high priority activity. In this regard, the ability of the extension service to provide an effective link between the research station and the farmer should be strengthened. Programs should be developed for the technical training and upgrading of extension supervisors so that they can communicate intelligently with the researchers and the farmers. Extension supervisors should also be provided with sociological/training

skills in order to be able to help
communicating with farmers and ur

8. Promote networking at
institutions

Current agricultural
communication among Sahelian
Vigorous networking among
overcoming the constraints
agricultural research with
of highly-qualified researchers
to optimize human and material
linking the national, regional
research and training institutions
interchange among researchers in the
new ideas and creative solutions to
avoids pitfalls already encountered, avoid
research. It can also enhance professional
examples of networks that could be strengthened or
networks on foodgrains, farming systems research, peanuts, fisheries,
small ruminants, soil fertility and soil and water, and women in
agricultural production.

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9. Increase information available to researcher

Access by the researcher to suitable, up-to-date,
appropriate scientific and technical information is one of the most
important and intractable agricultural research problems in the Sahel.
Thus, it is important to improve research efficiency by increasing the
quality and quantity of information available to researchers and by
increasing the researchers' awareness and use of it. In addition to
its traditional activities in this field--via its scientific and
technical documentation and information network, RESADOC--INSAH plans
to establish a data bank on agricultural research institutions and
research programs and projects. This activity will use the data base
from the survey done under this agricultural assessment project. This
additional service will make it possible for a researcher to question
the data bank and receive information on agricultural research,
training and extension activities in the region.

10. Increase opportunities for private sector participation

The private sector is not as effective as it might be in
helping increase agricultural production. Suitable ways must be
developed for private business to participate in delivering inputs,
providing services and in the marketing, processing and distribution
of agricultural commodities. Private sector participation can
contribute to more efficient agricultural production. The private
sector could also play a more active role in the research and
development of appropriate commercial technologies. While specific
action should take place nationally, regional meetings and a further
exchange of information on this important subject should help identify
the major areas suitable for study and action.

D. Regional Strategy Implementation

Twenty-seven regional agricultural research programs and activities have been proposed to carry out the above-described strategy. These programs and activities may be categorized as follows:

Research Networks

- Mali* →
1. Foodgrains and cowpeas research network
 2. Farming systems research network
 3. Soil fertility and soil and water research network
 4. Fisheries research network
 5. Research on irrigated crops
 6. Peanut research network
 7. Small ruminants network

Training Programs

- ✓ 8. Training of research scientists
✓ 9. Training of research technicians
✓ 10. Improvement of agricultural research management

Research Support Services

11. Strengthening INSAH's scientific and technical information
12. Dissemination of applied agricultural research results
13. Planning and analysis of agronomic experiments
14. Improvement of agricultural statistics
15. Private sector participation
16. Creating a regional phytogenetic resource center
17. Creating a regional center for introduction and quarantine of plants

Research Programs

18. Agricultural research policy
19. Production and utilization of firewood
20. Women in agricultural production
21. Technology and processing of foodgrains
22. Bovine pathology
23. Small-scale mechanization in agriculture
24. Climatology studies
25. Restoration of the Sahelian ecosystem
26. Improvement of the Azawak cattle breed
27. Animal breeding in the Tsetse-infested Sudanian zone

All of these programs and activities are essential to the successful attainment of the objective of improving agricultural productivity in the Sahel. Priorities have been suggested, however, in terms of their proposed start-up dates and level of priority relative to the whole strategy. These activities are set in a 20-year perspective and have been shaped so as to complement national research activities. They are designed to reduce the constraints to increasing agricultural productivity and to achieve the goal of production output increases greater than the population growth.

I. REGIONAL ANALYSIS

A. Agricultural Production in the Sahel¹

1. Overview

One of the critical problems facing the Sahelian countries today is the failure of food production to keep pace with population growth. While the traditional food production systems that have evolved over time are well-adapted to the physical characteristics and resource limitations of the region, they are inadequate in the face of rapidly expanding rural and urban populations. Moreover, the situation is not getting better; it is getting worse. In less than 70 years (by the year 2050), unless a rapid decline in fertility occurs, the population in the region will quadruple to 136 million people.² This could mean that unless dramatic advances are made in agricultural productivity in the next 10-20 years, the gap between domestic food supply and demand will continue to widen.

Over the last 20 years, a number of agricultural programs and projects have been undertaken to improve productivity in agriculture and in the rural sector generally. These have had mixed results, but less was accomplished than expected. Moreover, numerous constraints, both directly and indirectly related to production, continue to hamper the successful implementation of programs and projects in the region. As a result, no country has become food self-sufficient or even self-reliant.

Thus, to assure the availability of basic food supplies for the people in the region, most Sahelian countries have significantly increased their food imports. Traditional food production systems, which provide subsistence for producers, have adjusted to the substantial rate of increase in the rural population principally by increasing the area of land used. With stagnant or even declining yields, however, this growth in area cultivated has not generated a

¹In addition to the knowledge of the technicians involved, this background relies on the Sahel Development Planning Team's 1984 draft Strategy Paper, Club du Sahel documents, the Report of the Sahel Working Group Vol. I and II, IBRD, 1981, and Environmental Change in the West African Sahel and Agroforestry in the West African Sahel, National Academy of Science, 1983. A more detailed description of the Sahel Region may be found in Annex 1. Annex 2 contains a number of regional tables.

²See Table 2-3: Population Growth in the Sahel--1970, 1975, 1980, 1982, 2000, 2050, Annex 2.

surplus of foodgrains adequate to meet urban demands. Moreover, it is likely to have led to increasing degradation of the environment. If these trends continue, there will be little increase in standards of living and little real development in the Sahelian countries. An even further decline in per capita food availability will occur in these countries in the future unless major efforts are made to prevent it. In a region where over 80 percent of the population is rural and per capita agricultural production is virtually stationary, such efforts must focus on raising the productivity of the rural sector.

Agricultural research should underpin such efforts. Research must contribute to increasing per capita agricultural production and to productivity in the rural sector through the development of agricultural technologies and techniques which permit farmers to make more effective or efficient use of their resources--land, labor, capital, and managerial skills. The complexity of the research task, however, should not be underestimated. It reflects the complexity of the problems to be solved.

It is important to understand that farms are often very complicated operations. Farmers generally exploit all of the available ecological niches that are profitable. These include rainfed upland, flood recession areas, low-lying valleys which receive runoff water and irrigable zones. Farmers engage in both crop and animal production activities and often in non-farm activities as well. No single technology or technique to increase productivity will be appropriate to all conditions. Farmers differ in their managerial ability and in their access to land resources and are sensitive to economic conditions. Moreover, any long-term research program in the agricultural sector in the Sahel must consider maintenance, or improvement, of the fragile ecological base as well as production constraints. There must be an understanding of the environment and the effects of human activities in agriculture interacting with the environment.

The following sections describe in more detail the current food deficit situation in the region and constraints to improving productivity. Some efforts to resolve these constraints, including agriculture research and other agriculture development projects, are noted. These points provide a backdrop for the proposed zonal agricultural research strategy discussed in Chapter II.

2. Deterioration of the food balance in the Sahel

The Sahel has experienced a growing imbalance between domestic cereal production and consumption. For the region as a whole, over the 13-year period from 1970-82, domestic cereal production increased 27.8 percent (an annual compound rate of only 2.07 percent). During the same period, population increased 35 percent (an annual compound rate of 2.6 percent). Thus, although food production is increasing gradually, it is not keeping up with the growth of the population as indicated by the per capita data in Figure 2.

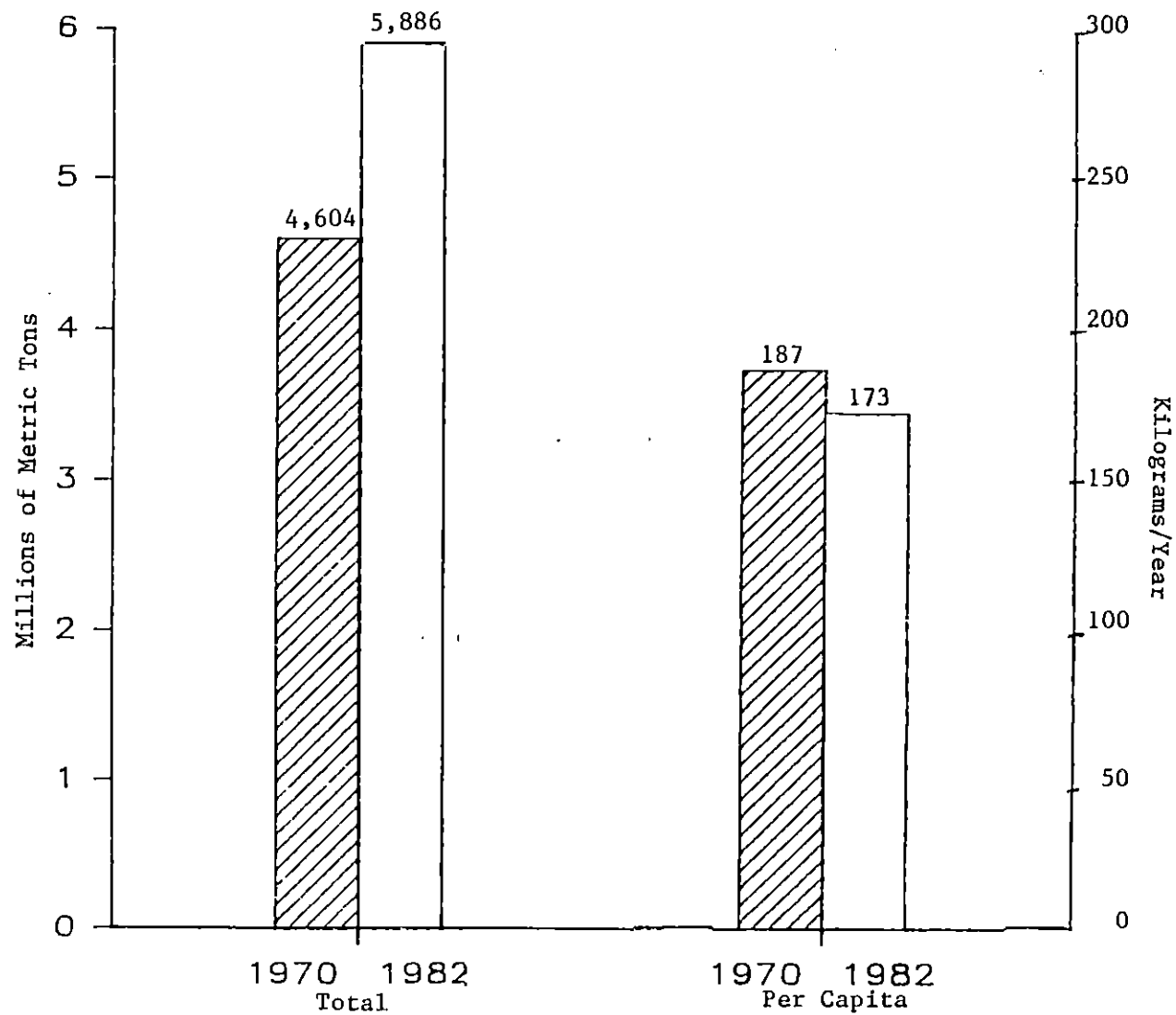


Figure 2: Cereal Production in the Sahel, 1970 and 1982

Sources: Tables 2-3 and 2-6 in ANNEX 2.

All of the countries in the Sahel have individually and collectively adopted a priority objective of achieving food self-sufficiency. In the short-term, however, they have had to rely on increasing their commercial and concessional imports of cereals to meet the food needs of their people. Figure 3 indicates the increase in cereal imports for the region between 1970 and 1982. At the beginning of the 1970s, the level of cereal imports for the Sahel was between 400,000 and 600,000 metric tons (MT) per year. During the drought years of 1973-1975, imports increased to between 800,000 and 900,000 MT annually. While imports dropped slightly in 1976 and 1977, they began to increase again in 1978. In the last five years (1978-82), regional cereal imports reached an average of one million MT--more than double the amount in 1970. In 1982, with exceptionally high assistance to Chad, imports were three times those in 1970. On a per capita basis, imports have more than doubled to meet consumption needs.

When cereal importations are examined by country, the situation is even more dramatic. While Senegal has consistently imported the most in terms of metric tons, its rate of increase since 1970 in gross imports is among the smallest. Niger has had the highest rate of increase in imports--more than 15-fold since 1970; Mauritania and Upper Volta have tripled their imports; Mali, Senegal, the Cape Verde Islands, and The Gambia have about doubled their imports. With the exception of the 1974 drought, Chad held its import level relatively steady during the decade until 1982 when civil disturbances interrupted production and marketing and exceptionally high imports were required. Table 2-7 in Annex 2 provides import figures for individual countries.

Given natural resources, most analysts agree that certain Sahelian countries, such as Chad, Mali, Niger, and Upper Volta, can realistically aim at nearly complete self-sufficiency in food, that is, aggregate domestic supply equal to domestic demand. For the other Sahelian countries, the food deficit is already so large that it may be more realistic to acknowledge that while a higher level of self-sufficiency is desirable, a more efficient strategy may be that of ensuring food security through imports. This implies the generation of exports to pay for an increasing part of the costs of importing the required foodstuffs.

Given the climatic variability of the region, however, all of the Sahelian countries are liable to have food shortages from time to time. This requires emergency food planning and perhaps the storage of emergency food reserves. Food aid, with all of the problems of its collective programming for consumption and security, has been useful in this regard. At the same time, many Sahelian countries have taken steps to ensure that the food aid does not engender disincentives for indigenous production and increased food dependency. Thus, food security may need to be ensured via imported food aid, but at the same time agricultural policies on production, prices and distribution must

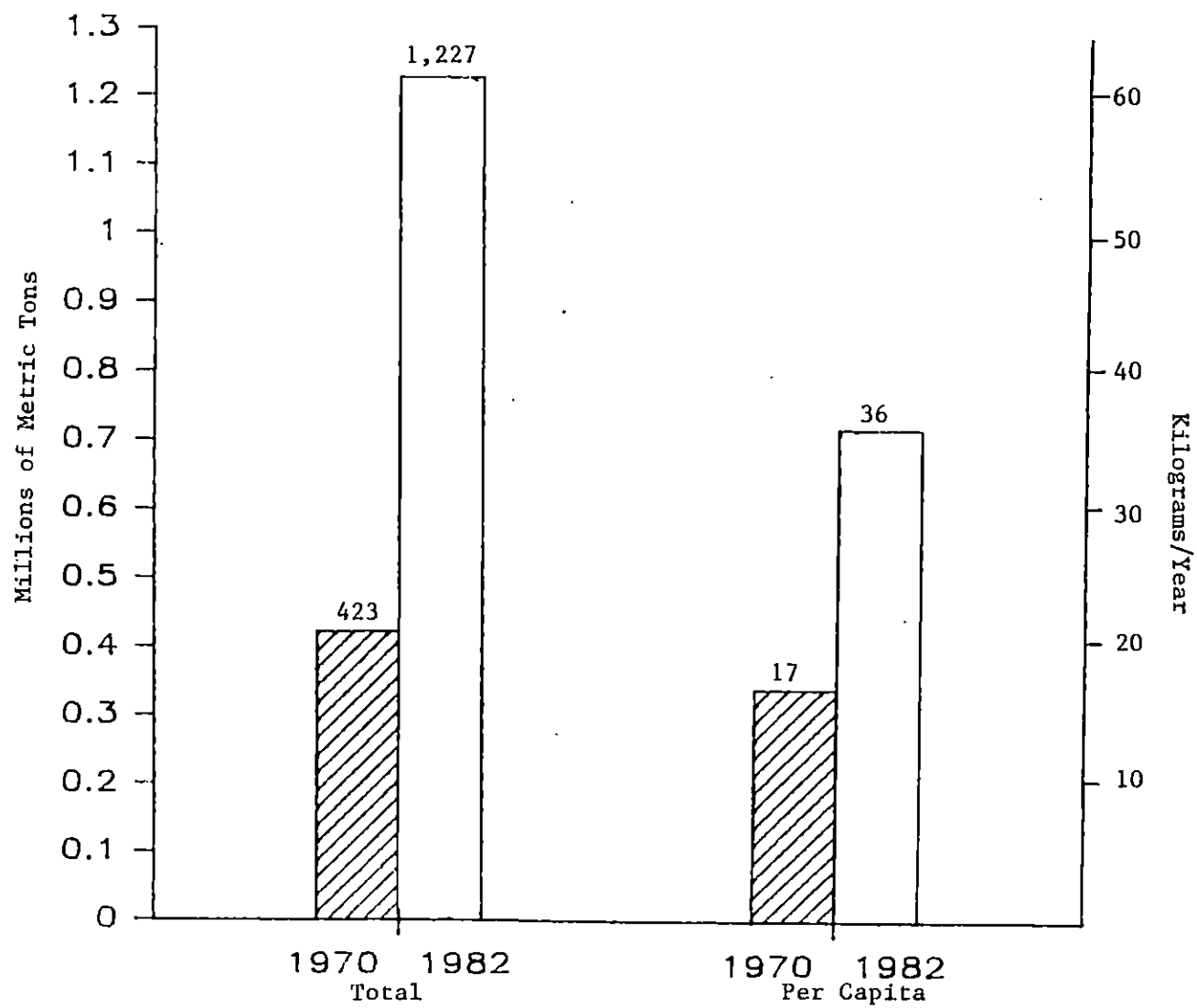


Figure 3: Cereal Imports in the Sahel, 1970 and 1982

Sources: Tables 2-3 and 2-7 in ANNEX 2.

provide adequate incentives to domestic producers. The liberalization of the marketing systems of cereals in several of the countries is a sound start in this direction.

B. Constraints to Agricultural Production in the Sahel

There are a number of serious constraints to increasing agricultural productivity in the Sahel. These may be categorized as follows:

- o Constraints that apply generally to all agricultural production;
- o Constraints to increased crop production;
- o Constraints to increased livestock production;
- o Constraints to increased agro-forestry production; and
- o Constraints to increased artisanal fisheries production.

Table 1 details these constraints. Each type of constraint is divided into two categories: (1) Direct Constraints--those factors which constrain production and productivity directly such as low soil fertility, deficient and poorly distributed rainfall; lack of appropriate technology for controlling plant diseases and pests, and for maintaining the fertility and physical structure of soils, and (2) Indirect Constraints--those factors which impede the development and application of solutions to the direct constraints such as institutional and policy weaknesses--e.g., including inappropriate institutional structures, poor project administration; insufficient understanding of socioeconomic factors.

These constraints are complex and interrelated, involving political, technical, physical, social and economic factors. To reduce these constraints and thus to move toward a situation of increasing food security, it is vital to strengthen both national and regional research capacity to: (1) plan and establish research priorities, (2) finance and carry out effective agricultural research programs, and (3) disseminate successfully to farmers the results of this work. Establishment of Sahelian capacity to create, manage, and utilize research results over the next 20 years is a sine qua non to achieving increased per capita agricultural output in the Sahel.

C. Agricultural Research in the Sahel

1. Assuring an adequate "critical mass"

Agricultural research, extension and training programs in the Sahelian countries differ substantially in terms of focus, number of personnel, funding and institutional support. A partial overview of the current extent of agricultural research, extension and training programs by country is presented in Table 2. Most of the Sahelian

Table 1: Major Constraints to Agricultural Productivity Found in the Sahel: General, Crops, Livestock, Forestry, and Fisheries

Direct Constraints	Indirect Constraints
<u>General Constraints^a</u>	
<ul style="list-style-type: none"> o <u>INSUFFICIENT NUMBER OF WELL-QUALIFIED AND EXPERIENCED RESEARCHERS AND TECHNICIANS:</u> There are not enough agriculturalists, social scientists and technicians working in research to meet the present and future needs of agricultural research. Advance degree training is needed, as well as training in carrying out field research successfully. A relatively large number of expatriates continue to be needed to carry out research and training activities. o <u>INADEQUATE RESEARCH/EXTENSION/FARMER LINKAGE:</u> There is often very little functional interaction between scientific information and technology (either from outside or from the national agricultural system) and the majority of the farmers. They may sometimes have direct access to this information, but usually it has come through an extension system. Too often potential solutions to farmers' numerous problems are constrained by lack of information on farm conditions, and they often do not address the most urgent problems. The extension workers therefore lose, in that the techniques which they propose are often either scientifically unsound or unacceptable to the farmers. The Sahel has an urgent need for a more effective association between research, extension and farmers. The agricultural training institutions could also be profitably included in the system. o <u>INADEQUATE TRAINING AND/OR EXPERIENCE IN AGRICULTURAL RESEARCH MANAGEMENT:</u> While many African researchers have received excellent training in their discipline, very few have received management training needed to administer an institute or specific research programs (e.g., including budget, personnel, procurement, etc.), or training in the establishment of priorities among research activities. 	<ul style="list-style-type: none"> o <u>INAPPROPRIATE AGRICULTURAL POLICIES:</u> Certain agricultural policies are not compatible with one another and hinder the accomplishment of self-sufficiency. Increase in food production, meat production, and fish is proposed for the domestic market, but at the same time significant increases are expected in exports of groundnuts, cotton, livestock, meat and fish. The sub-region does not currently have the capacity to satisfy both these demands at the same time. o <u>PRICE DISINCENTIVES:</u> Prices of imported foods are often maintained at too low a level, which can have a negative effect on the price of domestically produced foods. This does not provide a sufficient incentive to the farmers to undertake risks that may lead to an increase in production. o <u>DEFICIENT INFRASTRUCTURE:</u> The considerable investments made by the governments to improve the infrastructure and the national services and household water supply, should not only be directed towards the urban areas but also the rural. Otherwise, an increasing rural exodus will reduce the agricultural production capacity. o <u>INSUFFICIENT AGRICULTURAL CREDIT:</u> Except in production of cotton, there does not seem to be a practical system of short- and medium-term credit which provides the credit when it is needed and does not over burden the farmer. Cooperative credit remains to be organized almost everywhere in the region and in the sub-region. o <u>INSUFFICIENT INPUT AND SERVICE DELIVERY:</u> With the very tight government budgets, delivery of inputs and services, including appropriate machinery, often is not conducted in a timely fashion and hence production problems intervene. The private sector in some other countries has not played an active role in these areas, but potentially could be helpful.

^aThese include constraints which generally affect all of the sectors that are associated with food in a broad sense. These analyses draws heavily on the responses of the survey questionnaires.

SOURCE: Data collected from the DEVRES/INSAH Agricultural Research Resource Assessment, 1983.

Table 1: Major Constraints to Agricultural Productivity Found in the Sahel: General, Crops, Livestock, Forestry, and Fisheries (cont.)

Direct Constraints	Indirect Constraints
<u>General Constraints (cont.)</u>	
<p>o <u>INADEQUATE COMMUNICATION AND EXCHANGES AMONG EXISTING RESEARCHERS:</u> A frequent complaint among researchers is the lack of information and exchange of ideas about on-going agricultural research work in the same field, not only between researchers in the Sahelian countries but also with those in other West African countries, and semi-arid zones around the world. This lack of communication or "networking" can lead to duplication of effort and inefficient use of scarce human resources. In addition, it eliminates the synergetic results which can result from communication between agricultural researchers working on similar problems.</p> <p>o <u>LACK OF APPROPRIATE TECHNOLOGIES:</u> Progressive technological changes must occur if general productivity is to be rapidly increased. Drought and pest resistant varieties, tsetse fly resistant animals, proper light farm machinery, etc., do not exist for the most part.</p>	<p>o <u>CHANGING URBAN FOOD TASTES:</u> Food habits change rapidly especially among the continually increasing population in the towns. For example, people want to buy easy-to-prepare foods like bread, rice, milk, eggs, vegetables and conserves. In almost all of the countries new demand cannot be fully satisfied. Lack of a profitable processing and handling system for traditional and new foods is a constraint to increasing the consumption of local food crops.</p>

Constraints to Crop Production^a

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|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>o <u>RAINFALL DEFICIENCY:</u> Rainfall is inadequate either in total amount or in its distribution. There seem to be different elements of this problem. The Sahel as a zone has had a low rainfall throughout its known history, but the population has been able to adapt the food production to this permanent phenomenon. In the last ten years the sub-region seems to be passing through a marked cycle of dry weather which some experts feel could lead to irreversible desertification in numerous places. The present difficulties seem to be increased in their effect because people have not developed certain practical methods for conserving and using the limited quantity of rainfall to the maximum or to add to the groundwater.</p> | <p>o <u>LIMITED FARMING SYSTEMS APPROACH:</u> In Africa, as in other developing areas of the world, it is fashionable to talk of "systems of production". The basis of this new approach is logical. The attempt is made to work closely with the farmer by program including as many as possible of the factors necessary to obtain a much greater advantage from his physical and technical environment. However, in the Sahel, there is room for more work on season crops, relay cropping (two or three crops a year) with irrigation, and the possible combinations of crop production and production of different types of livestock and even agro-forestry and fishing in some regions.</p> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

^aIn almost all of the Sahelian countries the following are produced: millet, sorghum, rice, cowpeas, peanuts, manioc, maize, vegetables, sweet potatoes, mangoes, and papaya. The following are grown in more than one of the countries: cotton, citrus, pineapples, sugar cane, dates, sesame, shea nuts and tobacco.

Table 1: Major Constraints to Agricultural Productivity Found in the Sahel: General, Crops, Livestock, Forestry, and Fisheries (cont.)

Direct Constraints	Indirect Constraints
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Constraints to Crop Production (cont.)

CROP LOSSES DUE TO PLANT DISEASES, WEEDS AND

PESTICIDES: The insufficient level of food

crop production is further diminished by plant diseases, weeds and predators (particularly insects and birds). Losses start in the field but continue after harvest, during storage and marketing. In some cases the technology to correct this is known but it is normally too costly or too difficult to master for the majority of farmers. New methods are continually being sought which would be more adaptable and less costly.

UNAVAILABILITY OF MODERN AGRICULTURAL INPUTS:

There are sometimes difficulties for the farmers to buy certain factors of production such as fertilizer, pesticides, farm tools, and farm equipment. Often, these factors of production cannot be profitable in the present system because of logistical problems; the inputs arrive too late or they cannot be acquired in time because of difficulties with credit.

INADEQUATE SOIL MANAGEMENT: To allow a transformation

of the traditional system, most of the soils are not well enough known to be exploited in an optimal way and the management of soils needs to be improved; insufficient use is made of crop rotation, and transformation of the traditional system, most of the maintenance of soil fertility is a major concern. In short, what is known on soil management is difficult to communicate to the farmer.

LACK OF IMPROVED SUITABLE VARIETIES: Despite

the large number of crop varieties used, there remains a vast job of crop breeding to be done, and unfortunately Sahelian Africa has not yet been able to benefit from a "green revolution" with spectacular varieties and high yields. A patient approach is required for the improvement of a considerable number of traits—drought resistance, shorter growth cycle, disease resistance, increased yields, taste, etc. One means which is beginning to be used is a system of trials run under actual farm conditions and on sufficient scale.

Table 1: Major Constraints to Agricultural Productivity Found in the Sahel: General, Crops, Livestock, Forestry, and Fisheries (cont.)

Direct Constraints	Indirect Constraints
<u>Constraints to Crop Production (cont.)</u>	

Once an improved variety is identified, there is still the problem of multiplication of seed to obtain the required amount. The difficulties change with species and the individual varieties involved. Finally, the process has to reach the farmer's field as early as possible, with his agreement to and his understanding of the special requirements of the new variety. The survey respondents often deplored the damaging delays in the delivery of seed both of old and of new varieties.

EXCESSIVE SMALL FARMER RISKS: In introducing new techniques or methods to increase crop production, it is necessary to relieve the farmer from carrying the entire risk. Before a system can be extended, its technical validity must be established as well as its possible acceptance by the farmers. Many of the people surveyed identified non-viability of the extension themes as a major constraint.

Constraints to Livestock Production

DIFFICULT COMMUNICATION WITH HERDERS: The majority of the herders in the Sahel move constantly. It is difficult to reach these people with a fixed type of organization. The high level of illiteracy also makes it necessary to use oral means of communications, such as radio.

SOCIO-TRADITIONAL FACTORS: Such traditions as welcoming other herders who want to use a pasture are also mentioned.

INSUFFICIENT INTEGRATION OF FARMING AND LIVESTOCK PRODUCTION (mixed farming):

Programs for farmers tend to be compartmentalized into those for crops and for animals, falling therefore within the mandate of the sponsoring department.

However, from the standpoint of the farmer it is the timely and efficient utilization of all on-farm resources which offers substantial potential for increased productivity, (for example, programs which emphasize techniques such as use of animal droppings for fertilizer on plants, animal traction for plowing, use of remains in the fields after harvest for forage, etc.).

INSUFFICIENT DISEASE CONTROL: Control of the livestock diseases remains an enormous constraint (Pulmonary syndrome of small ruminants, rinderpest, bovine peritonitis, etc.). It is particularly appropriate to establish an effective mechanism for regional collaboration since the diseases do not respect political frontiers.

LIMITED SOURCES FOR NEEDED ANIMAL FEED: Improved access is necessary for livestock producers to agro-industrial by-products so that the periods of forage shortage can be covered and so permit finishing of animals to occur closer to the markets.

Table 1: Major Constraints to Agricultural Productivity Found in the Sahel: General, Crops, Livestock, Forestry, and Fisheries (cont.)

Direct Constraints	Indirect Constraints
<u>Constraints to Agro-forestry^a</u>	
<ul style="list-style-type: none"> o <u>LIMITED REGENERATION BECAUSE OF DROUGHT:</u> The great problem of the drought has made it difficult to preserve trees and obtain natural regeneration. o <u>DEMAND EXCEEDS PRODUCTION:</u> With a constantly increasing population wood consumption in many areas exceeds production and contributes to reduced resistance to desertification because the soils retain less moisture and the trees no longer impede the drying winds. o <u>DAMAGING BUSH FIRES:</u> Traditionally in the Sahel, farmers burn their fields to clear the land for the next planting. This practice often destroys pasture, tree leaves or forage needed by animals, and damages the trees themselves. o <u>LACK OF USE OF NEW TECHNOLOGY:</u> The technology for creating new forests or woods in the Sahel with woody species of forages is quite recent and needs to be consolidated, tested more, and put into use. 	<ul style="list-style-type: none"> o <u>TREE TENURE AND LAND TENURE LAW:</u> In some countries, tree and land tenure laws assign ownership to the state or tribal group. This is not conducive to individuals investing the time and effort required for trees to be planted and to successfully mature.
<u>Constraints to Fisheries^b</u>	
	<ul style="list-style-type: none"> o <u>INSUFFICIENT EARNINGS FOR FISHERMEN:</u> The current system of marketing does not always leave a sufficient profit in the hands of the fishermen. o <u>ABSENCE OF SUCCESSFUL COOPERATIVES:</u> In many areas a satisfactory system of fishing cooperatives has not been found and regular credit organizations do not exist. o <u>POOR EQUIPMENT:</u> Improvement is needed in the equipment used, including the boats, nets and other items.

^aThe attempts to obtain an orderly and structured utilization of the forest or of trees to provide fuel and wood for carpentry for farm and herding families as well as providing forage for animals and food for gathering by the rural population is a quite recent development. Examination of the constraints are more difficult because this sector is not yet well defined. Nevertheless certain constraints are mentioned.

^bThe survey was limited to artisanal sector of the fisheries, with the knowledge that some countries have an industrial sector which makes a considerable contribution to the food supply.

Table 1: Major Constraints to Agricultural Productivity Found in the Sahel: General, Crops, Livestock, Forestry, and Fisheries (cont.)

Direct Constraints	Indirect Constraints
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Constraints to Fisheries (cont.)

- o LACK OF SOCIO-ECONOMIC INFORMATION: There is a lack of information on how fishing fits with the other economic activities of the fishermen during the year, together with a lack of knowledge on the costs and returns from fishing in different types of waters using different equipment. There is a dearth of information on the socio-economics of fish production in ponds and how this fits with the calendar of work for farming.
- o LIMITED TREATMENT AND CONSERVATION: Post-harvest losses arise from the difficulty of treatment and conservation of fish prior to marketing. Another important problem is the protection of fish from insect loss once they have been preserved.

Table 2: Agricultural Research, Extension and Training Programs,
by Country and Number of Programs, 1983

<u>Country</u>	<u>Research Programs</u>			<u>Extension Programs</u>	<u>Training Programs</u>
	<u>Number of National Research Institutes</u>	<u>Number of Programs/Projects</u>	<u>Number of Research Stations</u>	<u>Number of Extension Institutions</u>	<u>Number of Training Centers</u>
Cape Verde	2	42	2	- ^a	1
Chad	3	13	10	3	5
The Gambia	2	6	3	4	2
Mali	3	31	16	2	5
Mauritania	3	11	19	- ^b	1
Niger	3	12	9	7	4
Senegal	4	17	16	11	12
Upper Volta	5	27	5	5	5

^aNo formal extension institution currently exists in Cape Verde. A National Agricultural Extension Service is projected.

^bNo formal extension institution currently exists. Work is carried out by six different "units" of different levels, either in a project or in the administration of various organizations including the Ministry of Rural Development.

Source: DEVRES/INSAH Agricultural Research Resources Assessment, 1983. (See Tables 2-10, 2-11, and 2-12 in Annex 2 for further detail.)

countries have two or three national agricultural research institutions, generally implying separation of crop, livestock, and forestry research. The focus of these institutes varies widely among countries. Collectively the inventory indicates that there are presently about 80 research stations and sub-stations in use across the Sahel.

Each national research institution carries out a number of research programs (Table 2-8 in Annex 2). Each program is composed of one or more projects, that is, research activities which are focussed on a particular commodity or a particular research problem, often financed by an external source for a specific period of time. The number of activities noted in the inventory varies widely, ranging from six (in The Gambia) to 31 (in Mali). The national reports, supplemented by other information available to the survey team, indicate that in 1983 there was a total of 289 agricultural research programs/projects in the Sahel. Of these, 223 were ongoing. Twelve "new starts" were reported for 1983 and 54 activities were proposed for implementation. Figure 4 indicates the distribution of these programs/projects by country and by type. Of the continuing activities, 53 percent were devoted to crops, 26 percent to livestock, 9 percent to forestry and ecology, 4 percent to fisheries, and 7 percent to technology and other activities. While the percentages change slightly when one adds in the "beginning" and "proposed" projects, the basic situation remains the same.

Perhaps a more useful indicator of level of research effort, however, is not the numbers of programs/projects, but the number of personnel engaged in conducting research. These data are presented in Table 2-9 in Annex 2. By this measure, it appears that Senegal has the largest agricultural research program in the region, followed by Niger, Upper Volta and Mali. Figure 5 summarizes the number and type of research and extension personnel in the Sahel region in 1983. The total number of professional researchers in the Sahel, according to the assessment, is 634. Of those research professionals specified by discipline (365), one-third of the total are agronomists. Plant protectionists, engineers, economists, veterinarians and animal scientists together comprise roughly 45 percent of the total; the remaining 22 percent are administrators. There are an additional 269 "unspecified" professionals whose disciplines were not indicated in the national reports; these represent 42 percent of the total number of professional researchers in the Sahel.

Extension programs also vary. Cape Verde and Mauritania have no national extension institutions; in contrast, Senegal carries out its extension efforts through 11 different entities. As in research, extension effort can be gauged to some extent by the number of professional personnel engaged in extension (Figure 5). There are a total of 1,261 extension professionals in the Sahel. Agronomists constitute the largest number of technical research personnel; engineers the smallest. The technical range of capabilities among extension personnel is broader than that of research, though

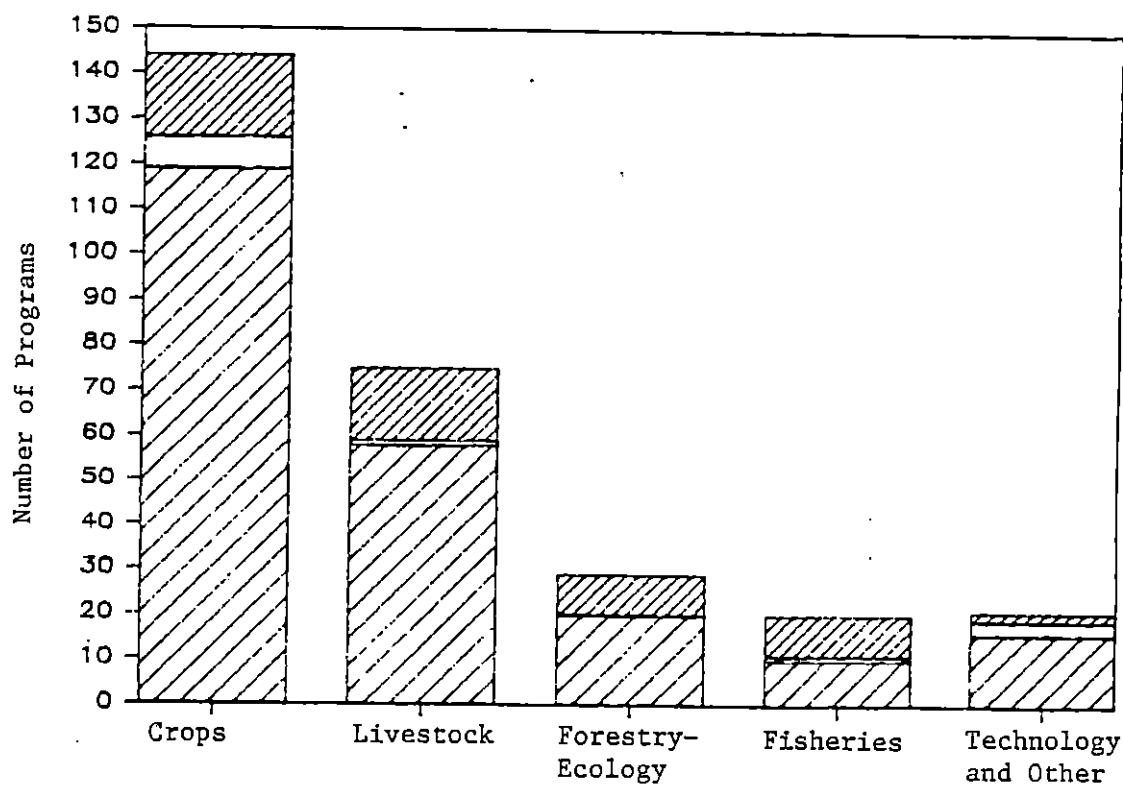
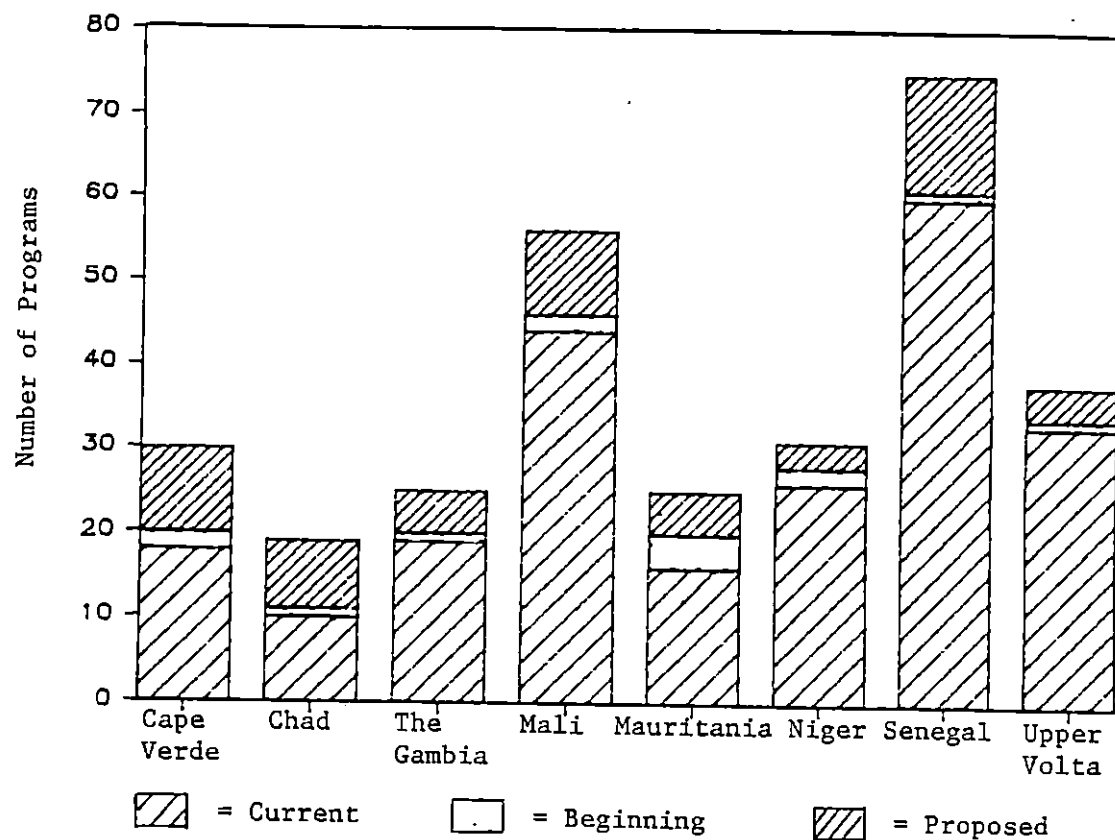


Figure 4: Number of Current, Beginning and Proposed Agricultural Research Programs in the Sahel by Country and by Sector, 1983

Source: Table 2-8 in ANNEX 2.

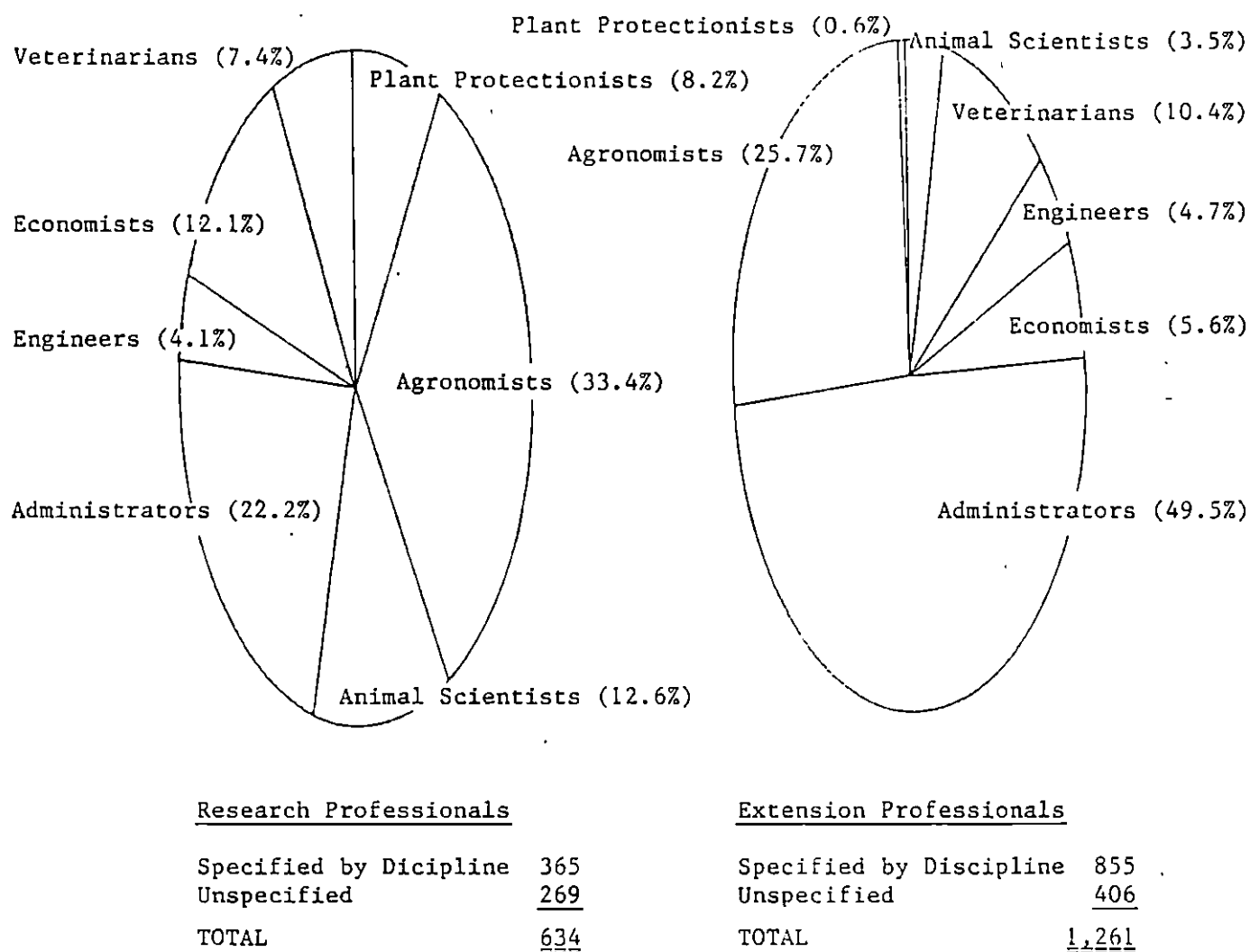


Figure 5: Research and Extension Professionals in the Sahel by Discipline

Source: DEVRES/INSAH Agricultural Research Resource Assessment, 1983. (See Table 2-9 in ANNEX 2 for more detail.)

agronomists comprise nearly 26 percent of the total professionals specified by discipline (855). Veterinarians are relatively abundant with slightly more than 10 percent of the total. Plant protectionists, animal scientists, and economists are in shortest supply, together constituting only 14 percent of all extension personnel specified by discipline in the national reports. The remaining 50 percent of specified professionals are classified as administrators. The 406 "unspecified" professionals represent 32 percent of the total number of professionals engaged in extension in the Sahel (1261). Table 2- 9 in Annex 2 presents a breakdown of these personnel by country.

Finally, the total number of agricultural training centers in the eight Sahelian countries is 40, of which Senegal and Mali have the most with 12 and 10 respectively, and Cape Verde and Mauritania the least with one training center each. Many of these do not operate at full capacity and do not offer senior professional degrees. Only five of these forty centers train degree level researchers.

While the above data highlight the fact that there is a basic infrastructure for agricultural research already in place in the Sahel, they also indicate that there is not yet a "critical mass" in any one place adequate to carry out the type of comprehensive program of agricultural research that is needed, for national or regional purposes. The quantity of the research effort varies widely from country to country and only in traditional research activities in the crop sector does one find substantial common activity. Thus, it would appear that some areas require much more research attention than they now receive. In the area of fisheries, for example, there are virtually no research efforts either underway or planned, even though inland fishing is an important source of protein in the Sahel. Only a small number of researchers are found conducting research on animal husbandry problems, as contrasted with veterinary research, even though better livestock management could mean substantial productivity gains. An important area of research--agricultural policy--also seems to be under-represented. While tentative policy research efforts are now beginning in many countries, they are often not closely linked with other agricultural research.

In general, it appears that in most Sahelian countries there are still inadequate numbers of national agricultural researchers available to meet research needs. In certain critical research disciplines, especially the social sciences, gaps of qualified professionals working on agricultural research are particularly noticeable. Research, extension and training institutions are relatively few and their efforts lack the breadth and depth necessary to ensure secular increases in the Sahel's agricultural productivity. Finance, adequate to launch and sustain needed research efforts, is also lacking (as discussed in the following section).

A regional approach, or framework, for agricultural research is one way to achieve the necessary "critical mass" in the region. Given the limited number of qualified personnel and funds in the Sahelian countries and the fact that many of the problems they face are the same, or very similar, collaboration among institutions can help to overcome certain gaps at the national level and to ensure that adequate resources are brought to bear on key national and regional agricultural problems. In this context, a regional approach helps to rationalize the effective and efficient use of scarce human, financial, technical and administrative resources.

2. Financing agricultural research

The countries of the Sahel face severe financial constraints which impact directly on their agricultural research, extension and training efforts. The national reports note the severe financial restrictions under which national agricultural research institutions operate, citing, for example, the operational difficulties caused by delays in the release of funds and the inadequacy of funds for follow-up on field trials. Extension services report difficulties in obtaining adequate funds for field work, training and upgrading staff. Training institutions report difficulty in funding adequate teaching staff. Researchers and technicians note their low salaries and lack of career opportunities.

Many of the Sahelian countries perceive serious difficulties with the mode in which donor funding of agricultural research is provided. While external donors provide substantial resources for agricultural development, agricultural research generally benefits little from them. The same donors that provide support for agricultural research are confronted with other sectoral needs by the national governments. The donors also have difficulty in planning the financing of research for periods of more than five years. Experience has shown that once the initial donor financing is exhausted on multi-year (three to five) projects, countries have severe difficulty in providing the funds to continue the projects. As a result, some promising agricultural research projects have not achieved their potential and, even worse, have wasted the initial investment of scarce human and financial resources that was made. Moreover, donors do not always consider the research priorities of the Sahelian states. Rather, they focus on the economic potential of programs. When national priorities are considered by donors their support is often limited to some very specific objective within a project and for some specific (usually short) period.

CDA donors currently sponsor over 130 programs/projects of varying scope and duration in agricultural research throughout the Sahel. (Annex 5 lists the CDA-financed projects by donor, by sector and by country.) Some of these programs are jointly funded by two or more donors. As indicated in Figure 6, these programs are not evenly distributed according to type or to country. Crop research programs outnumber both livestock and agro-forestry programs by more than three

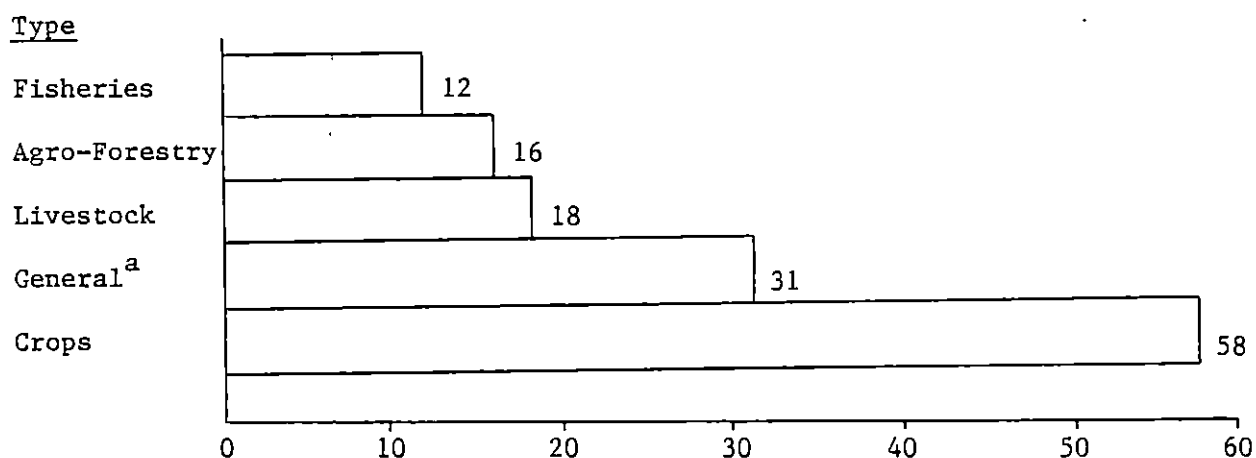
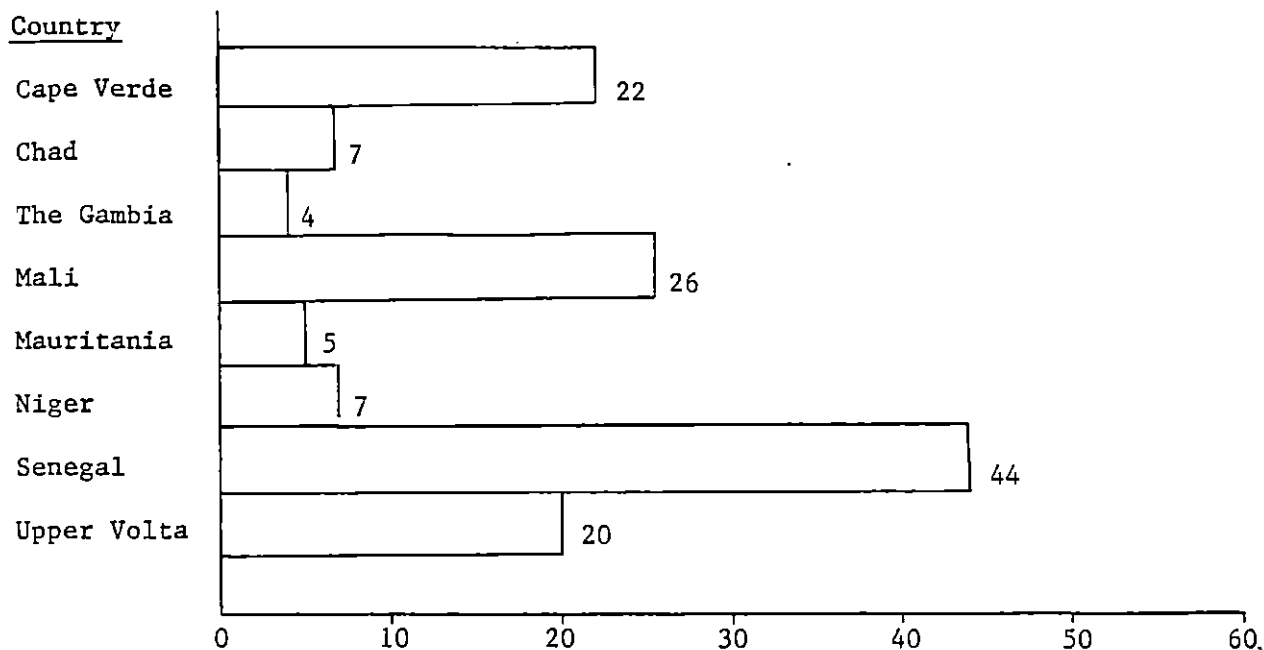


Figure 6: CDA-Supported Agricultural Research Programs and Projects in the Sahel by Country and by Type, 1983

^aIncludes integrated rural development farming systems, infrastructure and institutional support and agricultural research activities not specified by donors.

Source: DEVRES/INSAH Agricultural Research Resource Assessment, 1983.
(See ANNEX 5 for more detail.)

to one. Despite the potential for developing marine and inland fisheries in the Sahel to provide an additional nutritional food source, fisheries research has been largely neglected by CDA donors. There are five times more crops programs than fisheries programs. There are also a number of integrated rural development, farming systems and institutional support projects that have a research component.

The distribution of CDA-supported programs among the eight is also uneven. Less than 20 percent of the programs are in four countries—Chad, The Gambia, Mauritania and Niger which currently have nearly 40 percent of the population. Senegal alone has nearly a third of the programs. Cape Verde, Mali and Upper Volta together have about 50 percent of the CDA-supported research programs and 43 percent of the population.

Given their financial difficulties, initial and subsequent country contributions to research and related projects are likely to be modest, consisting mainly of personnel and facilities. Thus, more sharply focused projects of high priority, carefully designed budgets and improved project management must be pursued vigorously by each country. Even more important, donors must bear a major portion of the recurrent costs for both national and regional research projects. Also, to ensure the viability and success of long- and medium-term projects, donors--at the outset of such projects--must make certain that they are adequately financed for their entire life. Unless donors are prepared to cover these recurrent costs as well as the usual equipment and other start-up and training costs, attempts to increase the priority given to agricultural research in the region will fail.

3. Establishing policies for national and regional research

Given the limited resources available, an established and agreed-upon agricultural research policy framework is essential at both the national and regional levels for carrying out specific projects and programs. Agricultural research policy in the Sahel should be designed to:

- o Ensure sharply focused national and regional research efforts;
- o Encourage the establishment of clear research priorities;
- o Support careful evaluation of existing work;
- o Sustain that ongoing work most likely to produce the results desired and expected;

- o Account realistically for the time frame or range of time in which concrete results can expect to be achieved; and
- o Ensure the availability of the finances required.

Policies are also needed to encourage the development of management skills in the administration of research institutions and in the establishment of priorities for the careful use of scarce human and financial resources. Also, special policies are needed to overcome the tendency on the part of established research workers to continue doing what they have been doing. New disciplines and lines of work that are hard to get funded need encouragement so that they become a high enough priority to get "off the ground."

A policy framework that encourages the establishment and monitoring of research priorities is needed, especially when the task is to build an independent agricultural research capacity via national and regional institutions in the Sahel over a 20-year period. Establishment of research priorities requires the determination, at an early stage, of the commodities and mix of disciplines and sub-disciplines that research institutions are likely to be dealing with in ten, 15 and 20 years. For example, fisheries are important as an element in the economy but this is not now reflected in the resources made available for fisheries research. Environmental research and research on utilization of the environment by city dwellers, cultivators, herders, and wildlife are practically non-existent. Research on soil fertility and multi-disciplinary considerations connected with management of soil, water and plant resources must also be given their proper priority.

Despite this need to identify priority areas for research, it should be recognized that the information necessary to propose the optimum research "mix" often is not available. Where a value can be put on the output of each commodity (e.g., individual crops, livestock), ISNAR has proposed a fairly objective system of resource allocation.¹ This is a good first step. However, where a financial value cannot be placed on an "output" (e.g., environmental degradation, reclamation of dunes), the proposed system is less effective.

Determination of the research disciplines that will be required to carry out the desired research is also necessary. Given the limited resources likely to be available for future agricultural research in the Sahel, the choices made about what research skills to prepare for the future are of primary importance in any long-term agricultural research strategy. The lag time and expense involved in developing local research capacity in key areas are large and the retention rate of trained researchers in some disciplines is lower than that of researchers in other disciplines. Agronomists, for

¹ISNAR, R7, La Recherche Agronomique en Cote d'Ivoire, (October 1982): 27-33.

example, tend to remain in the research service while agricultural economists appear to be more likely to transfer to other posts, including administrative ones. Since there is no single systematic and practical approach for objectively defining an optimum mix of research disciplines over the longer term, experience and good judgement based on agricultural research assessments such as this one continue to be important means for forecasting the optimum set of research skills needed in the future.

Regardless of the research and training priorities established, governments need to provide adequate "status" and appropriate career opportunities for research workers. Unless these issues are solved, the flow of skilled researchers and technicians leaving the field will defy all efforts to achieve an effective and independent national research capability.

Recurrent costs must also be a prime policy consideration. In a situation of budgetary stringencies (presently being faced in most Sahelian countries), it is particularly important that future funding requirements for research be taken into account. Research institutions as well as donors must be clear about research priorities to minimize recurrent costs. Continuity of effort is essential; termination of a research effort for lack of funding can mean loss of initial investment. But trying to continue a research effort without adequate recurrent financing is also risky. These are illustrated by cases where governments have been unable to come up with the recurrent costs needed to sustain research efforts initially launched with external financing. Where salaries get delayed, or operating funds are not available, the research workers who can most easily find other jobs are likely to do so. CILSS and the Club du Sahel have been working on ways to alleviate the recurrent cost problems and to provide data for the design of projects allowing for this constraint.

Rec
In summary, research policy based on an understanding of research needs, such as those identified in this report, is needed. Given the role of donors in the financing of agricultural research, it is suggested that a frank dialogue involving key donors (the Club du Sahel, IBRD, FAO and others) and Sahelian researchers is important to developing a workable policy. The focus of this dialogue should be the appropriate medium- and long-term (ten years) distribution of agricultural research activities for the national organizations and between national regional and international (interregional) organizations.

D. Other Agricultural Projects in the Sahel--Problems and Potential

1. Overview

Over the last 20 years, a large number of development projects have sought to address the problems of agricultural productivity in the Sahel. From 1975 to 1982, donors contributed about \$11 billion in development assistance to the Sahel, more than 33

percent of which was for agricultural development. During this period, an increasing share of national investments also focused on agricultural development. Currently about 50 agencies and organizations other than national institutions are involved in some way in agriculture research in the Sahel with varying degrees of coordination and communication among them regarding different programs and projects. (For a detailed listing of these agencies and organizations, see Annex 3.)

The design and execution of these projects in the agricultural sector (including livestock, fisheries and forestry) have, however, produced generally fewer results than expected. The AID report entitled, "Sahel Development Program (SDP) Assessment, March 1983" concluded¹:

- o "There was not yet an adequate technological basis for wide-scale direct investment in production projects for development of rain-fed agriculture;
- o Additional effort was required in agricultural research, including farming systems;
- o Continued emphasis on training is required;
- o Institutional development and reform (e.g., parastatals) must be a priority;
- o Policy reform is essential;
- o Investment in irrigation is necessary to achieve the SDP objectives;
- o Livestock development projects are to be limited until there is increased assurance of success;
- o On the whole AID had too many projects underway in too many locations;
- o The effort in forestry and environmental stabilization is inadequate;
- o Strict and continuous financial and general management oversight is critical."

It should be noted that projects supported by other donors and those undertaken by national governments experienced similar difficulties and engendered similar conclusions.

¹"From the draft USAID "Sahel Development Strategy Statement, 1985" prepared by the USAID Sahel Development Planning Team (SDPT), November 1983, page 14."

2. Regional projects

Regional projects are conceptually attractive, but experience has shown that their successful execution is difficult primarily because of administrative and financial difficulties. These problem areas must be overcome for regional projects to be successful. For example, the regulations of donors and African organizations implementing such projects need to be compatible, participating states must make their contributions in a timely fashion, and ways must be found to effectively manage the projects in the very extended isolated areas of the region. Further, regional projects must be responsive to the needs of a group of countries which individually have very different human and physical resources. Project design must also include proper safeguards to assure that funds needed to cover operating costs are adequate over the life of the project.

In spite of these difficulties, in some circumstances regional projects offer significant advantages, particularly as complements to national programs. Some of these are:

- o The synergistic effect of exchanging information and combining collective experience of professionals;
- o The provision of better developed and more specialized educational opportunities within the region;
- o The achievement of economies of scale and efficiency;
- o The avoidance of duplication; and
- o The possibility of working in areas that might be politically sensitive at the national level.

Moreover, a number of agricultural problems facing the region are not bound by political frontiers and need to be dealt with at a regional level. These include: meteorology, plant and animal diseases, weeds and predators, certain aspects of the technology of soils, commercial movements of food stuffs, and quality of seed (acceptability of new varieties, their resistance to drought, and the level and stability of yield). It would therefore be logical for the Sahelian countries to establish a certain degree of complementarity in their national research programs and to participate in regional programs that benefit them all. These advantages and disadvantages have been considered in suggesting the regional programs and activities presented in Chapter III.

II. REGIONAL AGRICULTURAL RESEARCH STRATEGY

A. Objective

The objective of the 20-year agricultural research strategy is to achieve a significant increase in per capita agricultural output greater than the rate of population increase to enhance national food security in the Sahel.

This objective is also stressed in the Lagos Plan of Action of the Organization of African Unity (OAU) which emphasizes the importance and the necessity of developing a strong capability to increase agricultural productivity in Africa to achieve self-sufficiency or self-reliance in food supply. This objective has been endorsed by the CDA donors, the U.N. and the World Bank. The CILSS member countries, the Club du Sahel and the CDA donors have agreed that an essential element in achieving this objective is agriculture research.

Food self-sufficiency needs to be defined in the context of national food security. For some Sahelian countries (those whose current imports are only a small percentage of annual consumption requirements), the goal of food self-sufficiency may well be attainable--for others, the goal of food self-reliance is more realistic. For these countries, (e.g., Senegal), cereal imports are so large that meeting a goal of food self-sufficiency could only be met by taking large quantities of peanuts, cotton and other foreign exchange earning crops out of production and substituting food grains. Therefore the most useful development strategy for the Sahel countries is to seek the goal of economic self-sufficiency. Within this context, food self-reliance can be achieved with a proper mix of crop, livestock, and fish production for domestic consumption and export.

B. Strategy to Increase Agricultural Production in the Sahel

The proposed zonal agricultural research strategy set out below takes a "long view." It is designed to: (1) maximize the effectiveness of agricultural research in the Sahel over the next 20 years in fostering increased agricultural production, and (2) help ensure an independent research capacity on the part of Sahelian agricultural research institutions by the end of a 20 year period. The ten elements of this strategy are shown in Figure 7.

The strategy addresses the key constraints to agricultural productivity in the Sahel as identified in Chapter I. Table 3 indicates how the constraints are addressed by the various strategy elements.

Actions at both national and regional levels will be required to accomplish these objectives. National priorities for agricultural research and development activities will, of course, differ, depending on the particular constraints and opportunities existing in each

Strategy Elements

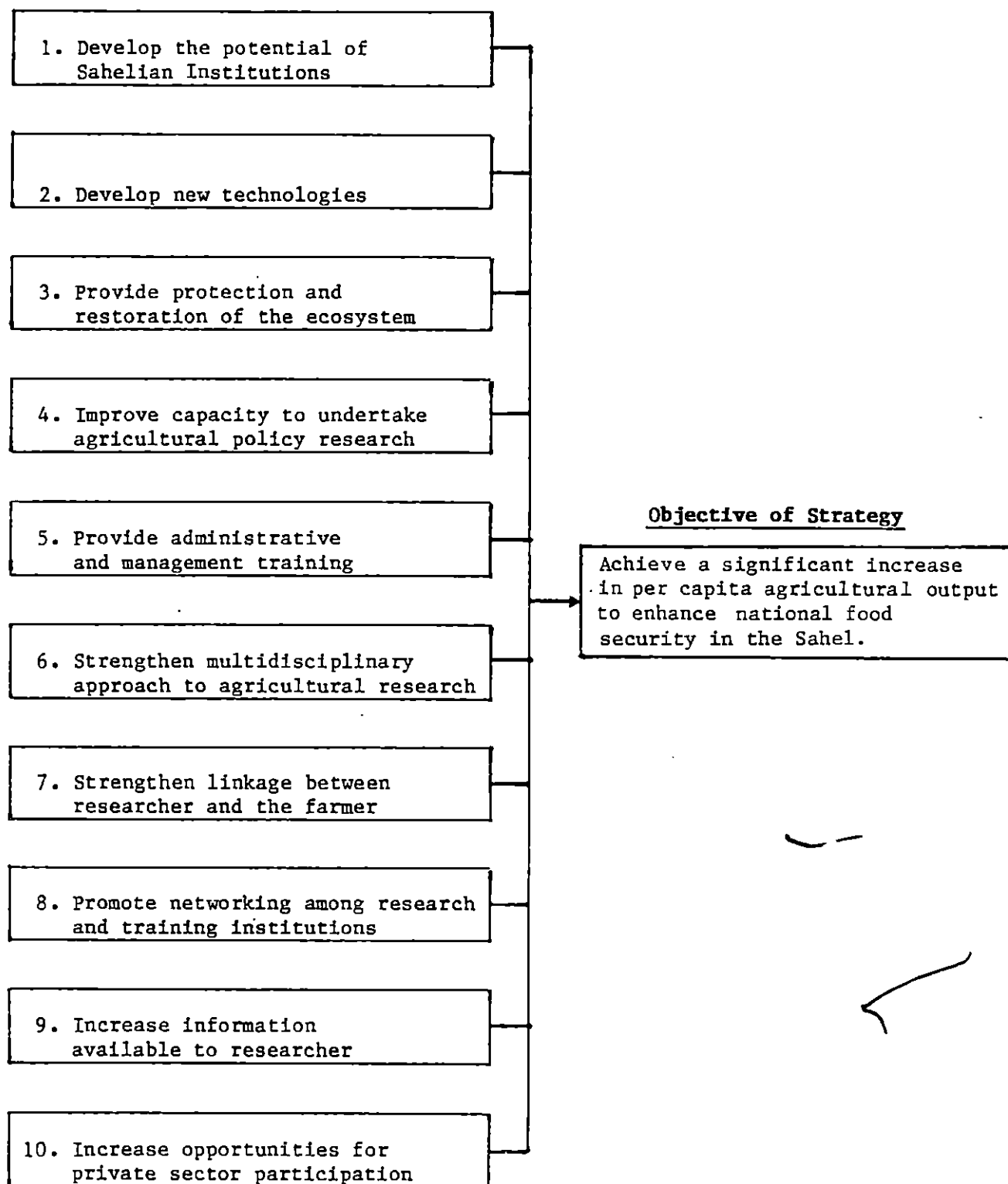


Figure 7: Regional Agricultural Research Strategy for the Sahel

Table 3: Major Constraints to Agricultural Productivity in the Sahel and Principal Elements of Regional Agricultural Strategy to Reduce or Eliminate These Constraints

MAJOR CONSTRAINTS	REGIONAL STRATEGY ELEMENTS									
	Develop the potential of Sahelian institutions Develop new technologies Provide protection and restoration of ecosystem Improve capacity to undertake agricultural policy research Provide administrative and management training Strengthen multidisciplinary approach to agricultural research Strengthen linkage between researcher and the farmer Promote networking among institutions Increase information available to researcher Increase opportunities for private sector participation									
<u>General Constraints</u>										
<u>Direct</u>										
o Insufficient number of well-qualified and experienced researchers and technicians	X			X						
o Inadequate research/extension/farmer linkage						X				
o Inadequate training and/or experience in agricultural research management				X						
o Inadequate communication and exchanges among existing researchers							X		X	
o Lack of appropriate technologies	X									
<u>Indirect</u>										
o Inappropriate agricultural policies				X						
o Price disincentives;				X						
o Deficient infrastructure				X						
o Insufficient agricultural credit				X						
o Insufficient input and service delivery									X	
o Changing urban food tastes	X		X			X				

SOURCE: Data collected from the DEVRES/INSAH Agricultural Research Resource Assessment, 1983.

Table 3: Major Constraints to Agricultural Productivity in the Sahel and Principal Elements of Regional Agricultural Strategy to Reduce or Eliminate These Constraints (cont.)

MAJOR CONSTRAINTS	REGIONAL STRATEGY ELEMENT									
	Develop the potential of Sahelian institutions	Develop new technologies	Provide protection and restoration of ecosystem	Improve capacity to undertake agricultural policy research	Provide administrative and management training	Strengthen multidisciplinary approach to agricultural research	Strengthen linkage between researcher and the farmer	Promote networking among institutions	Increase information available to researcher	Increase opportunities for private sector participation
<u>Constraints to Crop Production</u>										
<u>Direct</u>										
o Rainfall deficiency	X						X	X		
o Crop losses due to plant diseases, weeds, and predators	X					X	X	X		
o Unavailability of needed agricultural inputs			X							X
o Inadequate soil management	X		X		X		X			
o Lack of improved suitable varieties	X									
o Excessive small farmer risks			X			X				
<u>Indirect</u>										
o Limited farming systems approach					X					
<u>Constraints to Livestock Production</u>										
<u>Direct</u>										
o Lack of rainfall for forage and for watering	X	X		X	X	X				
o Insufficient disease control	X				X		X			
o Limited sources for needed animal feed	X	X								

Table 3: Major Constraints to Agricultural Productivity in the Sahel and Principal Elements of Regional Agricultural Strategy to Reduce or Eliminate These Constraints (cont.)

MAJOR CONSTRAINTS		REGIONAL STRATEGY ELEMENT									
		Develop the potential of Sahelian institutions	Develop new technologies	Provide protection and restoration of ecosystem	Improve capacity to undertake agricultural policy research	Provide administrative and management training	Strengthen multidisciplinary approach to agricultural research	Strengthen linkage between researcher and the farmer	Promote networking among institutions	Increase information available to researcher	Increase opportunities for private sector participation
<u>Constraints to Livestock Production (cont.)</u>											
<u>Indirect</u>											
o	Difficult communication with herders						X	X			
o	Socio-traditional factors						X	X			
o	Insufficient integration of farming and livestock production (mixed farming)						X	X			
<u>Constraints to Agro-forestry</u>											
<u>Direct</u>											
o	Limited regeneration because of drought	X	X				X				
o	Demand exceeds production	X	X	X			X				
o	Damaging bush fires		X	X				X			
o	Lack of use of new technology						X	X	X		
<u>Indirect</u>											
o	Tree tenure and land tenure law				X		X				

Table 3: Major Constraints to Agricultural Productivity in the Sahel and Principal Elements of Regional Agricultural Strategy to Reduce or Eliminate These Constraints

MAJOR CONSTRAINTS	REGIONAL STRATEGY ELEMENT
<u>Constraints to Fisheries</u>	<div> <div>Develop the potential of Sahelian institutions</div> <div>Develop new technologies</div> <div>Provide protection and restoration of ecosystems</div> <div>Improve capacity to undertake agricultural policy research</div> <div>Provide administrative and management training</div> <div>Strengthen multidisciplinary approach to agricultural research</div> <div>Strengthen linkage between researcher and the farmer</div> <div>Promote networking among institutions</div> <div>Increase information available to researcher</div> <div>Increase opportunities for private sector participation</div> </div>
<u>Indirect</u>	
o Insufficient earnings for fishermen	X
o Absence of successful cooperatives	X
o Poor equipment	X
o Lack of socioeconomic information	X
o Limited treatment and conservation	X

country. The emphasis in the discussion of each strategic objective is, therefore, placed on the identification of problems which have regional importance and of interventions which could be undertaken at a regional level to support the resolution of these problems at both the national and regional levels.

1. Strategy Element No. 1: Develop the potential of Sahelian institutions

Without sufficiently strong institutions, that is, with the ability to carry out needed agricultural research and to deliver results effectively to farmers, improved agricultural productivity is unlikely to become a reality. Full realization of the internal potential of Sahelian institutions to carry out and deliver effective agricultural research must, therefore, be a major thrust of a CDA program in support of agricultural research.

Training activities are a fundamental part of such strengthening efforts. In all countries, there is a serious lack of qualified, trained personnel (researchers, and technicians and managers) with experience. The number of training institutions in the region offering advanced degrees is extremely small and the variety of degrees available is limited.¹ Without a cadre of highly trained scientists, technicians, and managers, independent research organizations, regional or national, cannot be developed. Currently, most advanced degree training suitable for carrying out agricultural research must be done abroad. In addition, much of the agricultural research work is done or supervised by expatriate technical advisors. Given the necessity of moving ahead rapidly in the field of agricultural research, training abroad and expatriate technical assistance are necessary in the short and medium term. However, in the long term it is essential that Sahelian institutions develop an indigenous capacity to train their own personnel. Plans must be made now to provide the resources (human, technical and financial) needed to develop this capacity for the future. Similarly, additional steps should be taken to create the conditions and to instill in the researcher the professional conscience necessary to build strong institutions.

Ideally, in the long term, most research workers would be trained in their own countries within the sub-region or within the broader geographic area (e.g., West Africa). However, adequate facilities for the specialized training of research workers are, for the most part, unavailable. The curriculum for the first degree tends to emphasize the "known" and does not equip the student to deal with the "unknown"; the latter is usually provided by post-graduate education outside the country. At present, training opportunities in specialized disciplines exist in only a few places in West Africa (e.g., certain programs at the University of Dakar, the tsetse/trypanosomiasis

¹See Table 2-12 in Annex 2, and also Volume II, Summaries of the National Reports, for more details.

regional school at Bobo Dioulasso in Upper Volta, the University of Abidjan, as well as in some faculties in Nigeria).

Creation of a capacity in suitable local institutions to teach the third cycle in the French system would meet a large share of the needs. Within 20 years there will be a number of institutions in the Sahel which could develop the capacity to handle this third cycle. There would need to be, however, some degree of specialization within the countries so that a greater number of disciplines could be studied in the region.

Part of the training required for the staff of the training institutions as well as that of research workers could be included within research projects. This has the advantage of providing support and on-the-job training for the candidate after he/she has completed his/her degree. Chapter III contains specific suggestions regarding proposed training programs.

Strengthening internal management systems at both the professional and technical levels, policy analysis, data base use and management, outreach capability and other elements of existing research training and extension institutions is critical to improving agricultural research and its dissemination to farmers. Chapter III includes specific programs for these areas.

The following regional activities are proposed to help carry out this strategy element:

- o Training of research scientists;
- o Training of research technicians;
- o Strengthening of INSAH's scientific and technical information;
- o Agricultural research policy; and
- o Improvement of agricultural research management.

2. Strategy Element No. 2: Develop new technologies

The lack of appropriate and effective technologies is one of the major problems in increasing per capita agricultural productivity in the Sahel. To remedy this lack, the development of new technologies that increase agricultural productivity and employment opportunities and that are technically, economically, and socially acceptable is a fundamental research task. National efforts to provide appropriate technological packages for crop, livestock, agro-forestry, and fisheries production require stepped-up regional and international support.

National research activities which seem of highest priority when viewed from a regional perspective are summarized by sub-sector in the paragraphs which follow.

a. Crops

The priority for additional research effort in crop production lies in the relationship between soil, water, and plants. While climatic variability and low rainfall characterize the region, rainfed agriculture continues to offer significant opportunities for the development of new technologies. Some 60 hectares of land are under rainfed production for every one hectare being irrigated. Research work should be more sharply focused, as well as generally increased, on rainfed agricultural activities and accompanied by vigorous measures to accelerate use of the research results by the farmer. A narrow emphasis on yield-increasing objectives is not, however, recommended in the area of rainfed cropping, given the necessity of maintaining the environment as well as of increasing production.

There also appears to be a need for more research on the ecological effects of specific agricultural changes. The effects of the application of different fertilizers and cropping systems on different soils, as well as problems of soil erosion, for example, appear to be less urgent in the short-run but are essential for the long-term agricultural development of this environmentally fragile region.

Agronomists have tended to concentrate on measuring the results of new technology in terms of yields per hectare. However, farmers measure the results and base their adoption of practices on the returns (in crop products and by-products) to their most scarce resource; often, this resource has been identified as labor, particularly at weeding time. Thus, over the medium to long-term, there is a real need to study labor-saving technologies for planting, fertilizing and weeding. Farming systems research (FSR) is likely to play an important role in such research. FSR would permit, for example, mechanization (usually by animal traction) and spraying of herbicides using ultra low volume sprayers. It is essential to find profitable ways for farmers, with different levels of managerial ability, to intensify their crop production.

Irrigation technologies are also important. Although the results of many investments in irrigation, in part through river basin development programs, have been disappointing, potential for improvement exists and should be exploited. Research is needed to identify packages of technologies and practices that: incorporate more cost-effective irrigation system development; encourage self-management of irrigation systems by farmers, including farmer control of the water distribution; stimulate production of higher value crops and more effective use of existing irrigated perimeters; address problems of combining irrigated farming with the other systems of

production (rainfed crop production, livestock and fishing); and foster additional diversification of irrigated production (i.e., growing crops in addition to rice).

b. Livestock

It is important that research be directed at improving animal health, improved breeding and to pasture and fodder development with the objective of increased production of both meat and milk. Without production technology changes based upon such research, further development of livestock production in the Sahelian region may be difficult, if not impossible, to achieve at a reasonable cost. The results of livestock interventions have been generally modest and, in some cases, disappointing. Recent outbreaks of rinderpest, for example, have indicated that the countries in the region have neither the means nor the capacity to administer the prophylaxis. Despite these problems, however, attaining greater production in the Sudanian region in particular, by overcoming certain constraints (e.g., trypanosomiasis) is feasible. Thus, programs of research, emphasizing a combination of disease control, improved breeding and fodder development are needed for the development of livestock in the region.

c. Forestry

In this sub-sector, priority activities are likely to be further work on fast-growing species, on the protection and development of natural forests, and on the conservation and restoration of soils. In addition, a better understanding of natural vegetation patterns will contribute to the design of forestry and environmental interventions and to combatting desertification.

The effect of the demand for firewood on the environment is well known but so far no solution is apparent. Attempts to increase production, particularly with exotic species, have not been generally successful. Few Sahelian countries have yet established an adequate research program on this subject. Currently, national research programs include relatively few projects on reforestation, erosion control and reclamation, even though there is some knowledge of what may work in the Sudanian zone. More research is needed on the firewood substitute question which is important for cooking and for drying of fish. Also, there is need for socio-economic research to better define technical interventions which will be fully acceptable to the rural population.

d. Fisheries

Although the fisheries sector is fairly well-developed in half of the CILSS member countries, only one country has a substantial fisheries research program. A better understanding of the biology of different species and fish population dynamics is needed. There are also a number of problems in the fisheries area including

the lack of use of insecticides to conserve dried or smoked fish and the overfishing of the inland waters. In several countries there is interest in aquaculture. Research is needed to develop viable technical and economic systems that fit in with the socioeconomy of the people. Research is also needed on which to base inland fisheries, the development of new lakes (e.g., at Diama and Manantali) and on the socioeconomics of fishing. Research efforts on the protection of fisheries resources and on commercialisation of fish are also needed.

The following regional activities are proposed to help carry out this strategy element:

- o Production and utilization of firewood;
- o Technology and processing of foodgrains;
- o Bovine pathology;
- o Small ruminants network;
- o Animal breeding in the Tsetse-infested Sudanian zone;
- o Improvement of the Azawak breed; and
- o Small-scale mechanization in agriculture.

The networking activities covering foodgrains, soil and water, fisheries, farming systems, etc. will also contribute to the development of new appropriate technologies. (Strategy element No. 8 which follows later in this chapter contains further information on networking.)

3. Strategy Element No. 3: Provide protection and restoration of the ecosystem

Several important environmental problems have been shown to constrain agricultural productivity and output in the Sahel at present. These include, but are not limited to, the Sahel's dwindling firewood supply with the attendant destruction of forest and brush land in wide areas of the region, overgrazing by a cattle population that is too large for the natural resource base of many areas in the region, and over-utilization of fragile agricultural soils in both irrigated and dryland cropping resulting in declining yields on such soils. These and similar problems are most acute in areas where rainfall is 600 mm or less.

Efforts to solve these problems are meager and the results of environmental projects have been disappointing. Moreover, to date, little research has been carried out to define these problems and identify solutions. If more research work is not done to resolve these problems now, they will become even more important constraints

to agricultural output in the future. They may even turn out to be the ultimate constraints to increases in agricultural productivity in the Sahel during the next 20 years.

The ability of the Sahelian countries to support their population depends upon the quality of the long-term management of the Sahel ecosystem. As population pressure increases, and as population becomes concentrated in expanding urban settings, the effect of increased pressure on the environment becomes very apparent.

One of several urgent environmental problems is the dwindling firewood supply and the resultant destruction of woody species around urban areas taking place for hundreds of square kilometers. Governments are almost powerless to stop this degradation or to counteract it adequately by new plantings or forest management. Recently the FAO has stated a series of statistics on wood production in the Sahel, classified as fuel or firewood, charcoal and poles. There are no data for the Cape Verde Islands. The rate of increase shown in consumption of firewood is about 2.5 percent a year, approximately equal to the rate of increase in population.

Since the amount of land available for tree planting is limited and the programs to increase productivity and production have only been marginally successful on a limited scale, this growth in population and consumption is putting increasing pressure on existing wood supplies, and points up the urgency of finding ways to increase firewood production dramatically or find suitable economically viable substitutes.

Table 4 documents the modest growth rate in firewood production cited above. Of the eight members of CILSS, five (Chad, Mali, Niger, Senegal and Upper Volta) have significant wood production. Gambia's production is small but important given the size of the country. Mauritania's production is very small, and data are not available for Cape Verde which is very minor. An FAO study conducted several years ago showed that in some areas of West Africa the cost of heating the meal was more expensive than the ingredients.

Natural forest management should be explored further drawing on the national projects (for example, in Niger and Upper Volta). Some institutions need to be built at the national and regional levels to plan the utilization and management of national forest resources. Assistance is needed for public sector resource administration and management, forestry economics, and monitoring and evaluating environmental change.

Each of the CILSS countries has a forestry research organization, but thus far the results have been modest. The most well-endowed with personnel is INRZFH in Mali, whereas the most substantial operating budgets are in Senegal and Upper Volta. Although there have been considerable donor investments in this area, results have been limited to date. Replanting, village plantations and other interventions have

Table 4: Wood Production in Sahelian Countries

<u>Country</u>	<u>Fuelwood</u>				<u>Charcoal</u>				<u>Roundwood¹</u>			
	<u>1974-76</u>	<u>1980</u> (000 m ³)	<u>1981</u>	<u>1982</u>	<u>1974-76</u>	<u>1980</u> (000 MT)	<u>1981</u>	<u>1982</u>	<u>1974-76</u>	<u>1980</u> (000 M)	<u>1981</u>	<u>1982</u>
Cape Verde Islands	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chad	6,473	7,181	7,324	7,435	298	334	340	340	404	450	459	459
Gambia	766	870	888	905	32	35	35	35	10	10	10	10
Mali	3,420	3,917	4,027	4,141	NA	NA	NA	NA	238	269	276	276
Mauritania	6	6	7	7	NA	NA	NA	NA	39	44	45	45
Niger	2,768	3,199	3,296	3,396	NA	NA	NA	NA	184	211	217	217
Senegal	2,837	3,200	3,280	3,353	92	100	102	102	417	481	493	493
Upper Volta	<u>5,615</u>	<u>6,424</u>	<u>6,594</u>	<u>6,788</u>	<u>13</u>	<u>22</u>	<u>22</u>	<u>22</u>	<u>452</u>	<u>305</u>	<u>313</u>	<u>313</u>
Total	<u>21,885</u>	<u>24,797</u>	<u>25,415</u>	<u>26,005</u>	<u>405</u>	<u>491</u>	<u>499</u>	<u>499</u>	<u>1,744</u>	<u>1,770</u>	<u>1,813</u>	<u>1,813</u>

¹ Roundwood is actually "poles". It probably does not include bamboo, sawn wood or palm tree trunks.

Source: FAO, Monthly Bulletin of Statistics and Economics (Rome: FAO, November, 1983).

had little impact on the problem. Natural forests and plantations of local species show more promise than the use of exotic (imported) species.

As important as the whole firewood/forest resource problem is, an equally important environmental problem is inadequate soil and water conservation and management. Some individuals surveyed feel this is the most important environmental problem in the Sahel. Environmental protection and rehabilitation in the Sahel must be the result of ecologically-sound sustainable systems of agricultural production. The lack of such systems in the areas of soil and water use stands as one of the key problems, particularly in the areas of high population density. Plans are underway to give serious attention to this problem in the Mossi Plateau (Upper Volta) and the Groundnut Basin (Senegal). It is appropriate that these and other soil and water conservation activities be funneled, to the greatest extent possible, through agricultural institutions. Foresters can then be called upon to provide technical guidance on the use of vegetative cover to promote the broader soil and water conservation and management goals of such activities.

Given the vastness and complexity of these and other environmental problems in the Sahelian countries, it is essential that research priorities be established in this area, followed by building the infrastructure necessary to do the research. To set the stage for a major supplemental effort to present activities, an inventory of research work should be prepared. The French cooperation with GERDAT (CTFT and IEMVT) documentation and resources will be of great assistance. INSAH would need to be closely involved to assure the necessary Sahel-wide coordination. Since the Sahelian countries are just now beginning to seriously consider coordinated activities in this sector, it would be useful to consider a multidisciplinary committee of researchers who could exchange views, interact and propose activities. This sector has an especially acute shortage of trained experienced personnel (except perhaps in Mali where there is university level training).

In the longer term perspective, concern has been expressed over the uncertainty of whether the current period of dryness in the Sahel is cyclical, or represents a fundamental change in the climate of the Sahelian region. Research is essential to answer this question as well as to specify actions that need to be taken to combat desertification effectively, whatever its cause. For example, decisions about the appropriate extent of dependence on rainfed crops could be affected by the results of this research. Likewise, the development of hydrological models on the major river basins will be seriously affected by the outcome of such research. For this reason, a research project on climatology is included to carry out this strategy element.

While protection and restoration of the ecosystem is clearly an area of concern where local initiatives and conditions will predominate, it is also one where more regional research is required and where all countries will benefit from sharing the results of this research. The research programs in this area should be broad-based and should include foresters, environmentalists, wood technologists, economists and sociologists, in order to develop coordinated programs for which the CILSS countries and INSAH might seek financing. Priority should be given to natural forest development and management, soil and water conservation, and the interface between forestry and agriculture.

The following regional projects are proposed to help carry out this strategy element:

- o Climatology studies;
- o Farming systems research network;
- o Production and utilization of firewood; and
- o Restoration of the Sahelian ecosystem.

4. Strategy Element No. 4: Improve capacity to undertake agricultural policy research

There is an urgent need to improve the capacity of institutions in the Sahel to carry out agricultural policy research to provide information on which to base national and regional decisions affecting aggregate and per capita agricultural productivity. For example, certain aspects of agricultural policy pose serious constraints to improved agricultural production in the Sahelian region. These include:

- o Farm prices that for the most part do not encourage the farmer to produce a marketable surplus of food grains;
- o Input costs that are too high in relation to the prices of output;
- o Official prices that may be announced after the crops have been planted, preventing farmers from considering this important factor in their decision-making;
- o Agricultural credit that is largely unavailable to farmers; and
- o Absence of a special status for agricultural research professionals.

Most research on such policy issues is appropriately undertaken at the national level as political factors are generally important elements of the analysis. However, some governments do not have the

in-house capacity to carry out the kind of detailed agricultural policy research that is necessary. For example, agricultural policy research is just beginning in Senegal, Upper Volta, Niger while others are doing virtually none at all. A regional policy research program in a broader area (the West African Semi-Arid Tropics) has been initiated by IFPRI, ICRISAT, and GERDAT, with collaboration from CIRES, ISRA, and CEDRES. However, there is need for more multi-country or regional activity on some policy issues to enable individual countries to benefit from the experience of their neighbors and to resolve issues with regional import. A new regional activity, for example, would permit researchers in the units which have started policy research to help those which have not yet started and allow both groups to benefit from each other's experience.

Assistance with agricultural policy research may be needed because agricultural policies are interactive and complex, requiring, often, considerable sophistication in data collection and analysis. For example, to assess the impact of agricultural price policies on production, a determination must be made as to the farmers' responsiveness to prices and to the impact of other factors such as agricultural credit and input subsidies which also affect the farmers' responsiveness.

The ability to develop and combine effective policy responses appropriate for these and many other intertwined issues is critical to agricultural development in the Sahel. Thus, further agricultural policy research work is needed in these and many other areas to provide government policy makers with adequate information on which to make decisions affecting agricultural production and long-term agricultural and economic growth.

The following regional projects are proposed to help carry out this strategy element:

- o Agricultural research policy;
- o Strengthening INSAH's scientific and technical information; and
- o Improvement of agricultural statistics.

5. Strategy Element No. 5: Provide administrative and management training

The lack of administrative and management capability in the field of agricultural research has been one of the serious constraints to designing and carrying out research programs and projects in the Sahel. Personnel designated to become heads of research departments and institutions are often selected for their research success rather than for their management skills. In addition, support skills, such as those in finance, budget and personnel management, are very limited in the Sahel. This has led to poor record-keeping, procurement, and other operational procedures that have hindered the

actual operation of the research program. (For example, in a few cases, donors have withheld funds from recipients pending receipt of necessary administrative information.) Thus, supervisory personnel of institutions involved in the development, adaptation and dissemination of agricultural research results need administrative and management training as well as technical capability in order to carry out effective research programs.

Another kind of management constraint has been in the planning and establishment of research priorities. With limited human, material, and financial resources, training in the techniques and methods of establishing research priorities has become very important. With no systematic method of establishing research priorities, research efforts have been dissipated and vital resources have not been available when needed.

The lack of adequate administrative and management capacity in agricultural research, training and extension institutions has been recognized and some measures are already underway. For example, on a regional basis, a project known as AGIR (Agricultural Research Management Improvement) has been recently started by CILSS. ISNAR, which specializes in the management of agricultural research, is also working on research management in Africa under an AID-financed contract. These efforts are significant but not sufficient.

In fact, the importance of an intensive effort to improve the administration of existing research, training and extension efforts and to define and focus more objectively and effectively agricultural research priorities cannot be overstressed. This is both an immediate and long-term priority. In addition to actions which should be taken in the near term, longer-term plans need to be made to ensure that during the next 20 years countries of the Sahel will have an indigenous capacity to provide administrative and management training focused on agricultural research, training and extension institutions.

The following regional projects are proposed to help carry out this strategy element:

- o Improvement of agricultural research management; and
 - o Training of research scientists.
6. Strategy Element No. 6: Strengthen multidisciplinary approach to agricultural research

The compartmentalized, single disciplinary approach to agricultural research in the Sahel is an important constraint to the development of widely useful agricultural technologies and, thus, to increasing production. Traditionally, research has been conducted in a single discipline (e.g., plant breeding, livestock, or soil fertility, etc.) and has ignored other aspects of the agricultural production context which would enable the results of the research to

make an appreciable difference in agricultural productivity. To better account for these other aspects affecting agricultural productivity there is need for off-station research in which entire packages of technologies and practices are put together and related to other crops and/or livestock in association and rotation. A well-designed multidisciplinary activity provides these skills and assures that all the elements are available for a realistic test of the value of the agricultural research in the field.

Only in Senegal has the multidisciplinary approach made much progress. There the single discipline method has been changed to a more multidisciplinary approach to meet regional needs within the country and to build commodity (crop) programs and farming systems research. For example, a team is assigned to a commodity (e.g., millet, sorghum or maize) and research includes breeding, cultural practices, pest and disease management and other multidisciplinary foci.

The use of more multidisciplinary teams in Sahelian agricultural research will require specific action by donors and country governments. For example, a commitment to use more social scientists in agricultural research will be necessary. However, the assessment of agricultural research indicated that the number of agricultural economists, sociologists, anthropologists and other social scientists in the Sahel is small. Thus, action must also be taken to train more social scientists and to guide them into agricultural research activities. Likewise, support of a much expanded dialogue between biological, engineering and social scientists is needed. Often located in different institutions and responsible to different ministries, these professionals in various but relevant disciplines need to be focused simultaneously on the same problems so as to integrate all the "single" discipline solutions posed for solving them.

Two examples help illustrate the importance of this strategy element: First, there is a substantial regional Sahelian effort in pest control on crops and on integrated pest management (IPM). Yet, there appears to have been no serious effort to define indigenous knowledge of crop pests and diseases and the adaptive strategies farmers use in their own "system" of IPM. This is an area where a multidisciplinary approach would be helpful. Second, there has been research on the role of women in agriculture in the region. However, the results of this research have not been integrated with agronomic or extension research to identify problems or to prioritize research needs. A dialogue between the biologists and social scientists doing the research on women would help bring these two strands of agricultural research together.

Given the complexity of, and interrelationships among, these technical, social and economic factors, and the interdisciplinary requirements of much of the research concerning them, it is likely that the increased availability of inexpensive micro-computers will be

useful in providing additional national and regional analytical capacity for agricultural research institutions. There are already specialized computer programs on the market for the design, management and analysis of agronomic and similar types of experiments (e.g., livestock, fisheries, forestry); there are also statistical packages for the analysis of surveys as used in farming systems research and much social science research. Many standard programs for general data base management are also available. Introducing these, and the capacity to use them, to Sahelian researchers now will not only lead to improved efficiency and general performance in the short run, it will also help ensure that researchers and research institutions do not fall even further behind in the use of this important technology to spur their agricultural progress.

The following regional projects are proposed to help carry out this strategy element:

- o Farming systems research network;
 - o Training of research scientists; and
 - o Women in agricultural production.
7. Strategy Element No. 7: Strengthen linkages between the researcher and the farmer

At present a major constraint is posed by poor linkages between researchers, extension services, and farmers. The development of the essential two-way interaction between the agricultural researcher and the farmer by strengthening the functional capability of the public and private entities which link the two is a high priority strategic objective. Farmer output levels are reduced not only because of information dissemination problems, but also because farmers do not--and, in many cases, can not--use the information they receive. The information/technology being promulgated must not only be technically feasible, but also must be economically beneficial and socially acceptable to farmers before they will actually use it.

The research results that farmers could use include improved varieties, more efficient cultivation practices, methods of disease prevention or eradication, better storage, improved ration formulation for livestock and poultry and much more. While these results are often found nationally and then attuned to the local situation, researchers, extension workers and farmer's representatives also could benefit from "regional" exchanges of experience about how to achieve effective dissemination and utilization of research results.

The risk level imposed on the farmer by these new methods and technologies, however, must be minimal. Because of the substantial risks which already exist because of the limited amounts and uncertain distribution of rainfall, pests and other natural factors, farmers often cannot afford to take on additional financial or technical

risks. For example, the introduction of new varieties or techniques which require additional labor or special training constitutes an additional risk for the farmers on their own fields despite the verbal assurance of an extension agent that the new technique produced a significantly higher yield on the research station. There are also downstream considerations, such as the resistance of new varieties of crops to disease or pests, the ability to market the surplus at a fair price, and the effects on consumers should the new variety have a different taste or be harder to mill.

To be successful, a new variety, technology or practice must be communicated intelligently to farmers in the context of their own farming systems. The linkage must also provide for a two-way interaction so that the researcher or station is informed of field difficulties in a manner that can be understood and acted upon by the researcher. In this regard, the ability of the extension service to provide an effective link between the research station and the farmer should be strengthened. Programs should be developed for the technical training and upgrading of extension supervisors so that they can communicate intelligently with the researchers.

Extension supervisors should also be provided with sociological/training skills in order to be able to help their extension staff in communicating with farmers and understanding their problems. This combination of technical and social science skills on the part of the extension supervisors would enable them to complete the link between farmers and the station-based researchers by passing this information on to the researchers in a form which everyone can understand.

The following regional projects are proposed to help carry out this strategy element:

- o Farming systems research network;
- o Dissemination of applied agricultural research results; and
- o Women in agricultural production.

8. Strategy Element No. 8: Promote networking among research and training institutions

Current agricultural research suffers from a lack of communication among Sahelian research and training institutions. Vigorous networking among agricultural researchers is one way of overcoming the constraint to carrying out and delivering effective agricultural research which derives from the presently limited number of highly-qualified researchers in the region. Efforts to promote networking among agricultural researchers, both in and outside the Sahel, is a high priority element of this overall regional agricultural research strategy. Some networking already exists in the Sahel. For example, INSAH already holds regular meetings of research and development workers to review existing research and to suggest

other research and activities. This and other formal and informal groups have proven their usefulness. However, much needs to be done to strengthen these existing networks and to establish others in critical areas.

Networking would help to optimize human and natural resource utilization by more closely linking the national, regional and international agricultural research and training institutions and efforts. Intellectual interchange among researchers in their respective fields stimulates new ideas and creative solutions to difficult and complex problems and avoids pitfalls already encountered. Exchanging information on work already underway can speed research and avoid duplication of effort. Networking also can enhance professional development by facilitating contacts among more junior and senior professionals. By drawing on the more active or stronger research centers, networking can ensure a quality exchange of information, thereby increasing the value of research outputs and the rate and degree of adoption of the research results.

Examples of existing Sahelian agricultural research networks and areas in which new networks would be desirable are described briefly below. Over the next 20 years, networking requirements not mentioned here will surely become important as well.

- o Foodgrain networks: Regional crop research networks already in operation are the INSAH program for millet, sorghum, cowpeas, and maize financed by the European Development Fund (FED) and the OAU/SAFGRAD program for food grains financed by AID and other donors;
- o Farming systems research network: Research on farming systems has been going on for several years in Upper Volta and is beginning in a number of the other Sahelian countries. Given the growing importance of this multidisciplinary research approach in the region, either a revitalized farming systems research network for West Africa or a new one for the Sahel alone is needed;
- o Peanut network: Peanuts are an important cash crop and an exchange of information should make research more effective, avoid duplication, and permit researchers to learn from each other. Research is underway in four of the CILSS countries and in Nigeria and Cameroon;
- o Fisheries network: Although fish is an important source of protein for the sub-region, relatively little research activity is underway. A network is needed to promote the exchange of results from what little research is being carried on;

- o Small ruminants network: Surveys confirm the importance of small ruminants in the Sahel. A number of research programs are underway in the Sahelian countries and could be made more effective by more active use of networking;
- o Soil fertility and soil and water research network: All countries have a big stake in successfully managing their soil, water and plant resources. More and more countries are beginning to treat this as an interdisciplinary effort and networking could be particularly effective in fostering useful information exchange. Research is needed to increase the efficiency of use of rainfall (e.g., reducing run-off) and to overcome constraints associated with fertilizer use, such as weeds; and
- o Women in agricultural production network: The role of women in agriculture has begun to claim the attention of researchers in some of the Sahelian countries. Extension services, however, have taken little explicit note of women as farmers. Yet as more rural men migrate to urban areas, women have assumed additional responsibilities on the farm. Issues of access to agricultural credit, to advice from the extension service, training in irrigated agriculture, etc. merit more attention. Moreover, while the educational systems generally provide education and training in agriculture for the male population, training in these skills is less available or utilized by women. A network including both researchers and extension personnel would enhance the exchange of information on the different aspects of women's role in agriculture and help to focus research on critical issues.

The expense of network strengthening and support efforts need not be large. For example, relatively modest amounts of assistance by donors could finance annual meetings, provide for a technical journal, permit the exchange of scientific information, furnish an opportunity for network members to publish, allow participation in inter-station visits, cover costs of short term training at member institutions, and make possible evaluation of on-going work. The exact combination of networking activities would vary according to the network and its members' interests.

The regional activities proposed to start, or to strengthen, agricultural research networks include:

- o Farming systems research network;
- o Foodgrains and cowpeas research network;
- o Soil fertility and soil and water research network;

- o Fisheries research network;
- o Peanut research network;
- o Women in agricultural production; and
- o Small ruminants research.

In addition, regional support activities in the following areas are also proposed to contribute to achievement of the strategic objective of increased professional communication through networking:

- o Improvement of agricultural statistics;
- o Strengthening INSAH's scientific and technical information; and
- o Research on irrigated crops.

9. Strategy Element No. 9: Increase information available to researcher

Access by the researcher to suitable, up-to-date research documentation is one of the most important and intractable agricultural research problems in the Sahel. As long as communication facilities remain limited in the region, access to detailed, accurate and timely research information in printed form remains an essential tool of agricultural researchers in the design of projects, in professional training, and as a means of reducing duplication and raising the quality of research. It also relieves what researchers call "scientific isolation". Thus, it is important to improve research efficiency by increasing the quality and quantity of information available to researchers and by increasing the researchers' awareness and use of it.

The solution to the problem of a lack of timely research documentation can be divided into two parts: (a) the development of a central national agricultural or agricultural research library, and (b) the supply of key books, documents and journals to research stations and to extension and teaching institutions publishing scientific reviews. Additionally, the development of a professional journal would provide an opportunity for publication to scientists in the region. INSAH already produces a periodical, Profiles SQR, as well as a newsletter for specialists in integrated pest management. Technical meetings to discuss the information are needed, but they can probably be held within the framework of the specific networks.

The task of maintaining a quality, central library and a series of small collections in stations plus an interstation document loan system is complex and difficult, especially with existing budgetary constraints and the increasing cost of books and journals. INSAH has a scientific and technical documentation and information network

(RESADOC). RESADOC has a mandate to provide available documentation to the Sahelian institutions. While there have been delays in installing RESADOC's microcomputer system and making it operational, these tasks seem to have been completed and the major task of entering the catalog has started. Still in its start-up stage, the system has not been utilized very much. However, with the increased competence that will come from experience and expanded knowledge of its existence and capabilities, RESADOC will be an important element of Sahelian researchers' information flow.

INSAH/RESADOC plans to set up a data bank on agricultural research institutions and research programs and projects. This activity will use the data base from the survey done under this agricultural assessment project. For example, it will make it possible for a researcher to question the data bank and receive information on other projects on a similar subject in the region. RESADOC also proposes to organize a "current awareness" service, which would inform research workers and others of newly catalogued publications whose subject matter falls within an individually agreed profile of interest. Publications of interest to the individual or the institution could be provided and shipped at low cost on microfiches while copies of the original document would remain at RESADOC.

Some other work is also already underway. The French Cooperation Program (FAC) is helping to organize or reorganize some national agricultural research libraries. GERDAT and ORSTOM have the most important collections of relevant documents in existence. The collections are being microfilmed and indexed.

GERDAT has a substantial documentation service with an inventory of the research work that has been undertaken in the past. The GERDAT information should be made available to Sahelian research and planning institutions, especially INSAH/RESADOC. This would be of great value in identifying research already done. Such information is essential in preparing for new research projects because it helps researchers avoid duplication and to build on work already completed.

These and similar support services are vital to increasing the output of the Sahelian research effort and in using existing resources more effectively. Donor assistance will be required over the short- to medium-term to help with this series of activities.

The following regional activities are proposed to help carry out this strategy element:

- o Strengthening INSAH's scientific and technical information;
- o Planning and analysis of agronomic experiments; and
- o Research networks.

10. Strategy Element No. 10: Increase opportunities for private sector participation

The provision of increased opportunities for the participation of private business in delivering inputs and in the marketing, processing and distribution of agricultural commodities could contribute to more efficient agricultural production. For example, one of the constraints inhibiting agricultural production has been the inability of some government organizations to deliver inputs in a timely fashion or to provide the necessary training and backup support for the use of new kinds of equipment, fertilizers, pesticides, and other products. These are areas where the private sector could provide support. Also, some Sahelian governments have shown a growing inclination to allow the private sector to participate more actively in the rural areas in providing services and in the sale and distribution of inputs on a timely basis. Senegal has already taken some preliminary steps in this direction for fertilizers, peanut seed and other inputs as well as in the marketing of output. Other efforts are still needed. For example, local blacksmiths who do much of the repair for existing tools and farm equipment could be encouraged to market and service new tools.

The private sector also could play a more active role in the research and development of appropriate commercial technology such as the creation of a more productive and functional harness for animal traction or simple milling machines for millet flour. In forestry, there are opportunities for providing seedlings and for processing forestry products. In fisheries, products for the conservation of fish and protection against insect loss could be provided by private sector entities.

Regional meetings and a further exchange of information on this important subject should help identify the major areas suitable for study. Two possible study areas are: (1) the determination of areas and the development of guidelines for turning over to the private sector some activities that are now the responsibility of the government; and (2) joint consideration by business and farmers of the responsibilities of business vis-à-vis the farming community. A regional meeting also might be convened to focus on how the private sector might better support agricultural research generally.

The following regional projects are proposed to help carry out this strategy element:

- o Private sector participation; and
- o Small-scale mechanization in agriculture.

III. REGIONAL PROGRAMS AND ACTIVITIES FOR THE SAHEL, 1985-2005

A. Overview

The 27 regional programs and activities proposed to carry out the agriculture research strategy in Chapter II have been identified and selected from a large number of possible actions that might be taken by the countries in the Sahel as they work together to achieve the objective of increasing per capita agricultural production by strengthening national agricultural research programs. They are designed, individually and collectively, to help achieve each of the ten elements in the Chapter II strategy to strengthen agricultural research. Table 5 indicates the relationship between the strategy elements and the proposed programs and activities.

These regional programs and actions complement national programs. They act as a catalyst to fill in gaps where no national agricultural research activity is under way as yet. As regional programs and activities, they also help achieve economies of scale, reduce the risk associated with agricultural research efforts at the country level, develop synergistic effects between researchers and technicians working together and avoid duplication. Each program or activity is described in a one or two page description which explains the program idea or activity utilizing a common format: Background, Objectives, Suggested Approach and Expected Results.

B. Procedure and Criteria for Selection of Regional Programs and Activities

The following steps were followed in selecting the regional programs and activities:

- o Conduct of field work in eight Sahelian countries to assist in the preparation of country-wide agricultural research resource assessments, an element of which was to identify potential regional agricultural research needs and programs.
- o Examination of the country assessments, invitation of suggested regional program ideas from bilateral and international researchers and developers, and review of additional documentation from multiple sources. (See Table 2-10, Annex 2 for a listing of current national agricultural research programs by country);
- o Determination of principal regional constraints. (See Chapter I, Table 1);

Table 5: Programs and Activities that Carry Out Each of the Regional Agricultural Research Strategy Elements

Programs and Activities ^a	Strategy Elements									
	Develop the potential of Sahelian institutions	Develop new technologies	Provide protection and restoration of ecosystem	Improve capacity to undertake agricultural policy research	Provide administrative and management training	Strengthen multidisciplinary approach to agricultural research	Strengthen linkage between researcher and the farmer	Promote networking among institutions	Increase information available to researcher	Increase opportunities for private sector participation
<u>Research Networks</u>										
1. Foodgrains and cowpeas research network							X	X		
2. Farming systems research network		X			X	X	X	X		
3. Soil fertility and soil and water research network							X	X		
4. Fisheries research network							X	X		
5. Research on irrigated crops							X	X		
6. Peanut research network							X	X		
7. Small ruminants network	X						X	X		
<u>Training Programs</u>										
8. Training of research scientists	X			X	X					
9. Training of research technicians	X									
10. Improvement of agricultural research management	X			X						

^aThe descriptions of programs and activities listed in this table are contained in Chapter III, Section E and are numbered as shown in this table.

Table 5: Programs and Activities That Carry Out Each of the Regional Agricultural Research Strategy Programs (cont.)

Programs and Activities	Strategy Elements									
	Develop the potential of Sahelian institutions	Develop new technologies	Provide protection and restoration of ecosystem	Improve capacity to undertake agricultural policy research	Provide administrative and management training	Strengthen multidisciplinary approach to agricultural research	Strengthen linkage between researcher and the farmer	Promote networking among institutions	Increase information available to researcher	Increase opportunities for private sector participation
<u>Research Support Services</u>										
11. Strengthening INSAH's scientific and technical information	X		X					X	X	
12. Dissemination of applied agricultural research results							X			
13. Planning and analysis of agronomic experiments										X
14. Improvement of agricultural statistics				X				X		
15. Private sector participation										
16. Creating a regional phyto-genetic resource center	X									X
17. Creating a regional center for introduction and quarantine of plants	X									

Table 5: Programs and Activities That Carry Out Each of the Regional Agricultural Research Strategy Programs (cont.)

Programs and Activities	Strategy Elements									
	Develop the potential of Sahelian institutions	Develop new technologies	Provide protection and restoration of ecosystem	Improve capacity to undertake agricultural policy research	Provide administrative and management training	Strengthen multidisciplinary approach to agricultural research	Strengthen linkage between researcher and the farmer	Promote networking among institutions	Increase information available to researcher	Increase opportunities for private sector participation
Research Programs										
18. Agricultural research policy	X			X						
19. Production and utilization of firewood		X	X							
20. Women in agricultural production						X	X	X		
21. Technology and processing of foodgrains		X								
22. Bovine pathology		X								
23. Small-scale mechanization in agriculture		X								X
24. Climatology studies			X						X	
25. Restoration of the Sahelian ecosystem			X						X	
26. Improvement of the Azawak breed		X								
27. Animal breeding in the Tsetse-infested Sudanian zone		X								

- o Selection of specific strategies needed to reduce constraints. (See Chapter II);
- o Selection of individual regional/program activities needed to implement the strategy, so as to achieve the substantial increase in per capita agricultural production needed. (See Table 5 and Section E below); and
- o Preparation of a priority/time table establishing program priorities and starting dates. (See Table 6).

C. Priorities for Action

The regional programs and activities that follow have been assigned priorities in terms of both importance and timing as seen in Table 6. The ranking in terms of timing is designed to deal with the reality that all 27 projects can not realistically be undertaken at one time. A further selectivity among projects for initial implementation purposes is possible based upon the priority given them in terms of level of importance.

In establishing these priorities and assigning time frames for carrying out regional programs and activities, the following criteria were used:

- o Potential for successful outcomes/outputs and general level of importance;
- o Compatability with development sequence requirements;
- o Existence of host country(s) capabilities;
- o Potential for donor interest and funding;
- o Likelihood of realizing desired long-term consequences;
- o Reasonableness of scope and cost; and
- o Potential for rapid start-up.

\ The prioritization of the programs and activities should not be construed as an "options" list. All, or nearly all, of the programs should be initiated in the next five to seven years if the strategy for achieving the objective of increasing per capita agricultural production more rapidly than population growth is to be successful

*Use
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Table
6.*

Table 6: Prioritization of Regional Programs and Activities by Start-up Date and Level of Priority

<u>Level of priority^a</u>	<u>Start in 1984-85</u>	<u>Start in 1986 or later</u>
First Level	Foodgrains and cowpeas research network (1)	Soil fertility and soil and water research network (3)
	Farming systems research network (2)	Fisheries research network (4)
	Training of research scientists (8)	Research on irrigated crops (5)
	Training of research technicians (9)	Dissemination of applied agricultural research results (12)
	Women in agricultural production (20)	Technology and processing of food grains (21)
	Improvement of agricultural research management (10)	
	Strengthening INSAH's scientific and technical information (11)	
	Agricultural research policy (18)	
	Production and utilization of firewood (19)	
Second Level	Peanut research network (6)	Private sector participation (15)
	Small ruminants network (7)	Creating a regional phytogenetic resource center (16)
	Planning and analysis of agronomic experiments (13)	Creating a regional center for introduction and quarantine of plants (17)
	Improvement of agricultural statistics (14)	Small-scale mechanization in agriculture (23)
	Bovine pathology (22)	Climatology studies (24)
		Restoration of the Sahelian ecosystem (25)
		Improvement of the Azawak breed (26)
		Animal breeding in the Tsetse-infested Sudanian zone (27)

^aThe descriptions of programs and activities listed above are found in Chapter III, Section E according to the number assigned in parenthesis following the program and activity title.

within twenty years. Thus, donors and countries alike must put aside their "pet" projects and differences as to approach or what is important and cooperate to ensure that every important aspect of this strategy is completed on time. It will not be appropriate for donors or countries to "pick and choose" among these programs, disregarding some, while completing others. Nor will it be acceptable for donors or countries to try to implement this strategy without changing their own rules. Thus, donors must more completely fund recurrent program costs and countries must manage their agricultural policies and research apparatus more carefully to maximize their performance in terms of the objective sought.

To further assist donors and Sahelian countries, the programs and activities have been joined into functional groups. These groupings are indicated in Table 5.

D. Next Steps

Implementation of the strategy should be approached flexibly utilizing the administrative, technical, and program channels that seem most effective and likely to produce results. In dealing with national programs, national and international donor organizations should work directly on a bilateral basis with the country and institution involved. INSAH should be made aware of the negotiations and their progress. CDA member contacts will be made in the priority areas agreed upon by the CILSS.

When focusing on regional programs, donor organizations should take advantage of the assistance that INSAH can provide for coordination in the sub-region. The exact arrangements, selection of the sponsoring organization, convening of technical/administrative meetings, establishments of relationships with other national and international projects, financial arrangements, etc. will all need to be worked out on a case-by-case basis. It is assumed that individual donors will want to arrange for their own feasibility teams to prepare detailed proposals and design their own specific projects to carry out these priority programs and activities.

E. Descriptions of Regional Program/Activities

The following pages provide brief descriptions of the 27 programs and activities that will carry out the strategy for strengthening agricultural research in the Sahel.

1. Foodgrains and cowpeas research network

a. Background

Millet, sorghum, and maize are the most important food grains in the West African region and in the CILSS member countries. Cowpeas are an important pulse for most of the region, the leaves of which are also used in sauces prepared with the food grains. In spite of a considerable investment in plant breeding by international centers and in other research, the yield of these crops per worker has not increased.

Rice has been excluded in this proposal because the activities of WARDA seem to fulfill what is needed on a regional basis. Indeed, some aspects of WARDA might serve as a model of what is needed in a network.

In the area of food grains, there are already several regional activities having some overlap. INSAH, with EDF funding, has a multi-site variety testing program in each of the CILSS member countries. The SAFGRAD has trials for its member countries; in a few countries it also has ACPOs (Accelerated Crop Production Officers). IRAT, ICRISAT and IITA provide material for trials. FAO provides materials for trials but it is believed that their emphasis is on fertilizer use.

There is a memorandum of understanding between SAFGRAD and INSAH, but it is rather general and not binding. INSAH has the mandate to coordinate and promote agricultural research in the CILSS member countries, but it does not itself conduct research. All research institutions of CILSS countries participate in the INSAH trials done in different ecological zones. They also attend meetings organized by INSAH for coordination and information purposes. SAFGRAD has a broader mandate, similar to that of WARDA, in 23 countries. It does research via international centers such as IITA, ICRISAT, via universities such as Purdue and via ACPO's.

The staff of active research organizations such as SAFGRAD, IITA or IRAT can probably make a more specific contribution to national programs in the supply of information, opening new lines to research networks, and information on cropping practices. On the other hand, there is much to recommend the formation of a single network so that the national researchers can benefit from the opinion of the expertise available at the annual workshops, site visits, etc. Proceedings of the workshops should be published. The networking agencies should seek funding from international donors for national and regional research programs, assistance from IARCS and CRSPs.

The boundaries of the CILSS countries are not complete in an agricultural sense, and a grouping of West and Central Africa, including any countries in the "bulge" below the Sahara together with Chad, CAR, and the Cameroon makes sense.

This suggests that in selecting an agency for the network within CILSS countries, a coordinated effort involving INSAH and SAFGRAD should be considered.

b. Objectives

The main objective of the network is to provide stimulation and backstopping to research in food grains and cowpeas and to produce technical outputs that, passing through the extension service, will enable farmers to increase their productivity of these crops. The network should also point out new areas to be investigated.

c. Suggested approach

The network should:

- o Organize meetings as required, but not less than once a year, to discuss technical problems in plant breeding, crop production, pests, and diseases;
- o Organize smaller meetings to visit trial fields and discuss the work at an appropriate time of the year (annual regional monitoring visits);
- o Provide an information service, with access to other necessary resources to provide answers;
- o Provide a "current awareness" service with IRAT and perhaps with RESADOC to alert research workers on important publications that become available within their profile of interest;
- o Facilitate obtaining and exchange of germplasm between member countries; and
- o Provide short- and long-term training including the opportunity to work in laboratories of other members.

The number of research networks required can be agreed upon in the preliminary phases. Maize and cowpeas should probably be the subjects of two networks, but millet and sorghum might constitute one network.

d. Expected results

The expected results will be to increase the potential to produce the food grains and cowpeas more efficiently. If the prices are appropriate, there will be an increase in production and, with greater efficiency, a price more competitive with other food grains.

The greater productivity achieved would also permit production of other crops, such as export crops, with the land resources saved.

2. Farming systems research network

a. Background

Agricultural research is often said not to be sufficiently relevant enough, or to produce results which are not applicable in practice. In addition, research workers often do not have close enough relationships with extension workers and lack the communication with farmers which would inform them about the systems on which their solutions will be carried out.

b. Objectives

The main objective of farming systems research (FSR) is to provide researchers with the means to identify constraints which limit the increase of agricultural production and to direct research towards the elimination of these constraints. FSR also provides a means to conduct trials on farmers fields thus making sure that improvements found on research stations are also improvements for the small producer.

c. Suggested approach

A meeting at IITA has already been held more than a year ago to launch a West and Central African network on FSR. The participants at the meeting elected officers and distributed tasks to be performed. The network is independent; the regional and international agricultural research organizations (e.g. IITA, ICRISAT, SAFGRAD, IRAT, INSAH) participate in the meetings and can help the researchers in their organization. INSAH should be added to the group because it has programs dealing with farming systems research in rainfed and irrigated areas.

As a network on farming systems already exists, the task at hand is to help this network to be more effective. Research on crop production in all the different agricultural zones (rainfed, flood recession, and irrigated) and livestock production are already included, but we must now add fishing and agro-forestry. The network should encourage research on such topics as the interactions between agriculture, livestock production, mixed farming, socioeconomic constraints to planting trees and firewood production, and production constraints for families engaging in both fishing and crop production.

The network will help to provide a cadre of better informed researchers in FSR, can also divide up the tasks among themselves and thus avoid duplication and repetition. The role of the network will be to help the researchers in organizing meetings, workshops, exchanges of information, in finding the means for collaborating with colleagues at pre-determined times and places in identifying important gaps in the research programs, filling priority needs and in seeking the necessary funding for proposed research.

d. Expected results

The network provides an opportunity for research workers to keep their research up-to-date and to make it more effective. It will encourage full-scale trials on farms and the association of research workers, extension workers, and farm families to increase agricultural production and the income of the rural sector.

3. Soil fertility and soil and water research network

a. Background

The considerable increase in crop production in West and Central Africa during the last 20 years has been caused more by an increase in the area cultivated than by an increase in yields. Because of the higher demographic pressure (particularly in such zones as the Mossi plateau, the peanut basin in Senegal and part of Hausaland in Niger) an intensification of crop production is essential. At present, the use of fertilizer contributes only very little to agricultural production in the Sahel. One of the limiting constraints on the farmers' use of fertilizer is the risk that there will be no increase in yields because of a shortage or a poor distribution of rainfall.

b. Objectives

The objectives of the network will be to increase the efficiency of use of limited rainfall and fertilizer and to find the means to overcome other constraints (such as weeding) that are associated with fertilizer use.

c. Suggested approach

The network will be established in the same manner as the farming systems network (FSR), that is, by mutual information exchange among the researchers. A meeting will be organized for researchers currently involved in subjects associated with soil fertility, fertilizer use, and the soil-water relationships by regional institution, such as SAFGRAD, with the collaboration of INSAH. Funds for the initial stage would be supplied by one or more donors.

The participants will organize a network and divide up the tasks which must be done. The network will hold meetings and workshops and arrange the exchange of documents. There should also be an opportunity for researchers to work in collaboration with their colleagues in different countries for an appropriate period and in suitable situations.

d. Expected results

The expected results include an increase in production caused by an intensification of crop production, and at the same time, a reduction in the risks involved in the use of fertilizers by the farmers. For example, the use of tied ridges together with starter fertilizer placed near the seed has shown that it is possible to obtain increased yields and a better use of rainfall by reducing the run-off.

The network will also enable soil scientists to focus the attention of policy makers on long-term effects of neglecting a basic factor for food production that is the biological quality of soils, and total management of the soil-water resources.

4. Fisheries research network

a. Background

Fisheries are an important source of protein in the CILSS member countries, with three countries normally having a catch on the order of 100,000 MT tons a year. However, with the exception of a modest program of research at CRODT (Oceanographic Research Center of Dakar-Thiaroye) and the work of ORSTOM, in Senegal, there is no substantial research in progress.

Considering the limited resources of the countries involved and the similarity of many of the problems of marine and inland fisheries, serious consideration should be given to the common work. This includes methodology of research, statistics and the group of problems concerned with conserving fresh fish, drying and smoking fish (with the attendant energy problems), and control of the insects which consume the fish. The methodology of socioeconomic studies is also common ground.

The purpose of the network is, therefore, to attempt to conserve scarce personnel and financial resources and to make easier the provision of a "critical mass" of research workers. Senegal may be an exception to the need for this proposed unified effort of different disciplines, experience, and skills, given the established program of CRODT in that country. Senegal could however contribute a leadership role to the network.

The following are some of the subjects for consideration by the proposed network:

- o Gathering and exchange of statistics;
- o Conservation of fish, protection of dried smoked fish, energy conservation in drying;
- o Aquaculture;
- o Development of lake fisheries (in new lakes);
- o Socioeconomic studies of fishing, fishermen, and subsistence consumption of fish;
- o Technology; and
- o Training.

b. Objectives

The main objective should be to assist the countries in the rational development and exploitation of their fisheries resources by facilitating research, data collection and analysis.

c. Suggested approach

There are already a number of regional activities proposed in research and training, some by CILSS, others by the FAO, CEAO, etc. It is suggested that Senegal might take the initiative of convening the first meeting of the group with finance coming from a donor. The proposed network will reinforce the on-going programs and facilitate the dissemination of their findings. The network will function in two major areas--serving to provide training and a forum for information on the relevant aspects of fisheries, and serving to provide contacts between those studying the fisheries sector and others studying farming and livestock production systems. Such contacts should facilitate an understanding of how fisheries fit into the overall year-round activities of the rural population and of the contribution of fish to the diet of fishing families and others.

In countries with marine fisheries the network will also consider problems of the existing subcommittees, the COPACE, and of international poaching.

d. Expected results

The expected results are the development of a better informed cadre of research workers, conceptualization of a regional program of research on marine and inland fisheries, compilation of statistics and information on the sector, and socioeconomic understanding. These will serve to formulate effective development projects.

5. Research on irrigated crops

a. Background

The underdevelopment of irrigated crops in the Sahel and resultant poor yields have complex and multiple causes. Among them are the relative novelty of irrigation techniques for the Sahelian farmer, the flooding of natural pasture lands, the poor management of irrigation systems, the lack of reliable data on the socioeconomic situation, and poorly integrated agricultural, and forestry efforts.

To remove some obstacles to the development of irrigated crops, in the Sahel, a modified farming systems approach may be suggested.

The Senegalese have already proposed to do substantial FSR on the Senegal River region. They have added several economic studies in conjunction with their biological research in that area. The OMVS also has three agronomic research stations in the Senegal River region; one in Senegal, one in Mauritania and one in Mali. Finally, INSAH could initiate research projects similar to its projects on rainfed agriculture.

It seems that with the amount of important water volumes present in certain parts of the Sahel the long-term prospects are good of finding practical methods for efficient increased production of foods from irrigated lands.

b. Objectives

Research projects on irrigated crops and production systems based on irrigation in member countries of CILSS would aim to:

- o Encourage further technical studies to originate with Sahelian States research units (management of irrigation systems, farming systems, varietal testing, adaptation testing);
- o Intensify socioeconomic research and research concerning the integration of irrigated crops, livestock and forestry;
- o Promote the training of better qualified management personnel in sufficient numbers;
- o Promote studies in the field, and full scale trials on problems encountered in technology transfer between research stations and producers; and
- o Encourage the exchange of reliable, verified economic data which will enable the development of viable national economic models with coherent policies for the intensification of agriculture, animal husbandry and forestry on the perimeters of irrigated lands.

c. Suggested approach

The achievement of these goals will require a coordinated effort on the part of all those involved in this type of research--that is, INSAH, ISRA, WARDA, ABN, OMVS, etc. One of these units or programs, along with the national structures responsible for coordinating and implementing such programs could take on this role.

Rice is an important part of irrigated crop production but research must also include other plants. As well as technico-economic research at the stations, parallel studies must be conducted to determine the principal socioeconomic constraints to production systems for the irrigated crops in question. An extensive program of training for management of the perimeters at all levels of responsibilities must also be encouraged.

Research programs will also include, besides follow-up technical research, an important pre-extension component, which would be based on the evaluation and follow-up of rural farms.

d. Expected results

These programs should permit the retention of the best species at the end of varietal testing which has been adapted to specific conditions, and also in the proposal of new production systems for irrigated crops to guarantee a state of equilibrium between man and his environment and encourage new production systems which will be socially and economically viable.

Finally, program results should contribute to improved methods for Sahelian management personnel and their training and allow optimal usage of water/land resources. This will ultimately result in increased revenues for the farmers.

6. Peanut research network

a. Background

The West African countries in which peanuts are important both as a food crop and a cash crop are mostly confronted with the same problems (rosette, rust, leaf spot; aspergillus and aflatoxin; improving the effectiveness of rhizobia, etc.). It seems necessary to provide the research workers with practical means to coordinate their research, to stay as well-informed as possible, eventually to divide the research areas, and to avoid duplication. This network should include such non-Sahelian countries as Nigeria and Cameroon, who share the same problems. The University of Georgia has already started coordinating activities in this field. ICRISAT's Sahelian Center also conducts research on peanuts.

b. Objectives

The main objective is to encourage building synergy among research workers to find solutions that are adapted to a large number of areas. It is necessary to set up a practical channel for meeting, providing information, and coordinating the researchers. The program will encourage research on plant breeding to improve resistance to pests and diseases and to obtain more productive rhizobial bacteria.

c. Suggested approach

It is hoped that a research institution where a large number of scientists are working on peanuts, will take the initiative of convening a first meeting for the creation of a network. The research workers should be provided with finance from donors and practical means for communicating amongst themselves, with assistance and participation from outside organizations such as the peanut CRSP, IRHO, and ICRISAT. The association would facilitate communication and exchanges of documents, hold regular meetings or special meetings on demand, and provide an opportunity for a researcher to spend some time working with his colleagues in another country learning a technique or method. The creation of this network will be achieved by providing the researchers with the necessary funds, facilities and services to allow the exchanges of information, the meetings, travel and training judged profitable for the advancement of peanut research in the entire region.

d. Expected results

The results expected are an increase in the production and productivity of peanuts, more income for farm families, improvement in food self-sufficiency and an increase in the supply available for export.

7. Small ruminants network

a. Background

A study made by INSAH in 1980 and different other surveys carried out in the Sahel confirm the importance of small ruminant production (goats and sheep) in the family and national economies. The development of this enterprise cannot be accomplished without in-depth studies of the herd management, their grazing conditions, their socioeconomic importance for farm families, and also their pathological problems.

b. Objectives

The first objective is to identify the most important diseases that affect small ruminants (pulmonary syndrome, pox and pest of small ruminants, etc.). Then we would want to establish more appropriate preventive measures for adoption by farm families. From a socioeconomic point of view, another objective is to acquire familiarity with the methods, constraints and results of goat and sheep production, which is a very important activity in household production both for the income generated and for the consumption of associated animal products. The cost/benefit at the small farmer level would have to be considered.

c. Suggested approach

These objectives can be achieved through strengthening programs of immunization against the pest of small ruminants, pulmonary diseases, pox and control of parasites and by launching socioeconomic surveys of small ruminant production in the farm milieu. A research unit should be identified where additional work on these problems could be readily organized if financed by donors. This work would have to be envisaged on a regional basis; it would have to involve collaboration of scientists in other Sahelian countries and the results would be available to all CILSS countries. Suitable sites for this unit are the CVL, Bamako, where proposals exist for a small ruminant pathology unit and for epidemiological studies, ISRA/LNERV in Dakar-Hann, where small ruminant production and pathology research is conducted or at the Farcha laboratory in N'djamena, were it re-opened.

d. Expected results

This knowledge should permit the improvement of small ruminant production and the reduction of risks, and thus increase farm family incomes and their consumption of animal products.

8. Training of research scientists

a. Background

The strengthening of Sahelian research institutions will require a substantial effort in training research workers in the years to come. This project's survey identified the need for qualified personnel to conduct research in priority areas. It is, however, important to keep the number of research workers at a level which governments can support. Training priorities should be reviewed in association with agricultural strategy and national research priorities.

The strategy should take into consideration not only the more formal types of training which lead to a degree but also all efforts contributing to the improvement of scientists, such as the specialized course of integrated range management in the Sahel (UNESCO/INSAH/EISMV).

b. Objectives

To prepare a practical 20-year strategy, we must: enhance the DEVRES/INSAH survey on the priority areas of research by converting present data into specific training needs; suggest a workable method to have a growing number of scientists trained, preferably in the Sahel, then elsewhere in Africa and when necessary in developed countries; and establish a more formal system of financial assistance for qualified applicants who are not helped by the present sources.

c. Suggested approach

A small team of qualified experts (preferably Sahelian) should be immediately established to follow-up in more detail the work of the DEVRES/INSAH survey and the CILSS/Club du Sahel agricultural sector studies, and translate the priority research of each country into needs for additional scientists and technicians (the training of technicians is dealt with in another proposal) to be trained, taking into consideration all those who are already under a program. The next steps for the team will be to appraise:

- o What types of additional training for scientists can be presently obtained from Sahelian institutions;
- o What amount and what type of upgrading of the teaching personnel would be needed to enable these institutions to increase their output in their present areas of teaching and to start training in other selected areas;
- o If other institutions in Africa are capable of training scientists, using the French language and having access to an agricultural environment that is not too different to what is found in the Sahel; and

- o The conditions under which the continuing use of institutions in Europe and in America can be improved and particularly the choice of thesis and the methods of satisfying the requirements. It is imperative that the research requirements be meaningful to the Sahelian scene e.g., having the thesis field work done in the Sahel.

The team should also make recommendations on less formalized types of training that do not usually lead to a degree and which might not otherwise be covered in specific development projects. These include short courses or seminars, temporary exchange of personnel, training periods at a different research unit such as one of the IARCs or a university.

Finally, it will be useful if the team can recommend a system of scholarships and fellowships to complement those already in existence. A fund could be set up, with financial resources coming mostly from donor countries but also with meaningful contributions from Sahelian countries based on the number of their national applicants that are accepted. Such a fund could be administered through an appropriate non-governmental organization.

d. Expected results

A strategy would be proposed covering the next 20 years containing the following elements:

- o The training needs for research scientists corresponding to the present research priorities of the sub-region;
- o The methods by which a greater and greater proportion of the training would, with time, come from the Sahel;
- o Information on how and where to use other institutions in Africa and how to better use institutions in Europe and America;
- o Recommendations on less-formalized methods of training including for the future post-doctoral programs; and
- o Recommendation for a fund to supplement present methods of financial aid for Sahelian scientists involved in training.

9. Training of research technicians

a. Background

In order to do research work properly scientists need the assistance of qualified technicians to help with such things as field trials, laboratory analysis, equipment maintenance, etc. Unfortunately these essential research workers are often forgotten when decisions are made about manpower training.

b. Objectives

Find practical ways of preparing professionals to make a career as research technicians. Also ensure that research technicians can progressively increase their qualifications and thus have a chance for promotions in their chosen career.

c. Suggested approach

Conduct a study on the number of new research technicians to be trained in order to service the priority areas of research in the sub-region for the next ten years. Examine if the present training institutions in the Sahel can handle this load and what changes must be brought about in order to increase quality and the quantity of their output. This study could be a part of the terms of reference of the small team of experts mentioned in the proposal on training of research scientists.

Other less formal methods of training could be suggested by the team of experts, such as short courses or seminars at appropriate locations within the sub-region, and periods of training in one of the IARCs, at a national research center or in universities. Workshops could also be organized in conjunction with training and extension institutions in order to appraise technicians of the challenges met when research results are to be used on small farms.

It would also help research technicians if means could be established for experienced technicians to cross over to more academic training in order to become research scientists.

The program of less formal training could be a responsibility of INSAH or of another institution in the sub-region.

d. Expected results

The expected results are better research institutions with an increased number of better qualified technicians, better career patterns for research technicians to attract and retain better personnel, and better research work by scientists who would lose less time doing work that can be handled by technicians.

10. Improvement of agricultural research management

a. Background

Almost all the parties involved in agricultural research have spoken of serious deficiencies in management. Problems in management arise from the actions or attitudes of either the financial backers, the sponsoring ministries (Rural Development, Planning, Finance) or the research institutions themselves.

For the most part, the criticisms have involved two complementary aspects:

- o Management of the research institutions; and
- o Identification of priorities, planning and implementation of the projects and/or programs.

There are many well-known repercussions of deficiencies in administration and implementation that can affect the smooth operation of the institutions and projects, while the technical directors' competence is not implicated. For example, tardy provision or early depletion of funds to cover project activities; lack of funds for equipment and infrastructure maintenance; inadequate accounting systems to keep track of spending; incomplete inventory of equipment; or an administrative and management staff which is too large or too small, or even incompetent. Very often these factors encourage researchers to abandon their research activities; they also cause financial backers to cancel projects.

The second point of criticism is related to the identification of priorities, and the planning and implementation of research programs and projects. Very often, plans are not carried out due to a lack of knowledge of the administrative and technical aspects of a project or program. For example, when budget estimates are made improperly, the project may run short of funds before it is complete and all activities may stop.

b. Objectives

In order to improve the situation described above, measures must be taken on a regional basis to fulfill the following objectives:

- o For improved management of institutions, conduct a specific study of all problems encountered in order to detect deficiencies and obstacles to the proper performance of activities. This study should be conducted in close cooperation with institution directors, sponsoring ministries, financial backers, management training centers, and researchers. The data collected through the study should be used as the basis for drawing up practical training programs designed for staff at various management levels in the institutions (administrators, financial personnel, accountants, etc.); and

- o For improved planning and implementation of projects and programs, develop a training program for the head researchers of the projects.

c. Suggested approach

Training for improved institutional management can only be carried out after a detailed and objective study is conducted on the actual difficulties experienced by institutions and researchers.

Such a study is planned by the AGIR Project (Improvement of Research Institution Management in the Sahel). The project encompasses some of the agricultural research institutions in CILSS member countries. AGIR was approved by the CILSS authorities and is currently starting up activities with financing from the IDRC (International Development Research Centre). Funds are inadequate for accomplishing all the planned activities (in particular, training of the administrative and financial staff of the institutions). It should also be pointed out that the ISNAR (International Service for National Agronomic Research) has already had some experience with developing countries in this field. Its programs cover both aspects mentioned above, while AGIR is limiting its activities to institutional management.

AGIR and ISNAR provide an appropriate framework to carry out the proposed objectives. Thus, it would be beneficial to promote cooperation between the two institutions in order to have a rational and complementary use of their resources. For example, training activities could be divided between the two, after a joint study of institutional problems has been conducted. The proposed training should be given in short training programs (workshops, seminars, etc.).

d. Expected results

In addition to identifying specific deficiencies and problems in research institutions, the measures proposed herein will also make institutions more capable of managing the extensive resources available for agricultural research. To the extent that the Sahelian countries and their financial backers are assured that a competent staff will manage properly, and they will be encouraged to allocate greater resources to research activities.

11. Strengthening INSAH's scientific and technical information

a. Background

The national reports indicate the existence of serious problems in the area of exchange of scientific and technical information between individual research workers, and between research institutions.

The problems appeared at different levels such as: the research institutions which do not have the organization, the means nor the personnel necessary for accomplishing the collection and distribution of the documentation. Their meager financial resources do not permit them to subscribe to scientific journals, nor to purchase the necessary reference works; the African research workers who have difficulties in publishing their work; and information on activities which do not circulate freely between institutions, which in turn causes duplication of efforts and use of resources. It also makes difficult the tasks of planning and coordination vested in the regional and national organizations.

INSAH (Institute of the Sahel) was created to coordinate, harmonize, and foster research in the Sahel, as well as to collect, analyze, and disseminate research results.

Data has been gathered in the various CILSS member states and is now available at INSAH where it has been input and stored on an IBM-XT microcomputer.

b. Objectives

The activities described below have, amongst others, the following objectives: collect in the most efficient way the documents produced by research institutions (annual reports, monographs on research, proceedings of meetings) for use in training and organization; microfilm the documents collected and assure the widest possible distribution to research workers and to institutions; give Sahelian researchers access to the documentation resources available in the world by using national and international systems of information (e.g., AGRIS); provide Sahelian agricultural research workers with possibilities to publish their results in professional publications (reviews, monographs, etc.); establish, monitor and improve a data bank on agricultural research institutions started by the DEVRES/INSAH survey; make available to governments, donors, and research workers up-to-date information on research institutions, resources and programs; and transform research results into terms that can be used directly for training or extension purposes.

c. Suggested approach

The actions proposed are divided into different phases:

- o Development of the RESADOC network by increasing its activities which directly assist the individual national institutions. This is included in phase II of the RESADOC program (1983-88) and should be given an important place in the agricultural research institutions;

- o Strengthening the means of providing publications by INSAH with which to improve the quality of its own products (scientific review, monographs, etc.);
- o Maintenance and improvement of a data-bank on agricultural research, obtained in the DEVRES/INSAH project, through a permanent arrangement of periodic updating of the data. It will be necessary to have a complete list of researchers connected with different specialties;
- o Develop code books in French and English, including CARIS subject and activity codes and also acronyms;
- o Store all the above-mentioned codes in the microcomputer;
- o Prepare an instruction manual on how to use the data bank; and
- o Announce through INSAH publications that the bank is available to users.

d. Expected Results

Improved access of researchers to all types of scientific and technical information, as well as the diffusion of this information, will improve the efficiency and productivity of researchers, institutions and research programs.

INSAH will have a fully operational data bank, capable of providing information and answering questions asked by research and development agencies, technicians and country planners, and donors, among others. The data bank will have information on agricultural research conducted throughout the sub-region and, more specifically, on crops (food and cash crops), livestock, fisheries, agro-forestry, and production systems.

12. Dissemination of applied agricultural research results

a. Background

One of the major constraints to increased crop, livestock, or fish production is inadequate dissemination of agricultural research results in a form that producers can use. Even when a new plant variety or livestock production method has been proven valid in testing at research stations, it may not always be successful when producers use it. What is worse, producers often do not have the opportunity to tell researchers (directly or via extension agents) why the new method failed. For example, high-yielding food grains may not have acceptable taste, or some livestock methods may be incompatible with the herders' traditions, etc.

Until now, there has been no systematic study of the few cases which were completely successful in the Sahel (for example, increased output of sorghum and millet together with increased cotton output in Mali). One reason often cited is that extension agents lack the training required to correctly explain a technique or to make sure it is applied properly. The extension agents complain that the techniques are too complicated and not fully developed at the research station. They also stress that, too often, the necessary inputs are not available at the proper time or that the producers cannot buy them since they have no credit opportunities.

Even when researchers and extension agents do work well together and offer new techniques, often the producer cannot risk trying these new methods or the market is too small to absorb the expected increase in output. Finally, farm prices are often so low that producers cannot profit from new techniques even if they succeed in increasing output.

These comments, among others, demonstrate the need to develop a rational method of analyzing the linkage between researchers, extension agents and producers and of the interaction of various factors (technical, economic, ecological, social, etc.). At the same time, the link between training of extension agents and the provision of information to producers must also be investigated.

These comments also illustrate the urgent need to improve the training of extension agents so that they are competent enough not only to comprehend (and explain) the details and value of the techniques they disseminate, but also to objectively transmit producers' comments to researchers and vice versa.

Perhaps a higher-level extension training should be established--an intermediate level between field extension agents, who work side by side with producers, and researchers. With more in-depth training in teaching and technical methods, this higher-level extension agent could provide the linkage that is currently unavailable.

Of course, the practical applications proposed here will be different for each country according to its own method, and with certain modifications to adapt to local situations.

However, it would appear to be advantageous to conduct a region-wide study of certain interdisciplinary aspects, like the development of methods, techniques or models and their adaptations to the pertinent sector or product.

b. Objectives

The main objective is to considerably improve the lines of communication in both directions (researcher-producer and vice versa) using agents with the proper competence to carry out this mission.

c. Suggested approach

A special training program for high-level extension agents should be developed, working closely with research, training, and extension institutions; the program would train supervisors selected on the basis of their personal motivation. This training could take place at one or two appropriate national training institutions provided that candidates from other countries would be accepted.

One part of the training could deal with the use of microcomputers to solve complex extension problems.

d. Expected results

One of the results will be a higher success rate in the dissemination and application of agricultural research results in the selected fields.

Another will be the establishment of a better system of "back-and-forth" links between researchers, extension agents and producers. This will allow producers to use the information more quickly and faster and thereby increase productivity and output in all sectors.

13. Planning and analysis of agronomic experiments

a. Background

In each of the Sahelian countries there is a substantial number of agronomic experiments carried out each year. This includes varietal trials of different crops, fertilizer experiments, and FSR with its trials. The trials are carried out in several locations and are usually planned and analysed by hand, with or without the assistance of a hand calculator. The SAAR survey indicated that only one country had microcomputers and most did not have programmable calculators. Running these experiments takes a considerable amount of time, and the need for manual calculation of the results tends to constrain the design.

b. Objectives

The objectives are to improve the quality of experimental design in agricultural research, to speed up and improve the analysis of experiments and to save the time of research workers and technicians to permit them to run more experiments.

c. Suggested approach

Upon request, it is proposed to provide Sahelian countries with a suitable microcomputer program and where necessary a simple microcomputer and printer together with technical backstopping. This should include training in the use of the computer and information on the programs available for researchers, statisticians and computer operators. A unique and complete program for the design of experiments in all agricultural fields, management of the data, and its complete analysis has been developed by Michigan State University. The program is called MSTAT. It will run on CP/M and MS-DOS, currently the two most common operating systems. Both the program and the users' guide are available in French. A microcomputer, printer, and voltage regulating transformer or voltage regulator (if a transformer is not needed) together with the program could be obtained in the U.S. for under \$3,000 retail.

The research division of INSAH, which has been charged by the CILSS to coordinate and assist in planning the agricultural research programs in the member countries, has a series of trials for which it provides assistance to the countries (the INSAH/EDF food grain variety trials). INSAH also has microcomputer operating capacity. With additional funding and training of some staff members, INSAH could undertake this activity.

d. Expected results

The use of this high quality system for the design and analysis of experiments is expected to increase as well as improve the capacity of the Sahelian countries to run agronomic-type experiments. This should help agricultural, livestock and agro-forestry research workers.

With the recognition of the need to run more experiments at the farm level, the introduction of the hardware and MSTAT software with technical backstopping is expected to improve the planning and analysis of experiments which so far has been a constraint in increasing the number of experiments. The program is also expected to improve the quality of experimentation and speed up the analysis, thus producing usable results for extension more rapidly.

14. Improvement of agricultural statistics

a. Background

Delays in the publication of agricultural statistics and their lack of precision for most of the Sahelian countries constitute a serious obstacle to the conception of plans and evaluation of their effect on the development of livestock and crop production. It also affects the quality of work of many scientists who are unable to appraise the status of present conditions. This has led to the preparation of the INSAH project, "Improvement of Permanent Diagnostic Instruments for the Livestock and Cereal Production Sectors."

The proposed action is to expand the INSAH project to include other sectors: agriculture, livestock production, fisheries and forestry.

b. Objectives

The objectives are:

- o Strengthen the national services responsible for agricultural statistics;
- o Develop a methodology for collection and analysis of primary and secondary data, and identify intervention areas;
- o Interpret statistical data in order to permit their regular and rapid publication for national and regional dissemination; and
- o Create data banks at national and regional levels that can be used by research workers.

c. Suggested approach

In order to achieve these objectives at the national level it is necessary to train survey workers (data collectors), to set up an organisation for data collection (areas, yields, livestock numbers, exports, etc.) and to train specialists in computer management and data analysis. Collaboration could be organized with other institutions which could help data collection (FAO, AGRHYMET, CRTO, etc.). This would also promote organization of regional meetings, information exchange and sharing of experiences.

d. Expected results

The availability at national and regional levels of more reliable statistical data in a more timely way is the primary goal. This would provide a stronger basis for planning and evaluation of the progress of projects, programs and sectors. It would also enable many agricultural research workers to better appraise the present status of a problem and to calculate the improvements brought about by their work.

15. Private sector participation

a. Background

The nature of potential private sector participation in the development of the agricultural sector is diverse, including supply of fertilizers, chemicals, seed, sacks and machinery; drugs, mineral supplements and feed for livestock; boats, nets, motors, and insecticides for fishing. Other potentials lie in farm machinery manufacturing and repair of and processing of agricultural products and their export. Agriculture also depends, to a considerable extent, on the private sector for transportation of both inputs and outputs and this, too, could be further developed.

The place of the private sector in these activities has traditionally been important, for example in the trading of grain and other food crops and the provision of tools and small equipment (baskets, used sacks, etc.) Blacksmithing is a traditional craft, and with the help of several training projects it has developed some capacity for farm machinery manufacturing and maintenance service.

Recently some Sahelian governments have abolished certain state monopolies, for example, that of importing grain in Upper Volta, and Niger. Private traders can now acquire licenses to import rice and other food grains and the governments exercise control over the retail price.

In most of the Sahelian countries, there is a retail market for fertilizer and agricultural chemicals, using the private sector. In some cases, private traders are able to bid on the supply of fertilizer to development projects. Thus, entry into this area of trade is feasible in some countries. However, problems exist due to the availability of supply to the potential importer. There are only one or two companies delivering fertilizer to this part of Africa. This might pose a constraint in opening up the trade.

The SAAR survey reported repeated difficulties in the inability to buy fertilizer and of its late delivery, and of the inability to buy the inputs for fishing. In the case of fertilizer, the trade is complicated by government subsidies and the need of farmers for credit. The sale of fishing equipment may also be inhibited by lack of credit. The constraints to the distribution of insecticide to protect fish from insect attack are apparent, with up to a quarter of the total catch being destroyed by insects. Easier distribution and access to insecticides is a necessity.

Since losses of the import monopolies and other public sector commercial activities have put an excessive burden on the current account, the Sahelian governments have shown an increased interest in the role of private enterprises.

The new role of private enterprises is easier to appraise and analyse within the confines of each country; certain aspects can, however, also be looked at on a regional basis, an approach which eliminates the difficulty of pointing to specific business entities. There have been a few cases of private firms doing agricultural research in the Sahel. Such initiatives should be encouraged and new projects created.

b. Objectives

To increase the efficiency of distribution of inputs to the agricultural sector and the efficiency of domestic and imported food marketing by participation of the private sector.

c. Suggested approach

A regional study should be made, perhaps under the auspices of the CILSS/Club du Sahel on the activities of the private sector in the trade of agricultural inputs, credit problems, and in the importing and processing of agricultural commodities. This would serve as a basis for regional discussion on the possibilities for increased intervention by the private sector, and the activities required by governments to facilitate and supervise this intervention.

The study should also cover present agricultural research activities initiated by the private sector and suggest new projects.

d. Expected Results

The results of this activity are expected to increase the efficiency of the delivery of agricultural inputs, thus increasing the output of the agricultural sector by assuring a more widespread and timely supply of inputs. It should also improve the efficiency of marketing imported grain. By encouraging the private sector to work in the area of grain processing, for example, processing domestic food grains into flour with good keeping characteristics, the consumption of domestic grain could be increased and the need for imported grain would diminish.

16. Creating a regional phytogenetic resource center

a. Background

The improvement of the main Sahelian food crops began in the 1950s and 60s with the collection of local ecotypes. As a result of these research efforts, several improved local varieties, well-adapted to the Sahelian environment in general, are still the subject of successful extension efforts.

After 1970, national research organizations undertook partial inventories within their countries to restore and save their rapidly disappearing phytogenetic resources.

During 1975-76, IBPGR, ICRISAT and ORSTOM also carried out phytogenetic inventories in the Sahelian countries. The plant material collected is stored partly in France and India. The rest was destroyed by quarantine centers in receiving countries.

b. Objectives

A first meeting of Sahelian researchers, organized by INSAH in 1979, had as its primary goal the building of a collection of phytogenetic resources of principal Sahelian food crops.

Not only will this foundation permit a multidisciplinary study to improve Sahelian food crops, it will also serve to save dwindling phytogenetic resources destroyed by the combined effects of drought, desert encroachment and brush fires.

c. Suggested approach

Given that the varietal improvement program for Sahelian food crops will work from established, diversified populations with a wide genetic base, additional inventories in all eight member countries of CILSS will be necessary. In addition, requests for material already inventoried in these countries or countries with similar ecological conditions, would be made to IBPGR, ICRISAT, and ORSTOM.

Material collected will be stored in one or more regional phytogenetic resource centers selected on the basis of their present physical and human resources. These centers will encourage exchanges of material among national centers, international centers and universities. From the start the project will need a regional coordinating secretariat that may be placed in INSAH or elsewhere in order to initiate and then monitor this work.

d. Expected results

This program should result in the improvement of available genetic resources in the Sahel region, the establishment, storage and preservation of the collection, genetic evaluation, and the use of research results in national and international programs.

The initial surveys will also better inform scientists on the plant material of their country and of the entire sub-region.

17. Creating a regional center for introduction and quarantine of plants

a. Background

The exchange of plant material sometimes brings with it substantial risks of introduction of new parasites or plant diseases hitherto unknown in the zone. For example, this has already happened with sugar cane mosaic, and peanut rust. One of the proposals of the African Council on Sanitary Control of Plants is to build a regional station for the Sudano-Sahelian zone at Maradi to complement the existing stations at Ibadan and Nairobi.

b. Objectives

Establishment of a station in the Sudano-Sahelian zone for the introduction and quarantine of plant material under controlled conditions in order to avoid or to slow the spread of parasites and diseases carried by plants imported from other parts of the world.

c. Suggested approach

To accomplish this objective, a regional center should be created and equipped to examine and quarantine plants introduced to the region. The center must be located in an appropriate climate zone and must be within easy reach of all interested states. Such a center when accepted by member nations must be supplemented by an efficient method of controlling the frontiers of the zone.

d. Expected results

The sanitary control and observation of plants introduced into the Sahelian countries from the rest of the world is expected to protect the region from the introduction and spread of new pests, hitherto unknown, and against which there is usually no advance preparation. This will permit plant production with fewer diseases or pests coming from the outside.

18. Agricultural research policy

a. Background

In the survey on the constraints to increased food production and the policy problems faced by extension organizations in meeting their performance goals, the most common problems were: farm prices are too low to encourage the production of marketable surpluses; input costs are too high in relation to product prices; and inputs are not available at the right time.

The supply of wheat products and rice at relatively low market prices tends to favor urban consumers and depress demand for domestic grains. As the IBRD has frequently pointed out, other problems arise from the economic consequences of pursuing a policy of food self-sufficiency without taking into consideration the comparative advantages of exporting cotton and peanuts and importing wheat and rice.

Relatively little research has been conducted to find solutions to these problems. With the exception of different transportation costs of imported grains and exported crops, the problems are similar in nature in all the countries, but differ in degree. The Sahelian countries are recognizing that their present agricultural policy has not led to improvements in the food self-sufficiency rate (percentage of food grain consumption that is satisfied by domestic production).

In some countries (Senegal, Upper Volta, and Niger), food policy research supported by USAID is underway or in planning. Increasingly, it is recognized that policy and planning must be based on in-depth economic analysis to ensure policy compatibility with existing economic and social realities. To provide this critical analysis, short-term professional teams should be appointed to work with the government agencies to develop an immediate agricultural strategy or plan. In the longer term, a small group of qualified nationals should be assigned the portion of developing the necessary analysis on which to base agricultural policy.

The IFPRI, ICRISAT, and the GERDAT, working together with CIRES, ISRA and CEDRES, have initiated a regional project on "The Changing Role of Coarse Grains in SAT West Africa: Policy Implications of Substitution in Production and Consumption of Millet/Sorghum and other Food Grains".

A regional activity is proposed to serve as a forum for the researchers already working in national or regional research on food policy issues; this activity would also assist researchers in those countries which have not yet initiated a research project in the area of investigation. Finally a regional activity may reduce somewhat the pressure on researchers for maintaining the status quo.

b. Objectives

The proposal should help the CILSS member countries to: evaluate the effect of existing agricultural policies on agricultural production and marketing of local grains; obtain a base of information to analyze the outcomes of alternative agricultural policies, in order to improve policy making, to increase production and to move countries towards economic self-sufficiency; provide data for a quantitative system of allocating agricultural research priorities; evaluate the means for assuring food security in the face of fluctuating production and storage problems; and increase regional trade in agricultural commodities.

c. Suggested approach

Although agricultural policy decisions, research priorities and the like are strictly national decisions, a regional program can provide a valuable contribution in information, methodology, training and microcomputer technology. The agricultural statistics on which the analyses are based must be collected nationally; they are also the subject of a proposed regional activity. The methodology for policy research is quite well understood, but some of the researchers need doctoral degree training in agricultural economics. A training program will be needed for these specialists.

While it is desirable that African agricultural policy research be done mainly by Africans, a wide variety of highly trained, experienced researchers will be required. In terms of an African institution, probably only the ECA of the OAU at Addis Ababa may have the trained manpower to launch this activity. On the other hand, Michigan State University, Purdue University and particularly IFPRI have already made a start on food policy research in West Africa. IFPRI is the IARC with the mandate to work in this area. The institution responsible for the recently awarded agricultural policy CRSP could also provide assistance in this area of research. One of these institutions should organize a meeting mechanism where researchers could exchange ideas and information.

d. Expected results

This activity should lead to improved understanding of the agricultural economy and better informed policy decisions. Planning of the agricultural sector should be more realistic and research priorities should be established. Improved policies should stimulate technical change in agriculture, resulting in increased income, employment and reduction in rural poverty. Policies should also aim at increasing food security and decreasing food imports to a minimal level. With well-founded, well-researched agricultural policies, food aid could be more effectively used.

19. Production and utilization of firewood

a. Background

There is general anxiety about the Sahel's current environmental degradation. One of the causes of the degradation, particularly around the large urban agglomerations, is the removal of firewood at a rate that is faster than annual growth of the trees. There is an urgent need to correct this process while ensuring that the population's demand for fuel is satisfied.

There are presently many efforts in the Sahel related to the solution of this problem. New and old species are proposed in reforestation programs. Efforts are made to respect and promote the presence of trees in the environment. More efficient types of stoves are offered. Some alternative sources of fuel such as butagas are considered where people can afford them in cities.

b. Objectives

One of the primary objectives is to improve understanding of firewood production systems, of the interaction of these systems with other rural economic activities and of the constraints to increasing production. As well, the existing constraints to adoption of such innovations as improved stoves and fish drying equipment should be identified. Research is also needed into possible substitutes for firewood and into the conditions necessary for their use.

c. Suggested approach

The short-term approach will be to strengthen research on substitute means of producing energy for supplying the cooking needs of the populations. This will mean strengthening the programs of organizations working on forestry, environment and new energy sources (UNEP, National forestry services, CEAO-CILSS project, CTFT, CEEMAT, CRES, ONERSOL, etc.).

Another method would be to have one of the involved units create a network for the Sahel region on the basis of special financial help given by one or more donors. The network would permit researchers to pool information and efforts dealing with:

- o Substitutes for wood, particularly in cities, where some consumers can afford to pay the added cost;
- o Development and dissemination of improved stoves;
- o Protection of existing forests or clusters of trees; and
- o Reforestation programs.

The network should serve to identify gaps in the current research programs (i.e., the socioeconomic area) and help to develop the needed research. The network should publish a newsletter, similar perhaps to the Sylvan Africana, an IDRC-funded effort which has recently ceased publication. Any action should be integrated with the existing CDA forestry program and should take into consideration the research work already existing.

d. Expected results

In the short-term, increased information on the current firewood production systems will be gained, as well as greater awareness of the constraints (particularly economic) currently inhibiting the adoption of such innovations as improved stoves. Additional information on practical firewood substitutes and renewable energy resources, and on the conditions necessary for their development and use, is another expected result.

In the long-term, research results should allow an increase in the production of firewood, a reduction in the per capita consumption of firewood with increased use of substitute fuels and more efficient stoves, and a reduction in the over-exploitation of forest resources, perhaps with some environmental restoration.

20. Women in agricultural production

a. Background

As indicated by the paucity of gender-related data recovered in our survey, women's role in agricultural development remains a neglected area of serious research and statistical enquiry. Awareness has grown in recent years about the importance of women's economic role in Africa; in addition to their domestic responsibilities, women spend many hours on such agricultural duties as weeding, harvesting and post-harvest food processing. They are often the main providers of the family's subsistence foods and may participate in their own as well as their husbands' cash crop production. Women spend long, laborious hours in fuel-wood collection and drawing and carrying water, tasks which are becoming increasingly difficult with deforestation and lowering of the water table. Particularly in areas with high rates of male out-migration, women are left as effective heads of households and primary agricultural producers. Yet their role in agriculture and food production is not fully recognized.

b. Objectives

The objectives concerning women's role are fourfold:

- o First, to encourage research that will define and evaluate the nature and extent of women's agricultural activities and explore means of improving their productive capacity, and at the same time reduce the physical demand of certain activities;
- o Second, to consider future action which can increase education and training opportunities for women farmers who are currently vastly under-represented in such institutions;
- o Third, to decrease the existing gender bias and male orientation of the extension system through educative reform of the extension agents and an increase in the number of female extension agents; and
- o Finally, to explore ways for women to gain access to rural credit and/or become landowners.

c. Suggested approach

Research programs that focus on women's agricultural production should be established or strengthened within the Sahelian agricultural research institutions. The research programs should undertake serious interdisciplinary studies on the precise nature and importance of women's production in the various areas of the Sahel. With improved statistical data and more general socioeconomic studies, researchers would have the means to suggest ways of reducing women's heavy work burden and improving their productivity. These suggestions would, of course, refer to both technological

improvements, legal and financial changes and the more problematical social transformation necessary to effect a substantial improvement in the position of women.

Within the admittedly narrow constraints of the secondary school population, training institutions should be made aware of the need to educate and train more women in agriculture. This training needs to be increased at all levels, but special emphasis should be given to the training of female extension agents. Extension services for rural women typically do not involve adequate recognition of their agricultural production.

ICRISAT, with the help of the Ford Foundation, has begun research in Upper Volta. With added resources this could be used as a base for extending research to other Sahelian countries and for serving as a regional forum on the subject.

d. Expected results

It is expected that increased attention to women's work by Sahelian agricultural research institutions would lead to the generation of more precise statistics on women's input into agricultural production and to an improved awareness of the importance of their economic contribution. Such information should lead in turn to specific proposals and suggestions for improving women's productivity and income level and decreasing their work burden. Increased consideration of women's participation should also entail institutional reform to correct the existing gender imbalance of training and extension organizations and to provide access to agricultural credit. The end result of the various efforts would be an increase in the expertise and productive capacity of women farmers.

21. Technology and processing of foodgrains

a. Background

Systems for the batch pearling (decortivating) and grinding of cereals have been installed in urban and rural areas in the Sahelian countries. These serve the individual family and often perform only one operation--usually the grinding. Families bring in grain which is returned to them in processed form. This equipment does not remove the germ, and therefore provides a product, albeit more nutritious, which will not keep well.

The urban populations are increasingly consuming more prepared or ready-to-cook foods and less of the domestic grains which have to be prepared and which, normally, have very limited storage life. There are machines available which will pearl, de-germ and grind domestic grains into a storable flour, prepare couscous, etc. The capacity of the machines has to be matched to the potential market. A few of these machines have been installed in sub-Saharan Africa (e.g., Zinder, Khartoum, Botswana). A stable flour can be marketed which, as a convenience item, may increase the consumption of domestically produced grain and correspondingly reduce the demand to import grain or rice. The use of stable flour may also reduce the workload of the rural families by eliminating the need for daily trips to a mill.

Another method is to substitute some millet or sorghum flour for wheat flour in the making of bread. This works technically but unless the endosperm of the grain is of a suitable color, the bread is not white enough to be readily accepted. Sorghum flour is probably more easily used in this way than millet.

b. Objectives

The objectives are to increase the demand for domestically produced grain, and to reduce the demand for imported grain and to eliminate some of the heavy physical work imposed on women.

c. Suggested approach

The only practical method for achieving the objectives is first to conduct a market survey to estimate demand in as many of the Sahelian countries as possible. Then it will be necessary to introduce milling plants of suitable capacity and provide the training to operate them. Finally effective marketing methods will have to be established. Presently suitable milling equipment is available in Denmark and Switzerland but it may need to be better adapted.

The INTSORMIL CRSP has the technical capability to advise on the equipment and suitable varieties of grain. Some interesting work has been started in Senegal with IDRC financing. With additional resources these units may be willing to extend their work to the full Sahel.

d. Expected results

This technology may relieve the great burden on women by making food staples available that are partly prepared and still adapted to their food habits. It will also spark a demand for local grains that has fallen because of the limitations of preparation. This will slow down demand for competing imported products.

22. Bovine pathology

a. Background

After a period of relatively low incidence of rinderpest resulting from the first regional campaign to vaccinate cattle against rinderpest, the disease recently appears to have gained ground with the appearance of many new outbreaks. The preventive actions taken (upon requests) to eliminate the risk of renewed outbreaks have not been sufficient to prevent a new widespread epidemic of rinderpest. At the same time, outbreaks of contagious bovine pleuralpneumonia (CBPP) are also very widespread.

Effective vaccines are available and are manufactured in Africa. The rinderpest vaccine can be made in lyophilized or freeze-dried form which does not require refrigeration; this is not currently the case for CBPP. A combined vaccine is available but must be stored under refrigeration.

Animal health care delivery in some countries is in decline, with equipment that was renovated for the last international vaccination campaign ceasing to function effectively. Funds for fuel are inadequate, and causes the delivery system to fail in many areas. Residual pockets of disease then break out, and the problem spreads. Even with complete control within the region over the next ten-year period, protection against reintroduction from other regions will be necessary.

b. Objectives

The main objective is to have all livestock vaccinated as soon as possible to eliminate rinderpest and CBPP. It would be advisable to work with a single, combined vaccination against both diseases.

c. Suggested approach

First, veterinary research laboratories must step up efforts to make available a combined vaccine against rinderpest and CBPP. If the vaccine is available soon, it can be used. Otherwise double vaccination will continue. This will require a region-wide, joint campaign with substantial financial resources (for equipment, products, organizers, and technicians). If the vaccination campaign is successful, it could be followed up with the establishment of a system to closely control the boundaries of vaccinated regions to check for animals that might reintroduce the disease.

Before carrying out the vaccination campaign, a protocol agreement should be drawn up between all the countries involved concerning the participation of their livestock services. Programs should be formulated to inform herders (mainly by radio programs) of the campaign so they will become actively involved, and neighboring countries will need help in checking cattle movement across their borders.

d. Expected results

With the use of a combined vaccine (rinderpest and CBPP), or with double vaccination the major result expected is the total eradication of rinderpest and pleural pneumonia, and the ensuing improvement in animal health, higher productivity, and greater security.

At the same time, there could be increases in herders' incomes and meat availability for national consumers as well as dependable levels of animal-product exports.

23. Small-scale mechanization in agriculture

a. Background

Small-scale mechanization of agriculture in the Sahelian countries has largely been based on animal traction equipment designed in France, with whole machines or individual parts imported into Africa. Ties with French manufacturers have generally been maintained and have sometimes led to their assistance in manufacturing efforts in Africa.

There is a need for small artisan-used machinery for pearling and grinding grain, pressing oil, pumping water for irrigation, etc. (cf. CIEH). In some cases traders import this equipment, and an increase in production is realized.

There are also some problems in the farm machinery lines now available; for example, a low cost seeder would be very useful, particularly if it could be made locally. Some trade in farm machinery does take place between neighboring countries (for example, Senegal and Upper Volta export some machinery). However, the major need is for designs which are suitable for building in the individual countries.

The introduction of modernization to rainfed or irrigated agriculture produces major social problems as well as economic and technical problems. Experience gained over the last five years in this area indicates the need to be aware of gradual potential problems.

b. Objectives

The objectives are as follows:

- o Help establish more research units dealing with mechanization including introduce of motors where it is appropriate;
- o Make available to individual countries a collection of suitable plans and designs for simple machinery;
- o Provide information on manufacturing or assembly of the appropriate machines and help in training; and
- o Gather information on past experiences with motorization and identify the social implications and possible constraints.

c. Suggested approach

There are already considerable data bases available on simple agricultural machinery for manufacture, assembly and use in developing countries. The data comes from U.S., French, British, and Indian institutions and also from the IARC, IITA, IRRI, ICRISAT, etc.

An African institution within the sub-region, perhaps INSAH, would be identified and funded to set up a data base of suitable information synthesized from other sources. A sub-regional news letter would be prepared in French and English, using information from existing organizations.

A cadre of consultants, preferably Africans living in the sub-region, would be identified who would be capable of assisting private or public organizations who are interested in setting up plants to manufacture of agricultural machinery or parts or who desire evaluation of the varieties of available designs.

A review should be prepared of past experience and existing research on modernization and its economic, technical and social effects. This review should be distributed to policy makers and potential donors.

d. Expected results

This activity should indicate the constraints to motorization and assess the economic, technical, and social implications of its spread, all with the aim of eventual implementation to increase the productivity and income of the rural population. It should also increase production of the crops for which processing equipment is supplied. It may also provide an incentive to do away with monopolies, with the consequent increase in supply, lowering of price, and reduction of imports.

24. Climatology studies

a. Background

Given the severity of the drought in the Sahel over the last 15 years, the following aspect, which is of great concern and importance, has not been sufficiently discussed. Rainwater is the essential factor in any agricultural production in the broadest sense of the term. However, the alteration in climate that began in 1968 has often drastically changed earlier data on the "rainfall factor" so that, in a given place, the present ecological environment is generally very different from what it was previously. Production methods and experiments have been adapted, but what is vitally important at this time for the formulation of national agricultural policies is to know whether to expect additional changes in the environment and, if so, what kind of changes and for what period of time. Indeed, the drought (decline in average rainfall) raises doubts about the validity of current solutions and questions about the utility of certain adaptations or research.

Many serious studies have been done on this subject, one of which is the report of the U.S. National Academy of Sciences in 1982. So far most scientists have not come out with definite conclusions as to whether the desertification process is a slow and irreversible phenomenon or the result of a temporary cycle that will lead eventually to better moisture conditions. A regional organization, AGRHYMET, has already been set up in the Sahel to monitor, train and coordinate activities dealing with climatology. It is not certain that any new lines of investigation will be more successful, but because of the acuity of the problem, they should be tried.

b. Objectives

The main objective is to have a better idea of the probable length and development of the current climatic changes. It is desirable to determine if this change is an anomaly or a lasting situation resulting from new permanent factors. It is necessary to know whether the phenomenon will develop further, whether it has stabilized, or if it will be reversed. If this information proves to be reliable enough, it can be used to formulate amended policies for agricultural development and the use of water in agriculture.

c. Suggested approach

In order to gather additional data on climatic changes over as long a period as possible, a three-stage investigation is proposed:

- o In-depth study of climate parameters, mainly temperature and rainfall, after standardizing the series for the whole West African subcontinent from the start of observation; the study of rainfall will be conducted using the median as the statistical indicator (and not the average which is an inferior indicator when the statistical distribution is assymetrical as is the case in the Sahel);

- o Further study of land sediments deposited in several lake basins of the Sahel over a long periods of time (for example, Lake Chad, Niger Delta, Guiers Lake); and
- o Establishment of a correlation between these two series.

This may help in deciding whether one is dealing with recurring cycles, or whether recent climatic changes are a new development and are leading to permanent desertification. The sediment study would eventually be pursued over a longer time period in order to strengthen the conclusions.

Such a project would entail three to five years for data collection and processing and should be conducted by a team containing at least one hydro-climatologist highly experienced in the meteorology of the inter-tropical zone and with access to powerful computer resources. Such a study could be done under the aegis of AGRHYMET with adequate financial support from one or more donors.

d. Expected results

Better knowledge of probable climatic developments and, in particular, the rainfall of Sahelian countries, which would help to:

- o Redefine trends and establish new norms for rainfall based on the median;
- o Redefine the geographic thresholds at which it is risky to speculate on a rainfed crop policy and direct experiments accordingly; and
- o Readjust the hydrological models of the major river basins and hydrographic systems and, consequently, change, if necessary, some of the development policies planned for large-scale projects, in particular, hydro-agricultural projects.

25. Restoration of the Sahelian ecosystem

a. Background

While the traditional farming, herding, and fishing systems of the Sahelian countries are in general well-adapted to the realities of the ecosystem, having evolved over time to accommodate the environmental exigencies, these systems can no longer meet all the needs of the population. The recent climate changes and resultant problems have placed overwhelming burdens on the Sahelian population, who are increasingly contributing to the deterioration of the ecosystem by simply fulfilling their daily needs.

In agriculture, the requirements of growing populations have been met mainly by increasing the amount of cultivated land, steadily reducing fallow land, and, very often, by abandoning the practice of preserving some trees (for example, *Acacia Albida*) and shrubs that grow naturally in fields. All these steps have been taken because of the acute need for arable land. This has impoverished vegetation and sometimes disturbed soil ecology and nutrient replenishment, promoted runoff and erosion, and reduced replenishment of water tables.

The increased number of livestock between 1950 and 1968 and its recovery after the sharp drop due to drought have also contributed to the problem of over-exploitation of the Sahelian environment. In this case the most prominent effect is the deterioration of plant formations.

In forestry, the most important factor has been wood (or charcoal) consumption needs of urban populations and agro-industries (drying fish, for example). Enormous wooded areas, especially around large cities, have been emptied of all ligneous vegetation.

Environmental deterioration has been accelerated by recent low rainfall, below the long-term average of the last 15 years. Investigations are underway to ascertain if this is a permanent or a cyclical situation. In the short and intermediate terms there is clearly no means by which to change annual rainfall. It is possible, however, to improve the efficiency of the use of the rainfall. Currently, little research is directed towards this objective, and few projects are underway to identify means of combatting environmental degradation and to involve the rural population in restoration programs.

b. Objectives

The main objective is to identify means of action against specific aspects of environmental degradation and to provide documentation to aid the design and execution of conservation and reclamation projects.

c. Suggested approach

Studies are needed to identify constraints to the use of current technical knowledge in reducing and reversing environmental degradation. Critical subjects for these studies include land use, the use of trees and forest resources and management of common land.

A team of specialists should propose a small number of potentially viable technologies for implementation in the Sahelian and Sudanian zones. In collaboration with the national research and extension institutions, three to five sites should be selected for operational tests of the technologies. Each attempt should be designed as a distinct project, which could be attached to on-going development projects or to existing research organizations. In each case, socioeconomic research will be needed to identify the constraints against general adoption.

After three to four year trial period, a workshop should be scheduled, including site visits and demonstrations, to discuss the results and future action. These proceedings should be published and the results disseminated throughout the Sahel.

An organization must be contracted to field a design team, supervise the projects, conduct the workshop, and redesign and disseminate the resulting technologies.

d. Expected results

Halting the progress of environmental deterioration in the Sahel is not an easy task. The few results already obtained by various experiments in the different countries show that a rapid result cannot be expected, and even less so a spectacular one.

To obtain some initial results, however small, which would visibly curtail the on-going process would be of considerable merit. In particular, the psychological effect of such an action would aid a great deal in retaining the hope of all those whom this environmental deterioration gravely affects and who have sometimes lost faith that this deterioration can be stopped.

26. Improvement of the Azawak breed

a. Background

Work on the genetic improvement of the Azawak breed of Zebu began shortly before the 1940s at the Toukounous station in Niger and has had favorable results. However, it is feared that these accomplishments may be jeopardized since the country cannot find adequate financing to continue such a large-scale program.

The Azawak, bred at the Toukounous station, offers advantages to the countries of the region (particulalry Niger, Upper Volta, and Mali) mainly because of its excellent adaptation to the Sahelian pastoral environment and its milk production.

b. Objectives

The objective is to safeguard the accomplishments achieved by breeding the Azawak stock for more than forty years at the Toukounous station. The other goal is to assist in the distribution of breeding stock in all sectors of the ecological zone where its optimal habitat is found (that is, Sahelian pseudo-steppe with thorn bushes and annual grasses receiving approximately 300 to 400 mm of rain).

c. Suggested approach

The proposed action is to establish a protocol agreement between the donors and the countries whose territories include the Azawak habitat. This proposal is designed to secure financing to continue and improve the Zebu breeding program conducted at Toukounous.

In addition to participating in the financing of the genetic improvement program, it would also be useful to provide training opportunities to veterinarians or animal husbandry technicians from the countries involved. This training would keep them better informed of working methods and of the Azawak cattle potential in their respective countries.

d. Expected results

First, the genetic capital developed since the beginning of the program would be protected and increased, and there would be a greater number of available animals to be sent to the member countries.

The widespread distribution of this breed as proposed in the methodology, will then increase cattle products.

27. Animal breeding in the Tsetse-infested Sudanian zone

a. Background

Natural Sudanian pastures grow in the southern part of some Sahelian countries (except Mauritania and Cape Verde). These pastures have a high forage potential, but grazing is limited by the tsetse fly, a carrier of trypanosomiasis. The only cattle breed that are able to graze in these pastures are the N'Dama, or similar taurin cattle, or the crossbred Zebu-N'Dama, which have some degree of trypano-tolerance and are very adapted to this environment.

There are problems, however, in that besides their limited productivity and small size they do not currently exist in adequate numbers, nor are they prolific enough to ensure in the near future a sufficient population to occupy all the available grazing land. On the other hand, there is a large number of Zebu breed cattle in all Sahelian countries, but this breed is not trypano-tolerant and cannot be used to graze on the infested Sudanian pastures without taking major pathological risks.

b. Objectives

The proposal is to use a herd of N'Dama females from the infested zone, cross them with Zebu and produce first generation crossbreeds that will be trypano-tolerant and better sized.

By improving livestock production in the southern regions of Sahelian countries, this operation can partly offset the decline in livestock production resulting from pasture lands impoverished by drought in other parts of the Sahel.

c. Suggested approach

In order to provide the countries with enough animals as soon as possible, an N'Dama cattle breeding livestock center is proposed to produce ova from a cross between Zebu and N'Dama. The center would be located in a region with a favorable environment (that is, in Sudanian pastures infested by the tsetse fly), for example, in the Gambia. To maximize reproductivity, ova would be taken and transplanted into Zebu females which would be raised in the Sudanian pastoral zones of the various countries involved and protected by trypanocides. Finally through this project increased natural crossbreeding will also be encouraged in the Tsetse infested zones.

d. Expected results

The process will probably require a long time to be fully developed but will provide animals (F1 Crossbreeds, N'Dama X Zebu) to graze in pastures that are currently under-used because of the tsetse fly infestations. These animals supply increase output and thus offset the production losses seen in the northern zones of the countries.

ANNEX 1

Description and Characteristics of the Sahel

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The eight countries of the Sahel have important individual characteristics, but share a number of features which give to the sub-region its own identity as a distinct part of Africa. These fall into three major categories:

- o Physical characteristics;
- o Demographic and economic characteristics; and
- o Methods used in food crop production.

A. Physical Characteristics

Except for the Cape Verde Islands, the countries form a contiguous land area, mostly in the western bulge of Africa, with a very limited access to the Atlantic Ocean. Some general information on the geography, ecological classification and climate follows.

1. Geography

The eight countries extend from 25° longitude west to 25° east and from the 25° latitude north to the 10° north. The shape of the land mass is complex, much further from east to west than from north to south. The countries all lie quite close to the equator.

The total land area is about 5.3 million km².

The sub-region is bounded by the Atlantic Ocean, Western Sahara, Morocco, Algeria, Libya, Sudan, Central African Republic, Cameroon, Nigeria, Benin, Togo, Ghana, Ivory Coast, Guinea, and Guinea-Bissau. Apart from the Cape Verde Islands, only The Gambia, Mauritania and Senegal have direct access to the Atlantic Ocean; the international trade of the interior countries is more difficult and costly.

The surface water resources are quite limited, especially when only the permanent surface water is considered. The following are the most important river systems.

- o The Senegal River, which forms the frontier between Senegal and Mauritania, and also runs through Mali (total length 1,700 km);
- o The Gambia River which runs through Senegal and Gambia (total length 1,130 km);
- o The Niger River which runs through Mali and Niger (total length 4,200 km);
- o The Volta Rivers which run in Upper Volta (total length 1,600 km); and
- o The Logon and Chari Rivers which run in Chad (total lengths 900 km and 1,200 km).

There are only two major lakes, Lake Chad which lies partly in Chad and Niger, and the interior delta of the Niger, which during the flood of the river covers a large area in Mali.

Apart from some small chains of mountains in Chad, Niger and Mali (and the extinct volcanoes of the Cape Verde Islands), there is very little land over 1,000 m in altitude in the sub-region.

2. Ecological zones

As far as agriculture is concerned there are four large ecological zones, which are the Saharan, the Sahelian, the Sudanian and the Sudano-Guinean zones.

In the north is the Saharan zone which, as is indicated by its name, is made up of desert, with rocks or sand. It covers 77 percent of Mauritania, almost half of Mali and of Chad, and 65 percent of Niger. Apart from a small number of nomadic herds, crops are found only in the cases and in the mountains; there are a limited number of plants whose products are gathered by the people. This zone produces little in the way of food crops.

The Sahelian zone, which has given its name to the sub-region, occurs in all of the continental countries in the sub-region except The Gambia. It covers 35 percent of Senegal, 30 percent of Niger, 25 percent of Mali, 20 percent of Mauritania and of Chad, and 15 percent of Upper Volta. This zone has limited surface water resources and a low and poorly distributed rainfall. The lack of rainfall makes rainfed crop production difficult. Particularly on the banks of the rivers there is irrigated crop production, which can be quite large in scale. Perhaps more important but less dependable is the flood recession agriculture practiced on the flood plains of the rivers. The percentage of crop production from the Sahelian zone ranges from 90 percent in Mauritania, 47 percent in Niger, 27 percent in Mali, 16 percent in Chad, 14 percent in Senegal and 3 percent for Upper Volta. The Sahelian zone provides the pasture for a large part of the ruminant population; this ranges from 80 percent in Mauritania, 75 percent in Niger, 70 percent in Mali, 60 percent in Chad, 50 percent in Senegal and 20 percent in Upper Volta.

The Sudanian zone includes all of The Gambia and the southern part of the other continental countries. It has more surface water and more frequent and a higher average rainfall, with a greater reliability from one year to another. Most of the irrigated agriculture is in this zone as are the cash crops of rice, groundnuts, sugar cane, cotton, vegetable crops, bananas, and citrus. This zone is not present in Mauritania; it covers 5 percent of Niger, 25 percent of Mali, 30 percent of Chad, 65 percent of Senegal and 85 percent of Upper Volta.

The Sudano-Guinean zone includes only small areas in the south of Senegal, Mali, Upper Volta, and Chad. The rainfall exceeds 1,000 mm a year and the rainy season is up to six months in length. The small area of this zone in the sub-region limits its agricultural importance. The most important crops in this zone are rice, sorghum, maize, sugar cane, tubers and fruit and tea in Mali.

3. Climate

The climate of the Saharan zone is characterized by extremes of temperature between night and day and between the different seasons of the year. Night-time temperatures may fall to zero centigrade in January from 50° in daytime in May. Rainfall ranges from 0 to 150 mm a year.

The climate of the Sahelian zone is characterized by a smaller range in temperature difference, with lows of 10°C in December or January and over 40°C in May. The rainfall is from 200 mm a year in the north to 700 mm in the south. There are two main seasons; the dry season from November to the end of May and the rainy season from June to October. This was the zone which was the most affected by the recent series of dry years. The temperature is quite cool from November to February; the warm, dry winds, the harmattan, dominate the climate from March to June; and the humid winds, the mousson, blow in the rainy season.

The climate of the Sudanian zone and of the Sudano-Guinean zone is more humid and has a temperature ranging from 15°C to 40°C. There is a higher rainfall, 700 to 1,500 mm a year. The rainy season is longer, from May to November.

B. Demography and Economy

This section provides information on the population, the ethnic groups, the languages, the religions, the political systems, and the economy.

1. Population

The population of the sub-region in 1982 was 33,200,000. Population is increasing at the rate of 2.6 percent a year. There are substantial migrations, both temporary and permanent in the Sahel; people move both within and outside the region. Historically, economic differences have caused the flow of workers to other African countries such as the Ivory Coast, Cameroon and Nigeria, and also to Europe.

The illiteracy rate is still high; it ranges from 40 percent to 85 percent by country. The educational system still shows the form established by colonialism but increasing efforts are now apparent to provide education to all social classes as well as furnishing the elements of practical instruction (alphabetisation). In spite of all these laudable efforts the urban education is still far ahead of rural. There are also schools in the sub-region where some instruction is given in the vernacular; Arabic is being taught in some formal schools as well as in the traditional Koranic schools.

2. Ethnic groups, languages, religions

Each country has its own mixture of ethnic groups and the political frontiers never coincide with the ethnic or linguistic frontiers. Thus several related ethnic groups are found in several countries in the Sahel.

There are probably over a hundred ethnic groups living in the sub-region. The following groups are mentioned in the national reports as having a million or more people--Mossi, Hausa, Bambara, Fulani, Wolof-Lebou, Touareg, Maure, Serer, Toucouleur, Sara, Songha-Djerma.

The official language in the sub-region is French, except for The Gambia, where it is English and Cape Verde, where it is Portuguese. Each country also has a diversity of local languages and dialects. For example, Manding is widely spoken in The Gambia, Bambara in Mali, Morè in Upper Volta, Hausa in Niger, Wolof in Senegal and Chuta Arabic and Sara in Chad.

The Moslem religion predominates in The Gambia, Mali, Mauritania, Niger and Senegal and is the religion of the majority in Chad. Animism is the dominant religion in Upper Volta. Christianity is dominant in Cape Verde. Christians are numerous in Chad and make up a small percentage of the population in the other countries.

3. Political systems

All of the countries in the sub-region obtained their independence in the early 1960s, except for the Cape Verde Islands which became independent in 1975. Almost all of the countries had a long period of colonisation under the French which has left its mark on the institutions even today. The Gambia was a British colony and Cape Verde was a Portuguese colony. The French presence in the Sahel is still considerable. French is used as a language, as the medium of instruction and as part of the culture. Many French volunteers work in the Sahel and France also has a presence in banking and commerce.

The Sahelian countries are republics, with the majority having a strong presidency. Some of the countries have a single political party and some are run by the military.

The beginnings of effective collaboration based on the sub-region can be seen, but so far this has been limited and the most positive element has certainly been a common concern about the effects of the drought because of the CILSS. CILSS is a unique organization, with a mandate of informing the international community about desertification and its related effects. The word Sahel has, meanwhile, been accepted by all of these countries as describing a real entity, which is certainly a first step towards a more complex plan which is shown by the creation of other regional groups such as the Economic Community of West African States (ECOWAS), the Economic Community of West Africa (CEAO), and the Counsel of the Entente. It is also true that from the outside, the sub-region is a real entity and the international development community is ready to take it into account.

4. Economy

With an average per capita income ranging from US\$ 100 to US\$ 430, the sub-region is a developing zone which includes some of the least developed countries (IBRD definition).

A very large part of the working population is occupied in the primary sector, and is thereby associated with the production of food. In spite of this effort, given a number of adverse factors, this part of Africa has a food deficit which seems to get slightly worse each year. Although overall food production continues to increase in every

country, the rate of growth of the population (probably in excess of 2.5 percent per annum) substantially exceeds per capita growth of production.

The GDP's over the last five years have grown at estimated rates of between two and five percent a year. The primary sector, which employs the majority of the workers, in no case contributes over 40 percent of the GDP, which shows the weak economic power of the producers and the low level of their income in relation to those of the other classes.

Communication remains a major economic problem in the Sahel. Only four of the eight countries have direct access to the ocean. The railroad network is very incomplete. The investment required to make most of the communication routes serviceable during the rainy season is enormous and outside the range of existing national resources. Considering the vast size of countries like Chad, Niger, Mali and Mauritania, with less than seven inhabitants per km², it is clear that for a long time yet it will be difficult to provide all-season roads throughout the countries. The best method of transport for individuals remains the airplane; but most of the planes are not suitable for carrying heavy freight.

Except for The Gambia, Mauritania, and Cape Verde,¹ all of the countries have a currency tied to the French franc. The Malian franc is worth 1/100 of a French franc. The CFA franc, used in Senegal, Upper Volta, Niger and Chad, is worth 1/50 of a French franc. All of these countries have strongly felt the decline in value of the French franc in relation to the US dollar in 1983, because the dollar is used to fix the price of many of the imports.

None of these countries is yet a producer of petroleum and they have all been vulnerable to the energy crises which have occurred since 1973.

The sub-region has little hydro-electric power resources and so a large part of the energy for industrial and household use is based on petroleum.

A major part of the investments made in these countries since independence has come from transfers from the rest of the world. Very often, once the infrastructure or equipment is in place, it becomes clear that there are not enough funds in the operating budget to cover the cost of operation or the purchase of spare parts. This is one of the reasons difficulties are experienced that slow and complicate economic life. A large part of the public expenditure is financed by international development organizations and donor countries. All of the countries are subjected to an increasingly heavy weight of national debt.

C. Food Production

Although all of these countries have substantial differences with respect to their ecological zones, in the Sahel there are common characteristics in food production. The statistics available and the data for the commodities listed show these common characteristics.

¹Since 1984, the Malian franc has the same exchange rate as the CFA franc (1/50 of the French franc).

All of the countries in the sub-region have individually and collectively adopted a priority objective of achieving food self-sufficiency; in spite of this, the food balance does not seem to improve. One precise and rapid way to describe the evolution of the situation is to study the cereal imports in the Sahel as reported by the FAO. During the period 1970-1982, cereal imports for the region more than doubled to meet consumption needs.

At the beginning of the 1970s the level of cereal imports for the Sahel was between 400,000 and 600,000 MT per year. With the drought years in the 1970s it exceeded 800,000 tons. In the last five years (1978-1982) regional cereal imports reached an average of one million MT--more than double the rate in 1970. In 1983, the indications are that the situation has been even more critical.

It seems that the words "food self-sufficiency" can not mean much until improvements in productivity are developed by research and communicated by the extension service to the farmers who could put them into practice. The implementation of improvements should be encouraged by changes in national agricultural policies which would produce the necessary prices for the rural population to respond. Certain countries like Chad, Mali, Niger, and Upper Volta can aim at almost complete self-sufficiency in food. For the others, the deficit is so large that it would be more appropriate to talk about a higher level of self-sufficiency while hoping that certain exports could pay an increasing part of the cost of importing the remaining deficit.

1. General statistics

Agricultural statistics in industrialized countries are, at best, only approximations because the sector is always dispersed and difficult to census. However, the quality of such data is still more accurate than that found in countries like those of the Sahel.

Where accurate statistics are very difficult to obtain on a regular basis, the partial reports and the comments received on the 1983 harvest indicate a considerable reduction in production due to the drought. Once again, people are talking of the substantial losses in livestock and requests for increased food aid for the Sahel are becoming more and more urgent.

Some general conclusions can be drawn from the available statistics. The production averages for all of the major Sahelian commodities (see Table 2-4 in Annex 2) was about the same for 1966-70 and 1971-75, in spite of the fact that the population had increased by 14 percent during the five years. It would have been necessary to have produced 10,813,000 tons to provide the same per capita production during the second five-year period. The second period thus shows an adjusted deficit of 1,400,000 tons and the effect of the big drought in the early 1970s is apparent.

The third period 1977-1981 has an annual mean production of 11,169,000 tons. Following the same reasoning and allowing for the increase in population, taking 1971-75 as the base period, production per capita would be maintained with a total of 10,729,000 tons; using 1966-70 as the base, 12,327,000 tons would have been needed to maintain per capita production. In comparison to 1971-75, a period of relatively low production, there was a 4 percent increase in per capita production in 1977-81; while in comparison to 1966-70, a more

normal period, there was a decline of 9 percent. For the period which started in 1982, all indications are that there is little, if any, improvement. Hence, it will be necessary to use a lot of energy, a strong political determination, and a maximum of technological knowledge to reach the per capita level of production and food self-sufficiency of 1966-70, which itself was not optimal. It will be necessary among other things to find a more accurate system of following the changes of the statistics on the human food balance in the Sahel.

A comparison of per capita production for 1969-71 and 1977-79 demonstrates a decline in food production in seven of the eight countries; Upper Volta, as the exception, simply maintained the earlier levels.

a. Millet and sorghum

Some of the countries include the different types of millet and sorghum production together; this is why only one figure is available for the sub-region. Only in Upper Volta is more sorghum produced than millet; in the whole sub-region at least five times more millet is produced than sorghum. These two cereals are still the base of the diet in spite of the fact that the urban populations eat increasing quantities of rice and of wheat (in the form of bread). The three countries with the highest millet and sorghum production are Niger (33 percent of the total of the Sahel), Upper Volta (23 percent) and Mali (17 percent). The 14 percent increase in production from 1978 to 1981 has been about the same as the rate of increase in the population.

b. Groundnuts

A major part of the production of this commodity leaves the sub-region in the form of oil or cake. This is true especially from Senegal and The Gambia. This provides the foreign currency necessary to pay for part of the food imports. For several years the terms of trade have usually been favorable, but at the beginning of the decade of the 1980s the relative value of groundnuts declined sharply and the price of imported cereals increased; in this way the old economic equation (exercising the comparative advantage) was less profitable. Recently, the groundnut price has recovered. The two principal producers in the sub-region are Senegal (55 percent) and Mali (17 percent). The increase in production during the five years, 1977-1981, was 34 percent.

c. Roots and tubers

This includes mainly cassava and sweet potatoes. The most important producers are Niger (34 percent) and Chad (31 percent). The production has not changed much during the five years.

d. Pulses

Pulses are a good source of vegetable protein; they include peas and beans, with most of the production being cowpeas. The most important producers are Niger (45 percent) and Upper Volta (30 percent). The total production of pulses has increased by 18 percent in the five years, which is a little more than the rate of increase in population.

e. Sugar cane

The production is usually expressed in the weight of cane harvested in the field and not the sugar obtained. The two most important producers are Senegal (35 percent) and Upper Volta (27 percent). The production has increased considerably in the five years, by 55 percent.

f. Rice (paddy)

The production of rice has not increased greatly in five years (13 percent). This is slightly less than the rate of increase of the population. This means that the increasing demand for this food is increasingly satisfied by imports. The major producers are Mali (45 percent) and Senegal (25 percent).

g. Maize

Maize is slow to become generally established in the Sahel mainly because of its water requirement. The production has increased by 37 percent in the five years however, due to its increased planting in the areas of higher rainfall. This increase in production is much greater than the increase in population. The principal producers are Mali (35 percent), Upper Volta (28 percent) and Senegal (24 percent).

h. Fruits and vegetables

The composition of this category varies greatly from one country to another. The statistics probably do not include important amounts of production, especially that gathered in the bush and the production of the kitchen gardens. Four countries have a similar level of production: Senegal (22 percent), Niger (20 percent), Mali (19 percent), and Chad (19 percent). The data indicate an increase of 18 percent in five years.

i. Meat

This category is difficult to quantify because of the substantial movement of animals between countries by transhumant herders. The statistics used are those of the FAO. In spite of the 1969-73 drought which decimated the herds, a substantial increase in production has occurred, 28 percent between 1977 to 1981. The per capita production in 1981 was similar to that in 1966-1970. Unfortunately, recent information once again indicates the death of many animals from lack of water and feed. The principal producers are Mali (26 percent), Niger (20 percent) and Senegal (18 percent).

The quantity of hides and skins reported in 1981 was 58,000 tons, about the same as the 54,000 tons reported in 1977.

j. Fish

The production and consumption of fish in the Sahel is quite high, especially considering the limited access to the ocean. Some of the National Reports contain only fragmentary statistics and so the FAO statistics were used for marine and inland fish production. There seems to have been a slight reduction between 1977 and 1981. The average annual production during this period was 624,800 tons, which is about the same per capita as that in 1966-1970. The most

important producers are Senegal (56 percent), Mali (17 percent) and Chad (15 percent).

k. Non-food production

In the sub-region the important non-food commodity is cotton. The average annual production in the Sahel in 1966-70 was 200,000 tons, and in 1971-75 it was 274,000 tons. It was 346,000 tons in 1977, 370,000 in 1978, 321,000 in 1979, 349,000 in 1980 and 300,000 in 1981, giving an average of 337,000 for the five years. It normally has a strong extension service and more intensive methods of production are used (for example, more fertiliser) than those used for food crop production.

2. General remarks on crop production

The above commodities are those which are found in almost every country in the sub-region. Each country also has certain particular products or varieties, especially among fruits and vegetables. In the towns, the demand continues to increase for convenience items and items that are pre-prepared--rice, bread, flours, pasta, cookies, conserves, etc. This increases the food imports since the volume of rice produced in the region is insufficient and there is very little wheat produced.

The average area cultivated per farmer is still very limited. In rainfed farming, the traditional methods persist, for example growing cowpeas in association with millet or sorghum, and the use of a bush-fallow rotation; meanwhile the demographic pressure continues to increase. Hand tools, like the hoe and the cutlass, are still frequently used. There is a slight increase in animal traction, especially in Senegal, Chad and Mali, but the progress is slow.

3. General remarks on livestock production and fisheries

In spite of many years of drought, the sub-region is still distinguished by its large livestock population. According to the FAO (Yearbook of Production) the livestock population in 1981 in the Sahel was:

- o 19,000,000 cattle;
- o 21,000,000 sheep;
- o 23,000,000 goats;
- o 1,800,000 donkeys;
- o 1,700,000 camels;
- o 900,000 horses; and
- o 500,000 pigs.

In the pastoral zones, the large herds are continually on the move, either in a limited system of transhumance or covering much longer distances. Nomadism, in its strict sense, is disappearing.

There are official channels of export of animals and meat, in principle, under controls. But there is also a clandestine system, usually of live animals for which there are no statistics. The exports are not limited to the sub-region.

Meat is a quite important component of the diet of the Sahelian people but the per capita consumption is declining.

As stated earlier, there is a trend in several of the countries for animal traction to increase. The animals used are mostly donkeys and oxen. This trend is most marked for cotton and peanut production. The economic studies that have been done on the profitability of animal traction do not permit drawing general conclusions. Allowance has to be made for the different crops, soils, the area farmed per animal and the forage available.

Inland fisheries are certainly limited by the reduction in the area of surface water, but the local populations seem to take advantage of this high protein resource. Only Senegal, Mauritania, The Gambia and Cape Verde have marine fisheries. These countries also export fish.

ANNEX 2

Statistical Data on the Sahel

ANNEX 2

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Table 2-1: Agro-climatic Conditions

	<u>Area of Country (km²)</u>	<u>Percent of Land Cultivated</u>	<u>Irrigated Cropland^a (hectares)</u>	<u>Dry Cropland^a (hectares)</u>	<u>Range of Rainfall (mm/year)</u>	<u>Rainy Season Duration (months)</u>	<u>Ecological Zone^b</u>
Cape Verde	4,000	9.1	1,790	34,994	250-1,400	0-3	1,2
Chad	1,284,000	0.8	1,000	1,000,000	50-1,000+	3-6	1,2,3,4
Gambia	11,000	NA ^c	25,000	NA	800-1,400	4-5	2,3
Mali	1,240,000	1.7	90,000	2,000,000	200-1,700	3-6	1,2,3,4
Mauritania	1,031,000	0.2	8,000	184,000 ^d	100-350	2	1,2
Niger	1,267,000	3.1	24,000	3,842,000	0-800	0-3½	1,2,3
Senegal	196,000	26.0	127,000	5,000,000	350-1,600	2-5	2,3
Upper Volta	274,000	9.3	87,400	2,550,000	300-1,230	1-4	2,3

^aFigures here reflect the average area under actual cultivation; they often represent a fraction of cultivable land. Sources: Data collected during the Devres/INSAH/AID Agricultural Research Resource Assessment, 1983; and a provisional, unpublished report by W.H.M. Morris entitled "Recent History and Prospects of Agriculture in Sahelian Africa" (available through the Department of Agricultural Economics at Purdue University).

^bThere are 4 major ecological zones in the Sahel. Most countries fall within more than one zone. The numbers designate the following zones: 1=Saharan; 2=Sahelian; 3=Sudanese; 4=Sudano-Guinean.

^cNA = Not Available.

^dDryland agriculture in Mauritania takes place exclusively at those oases which have not been severely affected by the drought.

Table 2-2: Socioeconomic Indicators of the Sahel Countries^a

	Physical Quality of Life Index (PQLI) ^b	Population ^c 1983	People ^c Per km ²	Birth Rate Per 1,000 ^d	Death Rate Per 1,000 ^d	Life Expectancy at Birth ^d	Infant Mortality Per 1,000 Live Births ^d	Literacy ^e	Per Capita Public Education Expend's 1983 (\$)	Per Capita GNP 1981 (\$)	Per Capita GNP (Real) Growth Rate 1970-81 (%)
Cape Verde	57	296,000	73	29	8	60	82	37	NA ^f	300	3.8
Chad	24	4,600,000	4	44	24	40	149	15	3	120	-5.0
Gambia	20	696,000	65	49	28	41	198	15	15	348	1.6
Mali	23	7,200,000	6	52	24	42	154	9	8	185	2.0
Mauritania	27	1,700,000	2	50	22	50	143	17	17	484	-0.5
Niger	23	6,000,000	5	51	22	42	146	5	12	336	0.2
Senegal	24	6,200,000	31	48	22	48	147	10	18	499	0.2
Upper Volta	18	6,700,000	24	48	22	42	211	9	5	237	1.8

^aOverseas Development Council, U.S. Foreign Policy and the Third World--Agenda 1983, (New York: Praeger Publishers, Inc.), 1983, except for population and population density.

^bEach country's Physical Quality of Life Index (PQLI) is based on an average of life expectancy at age one, infant mortality and literacy.

^cSource: Data collected from the Devres/INSAH/AID Agricultural Research Resource Assessment, 1983.

^dAs these countries lack complete registration systems, these figures are from the late 1970's and are estimates.

^eLiteracy estimates generally represent the proportion of the adult population (15 years of age or older) able to read and write.

^fNA = Not Available.

Table 2-3: Population Growth in the Sahel--1970, 1975
1980, 1982, 2000, 2050
(millions of persons)

	1970 ^a	1975 ^a	1980 ^a	1982 ^b	2000 ^b	2050 ^b
Cape Verde	0.3	0.3	0.3	0.3	0.4 ^a	NA ^c
Chad	3.6	4.0	4.5	4.6	7	17
The Gambia	0.4	0.5	0.6	0.7	1.0 ^a	NA
Mali	5.4	6.1	6.9	7.1	12	31
Mauritania	1.2	1.4	1.6	1.6	3	6
Niger	4.0	4.6	5.3	5.9	11	29
Senegal	4.3	5.0	5.7	6.0	10	26
Upper Volta	<u>5.4</u>	<u>6.1</u>	<u>7.0</u>	<u>7</u>	<u>10</u>	<u>25</u>
TOTAL	24.6 =====	28.0 =====	31.9 =====	33.2 =====	54.4 =====	134 ^d =====

^aPopulation Reference Bureau, Demographic Indicators of Countries: Estimates and Projections as Assessed in 1980, (New York: United Nations, 1982).

^bWorld Bank, World Development Report 1984, (New York: Oxford University Press, 1984), pp. 192 and 218.

^cNot available.

^dTotal figure does not include the population of Cape Verde or The Gambia which together in 2050 would be about 2 to 3 million.

Table 2-4: Food Production in the Sahel 1966-70, 1971-75,
and 1977, 1978, 1979, 1980 and 1981
(in thousands of metric tons)

<u>Commodity</u>	<u>Average</u> <u>1966-70</u>	<u>Average</u> <u>1971-75</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>
Millet/Sorghum	3950	3600	4300	4970	4450	4570	4900
Peanuts(shell)	1610	1560	1100	1590	1140	1020	1475
Root crops	690	670	700	760	800	800	700
Pulses	400	600	700	590	640	600	825
Sugar cane	850	950	1100	1190	1360	1470	1700
Rice(paddy)	380	370	375	520	410	450	425
Maize	215	210	200	280	270	270	275
Fruits/Vegs	570	650	700	740	790	790	825
Meat	350	300	350	370	380	400	450
Fish	<u>490</u>	<u>501</u>	<u>625</u>	<u>655</u>	<u>593</u>	<u>651</u>	<u>600</u>
TOTAL	9485 =====	9411 =====	10150 =====	11665 =====	10833 =====	11021 =====	12175 =====

Sources: Food and Agricultural Organization, FAO Production Yearbooks
1966 to 1981 and data gathered from DEVRES/INSAH Agricultural
Research Resource Assessment, 1983.

Table 2-5: Agricultural Production by Commodity and Country^a

<u>Country</u>	<u>Millet/Sorghum</u> ^b (000 MT)						
	<u>Average 1967-70</u>	<u>Average 1971-75</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>
Cape Verde	<1	<1	<1	<1	<1	<1	<1
Chad	662	509	574	580	520	600	580
Gambia	41	43	19	29	20	29	38
Mali	782	664	751	1,035	744	750	930
Mauritania	89	47	21	17	35	19	67
Niger	722	850	1,472	1,494	1,592	1,732	1,632
Senegal	540	567	420	803	496	540	736
Upper Volta	917	896	960	1,016	1,035	889	1,150

^aAll statistics, except those for fish, taken from FAO Production Yearbook, 1971-1982, vols. 25-36 (Rome: FAO, 1972-1983). Fish statistics are from FAO, Yearbook of Fisheries Statistics, 1973, 1981, vols. 36 and 52 (Rome: FAO, 1974, 1984). In a number of instances, specific statistics varied from volume to volume. This may cause minor inconsistencies in these tables.

^bSome of the countries include different types of millet and sorghum together; thus, only one figure available per country.

Table 2-5: Agricultural Production by Commodity and Country (cont.)

<u>Country</u>	<u>Groundnuts in Shell</u> (000 MT)						
	<u>Average 1967-70</u>	<u>Average 1971-75</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>
Cape Verde	2	1	<1	<1	<1	<1	<1
Chad	107	62	85	86	87	110	113
Gambia	130	132	145	115	120	80	130
Mali	125	158	229	146	179	130	190
Mauritania	<1	1	2	3	4	4	4
Niger	257	148	82	99	81	100	96
Senegal	804	946	596	1,070	787	489	900
Upper Volta	76	69	75	70	75	77	77

Table 2-5: Agricultural Production by Commodity and Country (cont.)

<u>Country</u>	<u>Roots and Tubers</u>						
	<u>(000 MT)</u>						
	<u>Average</u> <u>1969-71</u>	<u>1975</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>
Cape Verde	14	16	21	18	18	18	19
Chad	303	101	106	367	386	392	396
Gambia	8	9	7	6	7	7	7
Mali	80	84	86	110	113	115	116
Mauritania	6	5	6	8	8	8	8
Niger	190	192	250	229	252	253	254
Senegal	174	118	135	125	125	126	NA ^a
Upper Volta	101	118	110	135	117	119	119

^a NA = Not Available.

Table 2-5: Agricultural Production by Commodity and Country (cont.)

<u>Country</u>	<u>Pulses</u> (000 MT)					
	<u>Average</u> <u>1969-71</u>	<u>1975</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>
Cape Verde	1	1	<1	1	1	2
Chad	56	56	57	56	56	56
Gambia	3	3	3	3	3	3
Mali	33	33	34	35	35	36
Mauritania	11	10	10	25	25	26
Niger	115	231	256	280	312	269
Senegal	22	21	21	13	14	15
Upper Volta	153	180	165	180	190	190

Table 2-5: Agricultural Production by Commodity and Country (cont.)

<u>Country</u>	<u>Sugar Cane</u> (000 MT)						
	<u>Average 1969-71</u>	<u>1975</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>
Cape Verde	11	7	8	14	15	15	15
Chad	22	NA	NA	165	215	220	220
Gambia	<1	<1	<1	<1	<1	<1	<1
Mali	56	94	102	145	213	220	225
Mauritania	<1	<1	<1	<1	<1	<1	<1
Niger	38	135	90	170	189	190	190
Senegal	<1	150	260	300	367	473	600
Upper Volta	<1	190	300	315	360	350	350

Table 2-5: Agricultural Production by Commodity and Country (cont.)

<u>Country</u>	<u>Rice (paddy)</u> (000 MT)					
	<u>Average 1967-70</u>	<u>1975</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>
Cape Verde	<1	<1	<1	<1	<1	<1
Chad	42	30	20	40	30	30
Gambia	39	31	11	25	21	25
Mali	161	218	182	252	177	200
Mauritania	1	4	5	4	4	4
Niger	34	29	30	32	24	32
Senegal	118	116	62	140	122	130
Upper Volta	35	40	23	28	30	30

Table 2-5: Agricultural Production by Commodity and Country (cont.)

<u>Country</u>	<u>Maize</u> (000 MT)					
	<u>Average</u> <u>1969-71</u>	<u>1975</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>
Cape Verde	2	5	2	9	1	5
Chad	9	10	10	10	10	10
Gambia	3	10	2	13	10	10
Mali	81	71	85	80	85	75
Mauritania	4	3	3	5	5	5
Niger	3	7	7	9	9	9
Senegal	42	49	46	53	45	45
Upper Volta	60	84	50	100	100	100

Table 2-5: Agricultural Production by Commodity and Country (cont.)

<u>Country</u>	<u>Fruits and Vegetables</u>						
	<u>(000 MT)</u>						
	<u>Average</u> <u>1967-70</u>	<u>Average</u> <u>1971-75</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>
Cape Verde	17	16	18	20	21	21	21
Chad	75	81	81	145	163	160	163
Gambia	8	10	8	10	11	11	11
Mali	116	103	105	129	134	139	145
Mauritania	41	17	19	22	23	23	23
Niger	88	122	96	146	172	171	172
Senegal	92	127	150	153	154	166	166
Upper Volta	93	87	85	112	124	125	128

Table 2-5: Agricultural Production by Commodity and Country (cont.)

<u>Country</u>	<u>Livestock^a</u> (000 head)		<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>
	<u>Average</u> <u>1966/67-</u> <u>1969/70</u>	<u>Average</u> <u>1971-75</u>					
Cape Verde	64	64	62	109	11	114	115
Chad	9,286	9,302	9,245	9,324	9,398	9,541	9,231
Gambia	412	472	490	621	638	663	690
Mali	13,993	13,991	16,010	16,670	16,911	18,733	19,261
Mauritania	8,392	8,690	9,519	9,227	9,527	9,693	9,706
Niger	13,494	11,340	12,578	13,385	13,792	14,348	14,502
Senegal	5,868	5,421	5,683	5,937	6,099	6,024	5,939
Upper Volta	7,247	5,980	7,168	7,467	7,651	7,847	8,056

^aLivestock includes cattle, horses, mules, asses, camels, sheep, goats and pigs.

Table 2-5: Agricultural Production by Commodity and Country (cont.)

<u>Country</u>	<u>Fish</u> (000 MT)						
	<u>Average</u> <u>1967-70</u>	<u>Average</u> <u>1971-75</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>
Cape Verde	5.0	4.8	8.3	8.3	7.5	8.8	11.1
Chad	112.5	115.0	110.0	111.0	115.0	115.0	115.0
Gambia	5.1	8.8	23.0	28.7	17.4	18.5	12.1
Mali	90.0	92.0	100.0	100.0	100.0	100.0	100.0
Mauritania	30.2 ^a	39.0 ^b	34.2	34.2	34.2	34.2	34.2
Niger	5.2	13.9	7.4	8.8	8.9	1.6	1.5
Senegal	175.3	287.2	267.8	279.4	242.5	250.2	206.7
Upper Volta	4.8	4.2 ^c	NA ^d	NA	NA	NA	NA

^a1967-69 average.

^b1972-75 average.

^c1971-73 average.

^dNA = Not Available.

Table 2-5: Agricultural Production by Commodity and Country (cont.)

<u>Country</u>	<u>Cotton (lint)</u> (000 MT)						
	<u>Average 1967-70</u>	<u>Average 1971-75</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>
Cape Verde	<1	<1	<1	<1	<1	<1	<1
Chad	43	48	45	50	43	30	26
Gambia	<1	<1	<1	<1	<1	<1	<1
Mali	18	26	42	48	48	56	40
Mauritania	<1	<1	<1	<1	<1	<1	<1
Niger	3	3	1	2	2	2	1
Senegal	3	11	14	12	13	8	15
Upper Volta	10	11	20	14	20	29	24

)

Table 2-6: Cereal Production in the Sahel, 1970-1982
(in thousands of metric tons)

<u>Country</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>
Cape Verde	12	12	13	13	1	5	4	2	9	1	7	3	5
Chad	789	693	407	389	603	571	590	622	648	652	678	661	683
The Gambia	66	88	90	92	110	123	68	48	71	57	80	89	86
Mali	859	1154	859	709	802	1012	1229	1070	1419	1236	955	1204	1227
Mauritania	74	80	54	34	57	37	38	29	26	44	29	80	56
Niger	1034	880	744	575	1137	929	1347	1508	1530	1629	1777	1684	1719
Senegal	720	729	380	581	954	806	714	517	996	665	663	896	828
Upper Volta	<u>1050</u>	<u>881</u>	<u>871</u>	<u>829</u>	<u>1193</u>	<u>1250</u>	<u>1194</u>	<u>1055</u>	<u>1208</u>	<u>1212</u>	<u>1036</u>	<u>1299</u>	<u>1282</u>
TOTAL	<u>4,604</u>	<u>4,517</u>	<u>3,418</u>	<u>3,222</u>	<u>4,857</u>	<u>4,733</u>	<u>5,184</u>	<u>4,851</u>	<u>5,907</u>	<u>5,496</u>	<u>5,225</u>	<u>5,916</u>	<u>5,886</u>

Source: Food and Agriculture Organization, FAO Production Yearbooks, 1971, 1973, 1974, 1976, 1978, 1979, 1981 and 1982, (Rome: FAO Statistics Division).

Table 2-7: Cereal Imports in the Sahel, 1970-1982
(000 MT)

<u>Country</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>
Cape Verde	24	47	45	35	45	40	28	53	68	42	64	46	57
Chad	10	9	10	20	50	12	20	18	18	20	8	14	57
The Gambia	18	12	13	17	11	26	50	42	61	45	47	42	41
Mali	31	63	65	156	227	192	30	18	69	40	81	87	143
Mauritania	63	75	83	105	126	122	139	160	201	87	172	167	219
Niger	8	6	19	19	27	27	65	30	83	34	87	141	120
Senegal	239	365	288	458	350	369	417	419	446	505	414	459	492
Upper Volta	<u>30</u>	<u>19</u>	<u>40</u>	<u>39</u>	<u>74</u>	<u>94</u>	<u>29</u>	<u>52</u>	<u>87</u>	<u>82</u>	<u>77</u>	<u>48</u>	<u>98</u>
TOTAL	423 =====	596 =====	562 =====	849 =====	910 =====	882 =====	778 =====	792 =====	1,033 =====	855 =====	950 =====	1,004 =====	1,227 =====

Source: FAO Yearbooks of Trade, 1970 to 1982, (Rome: FAO Statistics Division).

Table 2-8: Classification Of National Research Effort by Research Type and Operational Status

	<u>Cape Verde</u>	<u>Chad</u>	<u>The Gambia</u>	<u>Mali</u>	<u>Mauritania</u>	<u>Niger</u>	<u>Senegal</u>	<u>Upper Volta</u>
I. <u>Crops</u>								
<u>Cereal Production</u>								
Millet	C ^a	C	(C) ^a	C	(C)	C	C	C
Sorghum	C	C	(C)	C	(C)	C	C	C
Rainfed rice	P ^a	}C	P	(C)	—	C	C	—
Irrigated rice	—		—	C	(C)	C	C	C
Maize	C	C	C	P	(C)	(C)	C	C
<u>Legumes</u>								
Cowpeas	(C)	C	(C)	(C)	(C)	C	C	C
Peanuts	—	—	(C)	P	—	(P)	C	C
Soybeans	—	—	—	—	P	—	(C)	—
Other legumes	C ^a	—	—	P	—	—	P ^a	—
<u>Other</u>								
Roots and tubers	—	—	P	—	—	—	—	C
Sesame	—	—	—	(C)*	—	(C)*	—	(C)*
Sheanut	—	—	—	—	—	—	—	—
Cotton	—	C	—	C	—	—	C	C
Tea	—	—	—	C	—	—	—	—
Tobacco	—	—	—	C	—	—	—	—
Vegetables	C	—	C	C	C	C	C	C
Fruit (bananas, dates)	C	—	—	C	C	C	B*	(C)
Sugarcane	—	—	—	C	—	—	C*	C*

^aC = Continuing; B = beginning; P = Proposal; * = not listed in national report; () parenthesis indicates minor program or project.

Primary Source: Data gathered from DEVRES/INSAH Agricultural Research Resource Assessment, 1983.

Table 2-8: Classification Of National Research Effort by Research Type and Operational Status (cont.)

	<u>Cape Verde</u>	<u>Chad</u>	<u>The Gambia</u>	<u>Mali</u>	<u>Mauritania</u>	<u>Niger</u>	<u>Senegal</u>	<u>Upper Volta</u>
I. <u>Crops</u> (cont.)								
Pest management or Plant protection	C	C	(C)*	—	B	C*	C	C
Climatology	B	—	C*	C	C	C*	C	C
Farming systems research	P*	—	C	C	P	C	C	C
Costs of production	—	—	—	—	—	P	—	—
Mechanization, machinery	—	—	C	(C)*	P	—	P	—
Marketing	P	C	—	—	—	—	—	C
Germplasm banks	C	B	B	C	B	C	C	C
Quarantine station	—	—	—	—	—	B	P	—
<u>Soils</u>								
Fertility	C	C	C	P	C	C	C	C*
Water-plant	—	—	—	P	—	—	C	C
N fixation	—	—	—	—	—	—	C	P
Cultural practices	C*	C*	C*	C*	C	C*	C	C*
Irrigation water management	P	—	—	P	—	C	C*	—
Mapping, classification	C	—	C	C	—	C*	C*	C
II. <u>Livestock</u>								
<u>Animal husbandry</u>								
Cattle	—	P	—	C	—	C	C	—
Camels	—	—	—	—	P*	—	—	—
Sheep	—	—	—	}C	}C	}(C)*	}C	}P
Goats	—	—	—	—	—	—	—	—
Pigs	—	—	—	—	—	—	—	—
Poultry	—	—	—	P	—	—	—	—

^aC = Continuing; B = beginning; P = Proposal; * = not listed in national report; () parenthesis indicates minor program or project.

Table 2-8: Classification Of National Research Effort by Research Type and Operational Status (cont.)

	<u>Cape Verde</u>	<u>Chad</u>	<u>The Gambia</u>	<u>Mali</u>	<u>Mauritania</u>	<u>Niger</u>	<u>Senegal</u>	<u>Upper Volta</u>
<u>II. Livestock (cont.)</u>								
<u>Veterinary</u>								
Parasitology	P	—	—	C*	—	—	C	—
Bacteriology)P	P	—	C	C	—	C	—
Virology	—	—	—	C	C	—	C	—
Protozoology	—	P	—	C	—	—	C	—
Entomology	—	—	P	C	—	—	—	C
Acarology	—	—	P	C	—	—	—	—
Helminthology	—	—	—	C	—	—	C	—
Animal Health	—	—	C	C*	—	C	C	C
<u>Range</u>								
Ecology	C	—	C	C	—	—	C	P
Toxic plants	—	—	—	—	—	—	—	C
Range management	B	—	C	—	—	P	C	—
Forage production	—	—	C	C	—	P	C	C
Pasture improvement	—	—	—	C	—	—	—	—
Browse	—	—	—	C	—	—	C	—
Animal feeding	C	—	—	C	C	C	C	C
Bromatology	C	—	—	—	—	—	—	—
<u>Other</u>								
Livestock systems	P	—	C	C	C	—	—	C
Pastoral units	—	—	—	C	P	C	—	—
Milk production	—	—	—	—	—	—	C	—
Mixed farming	—	—	C*	C*	—	—	P	—

^aC = Continuing; B = beginning; P = Proposal; * = not listed in national report; () parenthesis indicates minor program or project.

Table 2-8: Classification Of National Research Effort by Research Type and Operational Status (cont.)

	<u>Cape Verde</u>	<u>Chad</u>	<u>The Gambia</u>	<u>Mali</u>	<u>Mauritania</u>	<u>Niger</u>	<u>Senegal</u>	<u>Upper Volta</u>
<u>III. Forestry and Ecology</u>								
Management of natural forests, replanting	—	—	—	—	—	—	C	C
Sylviculture, plantations	—	—	—	C	—	—	C	—
Irrigated production, water conservation	C	—	—	C	—	C*	C	—
Selection of trees, breeding, introduction	C	P	—	C	—	C	C	C
Gum arabic	—	—	—	P	(C*)	—	C*	—
Wood technology	—	—	—	C	—	—	P	—
Useful non woody plants	—	—	—	—	—	—	C	—
Trees nurseries, planting	C	—	—	P	—	—	—	—
Biogas and use of natural resources	—	P	—	—	—	—	—	C
Soil stabilization, conservation and reclamation	—	—	P	—	—	—	C	C
Other environmental	—	—	—	—	—	—	C	P
Wild life	—	—	—	P	—	—	P	—
<u>IV. Fisheries</u>								
<u>Marine</u>								
Biology	P	—	—	—	—	—	C	—
Management	—	—	—	—	—	—	C	—
<u>Inland</u>								
Biology	—	—	—	C	—	—	P	—
Management	—	P	—	P	—	B	P	—

^aC = Continuing; B = beginning; P = Proposal; * = not listed in national report; () parenthesis indicate a minor program or a project.

Table 2-8: Classification Of National Research Effort by Research Type and Operational Status (cont.)

	<u>Cape Verde</u>	<u>Chad</u>	<u>The Gambia</u>	<u>Mali</u>	<u>Mauritania</u>	<u>Niger</u>	<u>Senegal</u>	<u>Upper Volta</u>
<u>IV. Fisheries (cont.)</u>								
Ecology, environment	—	—	—	—	—	—	C	—
Fish culture	—	—	—	—	—	—	P	—
Fishing (artisanal)	P	—	—	—	—	—	C	—
Marketing	—	—	—	—	—	—	C	—
Processing, conservation	—	—	—	—	—	—	—	C
Socioeconomics	—	P	—	—	—	—	C	—
Consumption	—	P	—	C	—	—	C	—
<u>V. Technology</u>								
Cereals, pulses	—	—	—	C*	—	C	C	C
Fruit, vegetables	P	—	—	C	—	C	C	—
Meat	—	—	—	—	—	—	C	—
Milk	—	—	—	—	—	—	C	—
Fish	—	—	—	—	—	—	C	—
New foods	—	—	—	—	—	—	C	—
Fiber	—	—	—	P	—	—	—	—
Tea, tobacco, coffee	P	—	—	P	—	—	—	—
Aflatoxin	—	—	—	—	—	—	—	C

aC = Continuing; B = beginning; P = Proposal; * = not listed in national report; () parenthesis indicates minor program or project.

Table 2-9: Research and Extension Professionals³ in the Sahel by Country and Discipline

	<u>Cape Verde</u>	<u>Madagascar</u>	<u>The Gambia</u>	<u>Mali</u>	<u>Mauritania</u>	<u>Niger</u>	<u>Senegal</u>	<u>Upper Volta</u>	<u>Sahel Total</u>
I. Professional Research Personnel									
Administrators	—	—	2	41	—	27	—	11	81
Agronomists	—	5	8	—	—	25	84	—	122
Plant protectionists	—	3	—	—	—	13	—	14	30
Engineers	2	—	1	—	3	—	9	—	15
Economists	—	—	1	—	3	—	40	—	44
Veterinarians	—	8	—	16	3	—	—	—	27
Animal scientists	—	4	4	—	—	—	38	—	46
Unspecified professionals ^b	4	—	12	23	—	50	96	84	269
Total, Research	6	20	28	80	9	115	267	109	634
II. Professional Extension Personnel									
Administrators	—	12	31	53	1 ^c	82	174	70	423
Agronomists	1	7	—	61	—	11	117	23	220
Plant protectionists	—	—	4	—	—	—	1	—	5
Engineers	3	3	—	12	—	—	19	3	40
Economists	—	3	1	21	—	—	23	—	48
Veterinarians	—	15	12	21	—	31	10	—	89
Animal scientists	—	11	12	1	—	—	6	—	30
Unspecified professionals ^b	—	39	—	2	—	—	365	—	406
TOTAL, Extension	4	90	60	171	1	124	715	96	1,261

³Generally, staff having the equivalent of the BAC plus 4 or more years training are considered professionals for the purposes of this analysis.

^bUnspecified professionals consist of those researchers identified in the National Reports only in number and not by discipline. This category also contains a small number of social scientists involved in agriculture.

^cNumbers of professional personnel are not indicated for the major extension institutions in the Mauritania National Report.

Source: Data collected from the DEVRES/INSAH Agricultural Research Resource Assessment, 1983.

Table 2-10: Agricultural Research Programs, Projects, and Personnel
by Country and Research Institution

<u>Country</u>	<u>National Research Institution</u>	<u>Number of Programs or Projects</u>	<u>Number of Research Stations</u>	<u>Scientific and Technical Personnel by Program or Project</u>
Cape Verde	1. Center for Agrarian Studies			
	Improvement of food production Forestry production and reforestation Hydrobiological and soil science studies Use of pastures Renewable natural resources Agro-industrial development Production systems (TED)	6 (1 TED) ^a	2 (2 TED) ^a	27 researchers/ technicians
	2. Livestock Development Center	TED	2 TED	2 researchers/ technicians
Chad	1. Institute of Cotton and Textile Research	6	2	8 researchers
	2. Division of Crop Research	3	7	8 researchers
	3. Veterinary and Animal Husbandry Laboratory of Farcha (not functioning since 1979)	4	1	12 researchers
The Gambia	1. Crop Research	5	2	
	Upland crop improvement			1 agronomist 4 technicians 1 plant breeder
	Agronomy and farming systems research			3 agronomists 1 agricultural product economist 10 technicians
	Farm mechanization			1 research officer 2 senior technicians 3 junior technicians (mechanics)

^aTo be developed.

SOURCE: Data collected from the DEVRES/INSAH Agricultural Research Resource Assessment, 1983.

Table 2-10: Agricultural Research Programs, Projects, and Personnel
by Country and Research Institution (cont.)

<u>Country</u>	<u>National Research Institution</u>	<u>Number of Programs or Projects</u>	<u>Number of Research Stations</u>	<u>Scientific and Technical Personnel by Program or Project</u>
The Gambia (cont.)	1. Crop Research (cont.)			
	Horticulture			1 agronomist 7 technicians
	Rice research			2 agronomists 10 technicians
	2. Livestock Production	1	1	12 researchers 40 technicians
Mali	1. Institute of Rural Economy	14	7	358 researchers/technicians
	2. The National Animal Husbandry, Forestry and Hydrobiology Research Institute			72 researchers 48 senior technicians 35 junior technicians
	Division of Research in Forestry and Fisheries	6	5	
	Division of Research in Animal Husbandry	4	4	
	3. Central Veterinary Laboratory	7	0	9 veterinarians 42 technicians
Mauritania	1. National Center for Livestock and Veterinary Research	5	5	3 veterinarians
	2. National Center for Agronomic Research and Agricultural Development	6	7	2 senior agricultural economists 1 rural economist 8 research assistants
	3. National Center for Oceanographic Research and Fisheries	(TBD)	7	NA ^a

^aNot available as these data were not specified in the national report.

Table 2-10: Agricultural Research Programs, Projects, and Personnel by Country and Research Institution (cont.)

Country	National Research Institution	Number of Programs or Projects	Number of Research Stations	Scientific Personnel by Program or Project
Niger	1. National Agronomic Research Institute of Niger	10	7	48 researchers 52 technicians
	2. National Office of Solar Energy	1	1	4 researchers 4 technicians
	3. Research Institute for Human Sciences	1	1	7 researchers 2 technicians
Senegal	1. Institute for Agricultural Research	6	10	174 researchers
	2. Institute for Food Technology	4	1	100 researchers/technician
	3. Office of Overseas Scientific and Technical Research	5	4	42 researchers 5 trainers
	4. Organization for Research on Food and Nutrition in Africa	2	1	13 researchers 4 technicians
Upper Volta	1. Institute for Biological and Tropical Ecology Research	4	1	8 researchers 7 technicians 33 technical assistants
	2. Voltaic Institute for Crop and Animal Husbandry Research	10	2	55 researchers 19 technicians
	3. Division of Agricultural Services	8		23 researchers 40 technicians 5 technical assistants
	4. Office for Scientific and Technical Research Overseas (France)	4	2	30 technicians 20 technical assistants
	5. Agrometeorological Service	1		10 researchers 20 technicians 40 technical assistants

Table 2-11: Agricultural Extension Activities and Personnel by Country and Extension Institution

<u>Country</u>	<u>Extension Institution</u>	<u>Extension Activities</u>	<u>Extension Personnel</u>
Cape Verde	1. No formal extension institution	Farmer support and locust control on Santiago	
	2. National Agricultural Extension Service (Projected)	Assomada Integrated Development Project (PRODESA)	2 <u>ingénieurs</u> 7 extension agents
		Santiago Watershed Development Project	1 agricultural engineer 1 technical engineer 4 extension engineers
Chad	1. National Office of Rural Development	Improvement of crop production Training of small-scale rural tradesman Farmer training Livestock improvement	2 agronomists 3 agricultural economists 5 generalists 34 administrative 4 others Moundou - 31 generalists 42 others Elsewhere - 1423
	2. Department of Livestock	Animal health and production	8 veterinarians 10 livestock engineers
	3. Department of Water and Fisheries	Fish production and forestry resource management	1 engineer for water & forests 3 engineers for forestry 1 technician
	1. Ministry of Agriculture	Raised farmer awareness of GOTG agricultural policy Promotion of use of inputs	
	2. Department of Animal Health and Production	Livestock production, health	278 agents
The Gambia	3. Plant Protection Service	Crop protection, research statistics, pest and disease surveys, monthly publication	
	4. Fisheries	Statistics Technology of equipment Mechanical use	
	Total Extension Personnel		940

SOURCE: Data collected from the DEVRES/INSAH Agricultural Research Resource Assessment, 1983.

Table 2-12: Agricultural Training Programs and Personnel by Country and Training Center (cont.)

<u>Country</u>	<u>Training Center</u>	<u>Types of Training Programs</u>	<u>Number of Training Personnel</u>	<u>Number of Trainees</u>
Niger (cont.)	Institute of Practical Training for Rural Development	Entry-level training to technical agent level	43 full-time instructors 18 part-time instructors 18 administrative staff 51 support personnel	N ^a
		Technician training for Ministry employees		
		Plant protection training for the region		
	School of Animal Husbandry Technician Training	Trains livestock production assistants and agents	9 full-time instructors 2 assistants 6 administrative staff	NA
	Regional Center for Training and Application of Agricultural Meteorology and Hydrology	Trains higher-level technicians from the region	11 full-time instructors 11 part-time instructors	320 ^b
Senegal	Inter-State School for Sciences and Veterinary Medicine	Veterinarian degree	NA	80 ^c
		Graduate courses in agro-pastoral development		
	National Institute of Rural Development	5-year technician in agricultural research animal husbandry, water and forestry	NA	9 ^d
	National School for Professional Rural Training of Bambey	3-year course in several agricultural fields for middle level implementation staff	NA	NA

^aData not specified in the National Report.

^bThis figure represents the capacity rather than the number of trainees enrolled at the time of the Devres/INSAH assessment.

^cThis figure exceeds capacity by 20 trainees.

^dCapacity at this institution is 40 trainees.

Table 2-12: Agricultural Training Programs and Personnel by Country and Training Center (cont.)

<u>Country</u>	<u>Training Center</u>	<u>Types of Training Programs</u>	<u>Number of Training Personnel</u>	<u>Number of Trainees</u>
Senegal (cont.)	National School for Applied Economics	2-year course for technical agents	NA ^a	180
		3-year course for supervisors and <u>ingénieurs</u>		
	National Graduate University of Technology	2-year course in technology for senior technicians, <u>ingénieurs</u> , and technical school teachers	NA	15 <u>ingénieurs</u> ^b 12 technology students
	School for Technical Agents in Agriculture	3-year course	NA	20-30
	School for Technical Agents in Livestock	3-year course	NA	20-30
	School for Technical Agents in Water and Forestry	3-year course in forestry and aquaculture	NA	20-30
	National Horticulture School of Camberene	3-year course	NA	80
	National School for Maritime Training	Basic training for sea-going personnel	NA	NA
	School for Technical Agents in Oceanography and Marine Fisheries of Thiaroye	Trains middle and lower level staff for research and extension in deep-sea fisheries	NA	NA
	Training Center for Fishermen in Joal	Trains fishermen on improved techniques	NA	NA
				4 visiting teachers

^aData not specified in the National Report.

^bThis figure represents the capacity rather than the number of trainees enrolled at the time of the Devres/INSAH assessment.

Table 2-12: Agricultural Training Programs and Personnel by Country and Training Center (cont.)

Country	Training Center	Types of Training Programs	Number of Training Personnel	Number of Trainees
Upper Volta	Advanced Polytechnical Institute	3-year technical level course	50 full-time instructors	560
	Agricultural Training Center at Matourkou	2-year certificate level training	2 administrators 23 full-time instructors 10 part-time instructors 13 visiting teachers 9 teaching assistants	90a
	National School for Animal Husbandry and Animal Health	2-year certificate level	1 full-time director/instructor several visiting teachers	NA ^b
	Anti-Tsetse Training School	2-year certificate level	NA	NA
	National Forestry School of Minderesso	2-year certificate level	5 full-time instructors 3 assistants 4 visiting teachers	70a
			4 visiting teachers	

^aThis figure represents the capacity.

^bData not specified in the National Report.

ANNEX 3

Agencies, Organizations, Programs and Projects Other
Than National Involved in Agricultural Research in the Sahel

ANNEX 3

Agencies, Organizations, Programs and Projects Other Than National Involved in Agricultural Research in the Sahel

There is, at the level of the Sahelian sub-region, a complex and entangled network of various agencies which, either directly or more often in collaboration with the national institutions, provides significant input in the sector of agricultural research. These must be considered both in the description of the sector and in the development of any new strategy.

The following list includes most of the agencies or organizations which are cited in the national reports. These entities have been classified as follows:

- o Sahelian or African organizations;
- o Organizations associated with the United Nations;
- o Organizations associated with the International Agricultural Research Centers;
- o French organizations;
- o U.S. organizations; and
- o Organizations of other donors.

A. Sahelian or African Organizations

1. The Permanent Interstate Committee for Drought Control in the Sahel (CILSS)

This is a committee of the eight Sahelian states. CILSS is responsible for combatting the drought and sensitizing the international public to the need to mobilize food aid and development funds for food self-sufficiency and for combatting desertification. The CILSS, with its headquarters in Ouagadougou, has created two specialized institutions, INSAH in Bamako and the AGRHYMET with its center at Niamey.

a. The Institute of the Sahel (INSAH)

This is a specialized institution of the CILSS, responsible for the coordination and promotion of research, for training of research workers and technicians, and for collecting, classifying and disseminating scientific and technical information. It is located in Bamako. Through international cooperation, INSAH coordinates networks and projects on the improvement of millet, sorghum, cowpeas and maize, on demography, ecology, training in pastoralism, on crop protection and on the collection, classification, and dissemination of information for the research services and the

development services. These INSAH projects cover all eight countries of the Sahel.

b. The Regional Center for Training and Application of Agricultural Meteorology and Hydrology (AGRHYMET)

A specialized institution of the CILSS, AGRHYMET has its headquarters at Niamey. It is responsible for training and for applied agricultural meteorology and hydrology.

2. The Club of the Sahel

This is a group of government development agencies with the secretariat located in the headquarters of the OECD (Paris), with the purpose of studying all of the development problems of the Sahel and coordinating the actions. The Club of the Sahel has always worked in close collaboration with the CILSS and provides an ideal forum for common actions undertaken by the donors.

3. Organization of African Unity/Science and Technology Research Committee (OAU/STRC)

The OAU/STRC is engaged in agricultural research both in the Sahel and in other semi-arid African countries, principally through its management of the SAFGRAD Project (Semi-arid Food Grain Research and Development). Launched in 1979, the SAFGRAD project is financially supported by the U.S., France and IFAD. Its execution is through IITA, ICRISAT and Purdue University. The OAU coordination office is located in Ouagadougou; the maize and cowpea improvement efforts and the farming systems research are also headquartered in Upper Volta. Mali, Senegal and Upper Volta participate in the SAFGRAD Accelerated Crop Production program, which promotes on-farm trials of selected experimental technologies.

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

Established in 1956, ORANA was attached in 1961 to the Organization for Coordination and Cooperation for Combatting Contagious Diseases (OCCGE), which includes Benin, Ivory Coast, Mali, Mauritania, Niger, Senegal, Togo, and Upper Volta. It has a center for research in Senegal.

5. The West African Rice Development Association (WARDA)

This association was established under the CGIAR to stimulate and partially fund research and development projects and to provide training in rice production. It is based in Monrovia, Liberia.

6. The Senegal River Basin Commission (OMVS)

The OMVS, with headquarters at Dakar and a substantial documentation center at St. Louis, covers all of the aspects of development of the area adjacent to the Senegal River. It involves Senegal, Mauritania, and Mali. It also encourages and finances agricultural research appropriate to its development activities.

7. The Gambia River Basin Commission (GRBC)

The role of this organization is the development of the area adjacent to the river in Senegal and The Gambia. It has its headquarters at Dakar and conducts activities in agricultural research.

8. Economic Community of West Africa (CEAO)

This organization endeavors to facilitate the economic integration of six countries in West Africa, of which five are Sahelian. It has implemented several projects involving research (including solar energy with the CILSS) and training (marine fisheries, mines, management, etc.). The headquarters are at Ouagadougou.

9. Interafrican Center for Studies in Hydraulics (CIEH)

This is an organization, with its headquarters at Ouagadougou, which has very substantial documentation on water resources and their development, roads, etc. in the Sahel.

10. Niger River Basin Commission (ABN)

This is an organization of some of the countries in West Africa bordering on the Niger River. Its headquarters is at Niamey, where it has a substantial document center.

11. Regional Center for Remote Sensing at Ouagadougou (CRTO)

This center uses satellite data and trains specialists in remote sensing techniques which in turn have application in agriculture (e.g. ground water, land use mapping, etc.).

12. Commission for the Lake Chad Area (CBLT)

Created in 1964, the CBLT has its headquarters in N'Djamena. Its activities are centered on improving the Lake Chad area by rational use of the lake waters and of its tributaries. The Commission is involved with agriculture, livestock, waters and forests, marketing, etc.

B. Specialized Institutions of the United Nations

1. Food and Agriculture Organization (FAO)

The FAO remains the major supplier of agricultural statistics in the sub-region. It also contributes to the dissemination of information by its AGRIS system. In collaboration with the UNDP, it finances or partly finances a number of projects.

2. United Nations Development Program (UNDP)

This organization finances by itself or with the FAO the preparation and/or execution of agricultural development projects.

3. World Meteorological Organization (WMO)

This organization provides technical assistance for a large number of research projects, a number of which have a direct (or indirect) bearing on agriculture, particularly in semi-arid regions.

4. International Bank for Reconstruction and Development (IBRD)

The World Bank conducts economic and social studies in all the Sahelian countries. It also finances research programs and institutions dealing with agricultural research.

C. Organizations Associated with the Consortium for International Agricultural Research Centers

1. The International Institute for Research in the Semi-Arid Tropics (ICRISAT)

This organization, with its headquarters at Patancheru in India, provides scientific information, genetic material, and technical information to researchers in the Sahel. It is responsible for execution of certain research projects in the region (SAFGRAD and UNDP regional projects in Upper Volta, USAID bilateral contract in Mali, etc) as well as liaison with other projects. ICRISAT also has a research center near Niamey.

2. International Institute of Tropical Agriculture (IITA)

This organization, with its headquarters at Ibadan, Nigeria, provides information, seed, plant material and training for research workers. It is involved in the SAFGRAD regional project and collaborates in other research projects.

3. International Rice Research Institute (IRRI)

This organization, with its headquarters at Los Baños, Philippines, provides scientific information and genetic material to countries in the sub-region, mainly acting through WARDA.

4. International Livestock Center for Africa (ILCA)

This organization, with its headquarters in Addis Ababa, Ethiopia, provides scientific information and technical assistance to the countries of the sub-region. It has a research program in Mali, collaborates with other research projects and is also active in Niger.

5. International Food Policy Research Institute (IFPRI)

This organization, located in Washington, D.C., has started work on the agricultural policies of West African countries, in addition to its work in other developing areas.

6. International Service for National Agriculture Research (ISNAR)

This organization, located in The Hague, Netherlands offers its services to developing countries to analyze and advise on national agricultural research systems.

D. French Organizations

1. Group for Studies and Research for the Development of Tropical Agriculture (GERDAT)

This is a collection of several institutes located in France, whose principal objective is to promote applied agricultural research and development in the tropics. It is associated with the Ministry of Foreign Affairs and Cooperation. Six of these institutions have activities in the Sahel:

- o The Technical Center for Tropical Forestry (CTFT) (which also works on fisheries);
- o The Institute of Livestock Production and Veterinary Medicine in Tropical Countries (IEMVT);
- o The Institute for Research in Tropical Agronomy and Food Crops (IRAT);
- o The Institute for Research on Cotton and Exotic Textiles (IRCT);
- o The Institute for Research on Fruits and Citrus (IRFA); and
- o The Institute for Research on Oils and Oil Crops (IRHO).

GERDAT manages research units in the Sahel in association with the national institutions. It also assists in the area of scientific information and occasionally provides personnel to other centers.

2. The Office for Scientific and Technical Research Overseas (ORSTOM)

This is an organization connected to the network of scientific research in France, whose objective is to promote all fundamental research associated with problems of the developing world. ORSTOM has research activities, basic and applied, in Senegal, Upper Volta, Mauritania, Mali and Niger. It also provides information and training to researchers and collaborates in certain work done by other centers.

3. Funds for Cooperative Assistance (FAC) and Central Bank for Economic Cooperation (CCCE)

These two French organizations provide financial assistance for several agricultural research projects in the Sahel, and are located in Paris.

E. U.S. Organizations

1. United States Agency for International Development (USAID)

This organization is responsible, on behalf of the U.S., for all of the development assistance programs in developing countries as well as food aid. It is involved directly or indirectly in the work of agricultural research in all of the countries of the Sahel. Support given includes the provision of training, scientific information and in the loaning of personnel.

2. International Fertilizer Development Center (IFDC)

This center, with headquarters at Muscle Shoals, Alabama, and mainly financed by USAID, is involved in research projects on soil fertility in the Sahel.

F. Organizations and Activities Supported by Other Donors

1. International Development Research Center (IDRC)

This organization, financed by the Canadian government, has the objective to support and conduct research in developing countries. IDRC is currently financing agricultural research in several Sahelian countries. It is also active in the area of scientific information.

2. Canadian International Development Agency (CIDA)

This Canadian organization finances agricultural and fisheries projects in Niger, Upper Volta, Mali and Senegal. Canada is a member of CDA.

3. European Development Fund (EDF)

This fund, coming from the activities of the European Common Market, is used to finance all or part of the cost of several research projects in the Sahel--for example the project for improvement of millet, sorghum, cowpeas, and maize of INSAH.

4. Arab Technical Assistance Fund (FAAT)

This Fund covers the common actions of several Arabic, petroleum producing countries. It finances certain agricultural research projects particularly in Niger.

5. The Federal Republic of Germany (GTZ)

This country finances certain projects in the Sahel, particularly in the Cape Verde Islands. It is also a member of the CDA.

6. Italy

This country, which is also a member of the CDA, finances research-development and training projects in several countries in the Sahel, and is proposing a substantial funding in research-training-extension at INSAH.

7. Netherlands (ITTR)

This country is active in the support of agricultural research in the Cape Verde Islands, Mali and Niger.

8. Portugal

This country finances certain projects in the Cape Verde Islands.

9. United Kingdom (ODA)

The UK finances certain projects in The Gambia, and in Senegal. It is a member of CDA.

10. Other countries

Switzerland, Austria, Denmark, Sweden and other countries also participate in financing of research and development projects in various Sahelian countries.

11. Non governmental organizations (NGO)

There are many private organizations supported by other donors which promote certain new technologies provided by research (e.g. applied research related to specific projects).

ANNEX 4

Methodology of the Agricultural Research Assessment
and Creation of the Data Base

ANNEX 4

Methodology of the Agricultural Research Assessment and Creation of the Data Base

The information for the Assessment of Agricultural Research Resources in each of the eight countries of the Sahel was obtained from questionnaires developed with researchers from the participating countries. This data has been put on disks and processed on micro-computers, and forms the basis for both the national and the zonal reports.

The purpose of the data is intended not only for use in the preparation of these reports, but also to form a Data Base at INSAH. This data base can be used by project designers, planners and financiers from member and donor countries for obtaining basic information needed in the design and approval of agricultural research projects.

The INSAH Data Base inventories research programs and projects and research, training and extension institutions (including their facilities, their human resources, and their future personnel needs) throughout the entire agricultural sector. It can also be used to obtain national or regional data on such items as research programs by subject and activity, budget data, personnel constraints, and production information.

As regards the future operation of the Data Base, one activity proposed in Chapter III of this report indicates a need for donor support to strengthen INSAH's Scientific and Technical Program. Such support should include assistance in financing the technical personnel needed by INSAH to respond to inquiries for information from the Data Base, and to further expand and improve the Data Base.

The following paragraphs describe in more detail the methodology of the survey, the content of the questionnaires, and the type of programs used in the micro-computers.

A. The Questionnaires (Documents)

The National Reports prepared for each of the eight Sahelian countries are based on information from four survey documents. These documents were designed to provide data on the institutions, the stations, the human resources (present and future), the budget, the infrastructure, the libraries, the experimental or training farms, and the constraints to performance enumerated by the personnel.

1. Document I

The survey of the research institutions conducted in Document I includes a list of research programs and projects, donors, human resources, collaborating institutions, and the use of the facilities by the extension service.

2. Document II

For the survey of training institutions, Document II was used to provide information on the courses taught, the admission requirements, the number of students admitted, the capacity of the institutions at each level, the number of students graduating and the short courses and employment offered by each institution.

3. Document III

The survey of extension institutions covers the various areas of activity of the extension projects, the results of the extension, and the linkages with research.

4. Document IV

The last survey document attempts to identify the ecological zone, production and constraints for each agricultural product (often defined by region), each type of livestock, each fishing unit and, for forestry, the area involved. This document also includes an estimate of the increases in yield and area cultivated in the short term (three to five years) and long term (six years and over), as well as a list of research and other actions that must be undertaken. In addition, this document attempts to establish a list of priority actions and of the additional personnel necessary to attain additional output and eliminate constraints.

B. The Data Base and its Uses

As previously stated, the purpose of the Data Base is to establish an inventory of research programs and projects and of research, training and extension institutions. With an index of more than 1,500 variables, a great number of comparisons can be drawn to assist in the analysis of constraints to production. Any desired matrix can be created--from the very specific to the general, and covering a single country or the entire region--by writing a short dBase program.

For example, in a synthesis of the National Reports, several analyses can be added, after the data base has been sufficiently "cleaned" and reformatted where necessary. Some examples are presented below.

1. Personnel

Relevant factors can include the number of research workers by discipline and level of training; the need for additional personnel; the percentage of research workers who are nationals; and training needs for additional personnel.

2. Research programs by subject and activity

Analysis of research projects can also be performed by subject and activity; and also of the number of research workers by program.

3. Budget data

The operating budget expended per research worker could be identified where the basic data is available in the questionnaires.

4. Constraints

Short and long term constraints to increased production can be identified, as can the research and activities proposed to relieve those constraints.

5. Production

The possible increase in production proposed as possible in the short and long terms can be identified by enterprise and by product.

C. The Micro-Computer Program--dBase II--and Its Use

1. Program used

The program dBaseII from Ashton-Tate was used on an IBM PC XT to store and handle the data obtained. This program requires setting up the data in files, following a structured format which permits up to 32 fields in a file. The fields can be of three types:

- o Character, that is, words or letters;
- o Numeric; or
- o Logical, that is, where there are only two possibilities (e.g., yes/no, true/false).

The length of the field must be specified, except for logical fields which have only one space. Fields may not exceed 256 spaces, but two fields may be used in sequence to provide more spaces. Each file is limited to a total of 1,000 spaces, and the number of records is limited to 65,535. As the survey contained a considerable amount

of data, and the capacity of a 5 1/4 inch, double-sided diskette is limited to 320,000 bytes, manipulation of the data is greatly simplified by the use of a hard disk which, in this case, had a capacity of ten million bytes.

2. Editing of survey data

The data have been recorded from the survey forms, and the program provides the necessary prompts. The files could be printed out as a report, updated, reorganized or rearranged, read, counted and displayed.

Because of the different backgrounds of the interviewers who completed the forms, the questionnaires were received in varying states of completion--some were handwritten and others contained typing errors. It therefore was necessary to ensure that the operators, who were not experts in the agricultural field, could easily read the data which they had to enter into the computer.

DBaseII requires the specification of the maximum field length. This was set up after receiving some of the completed forms. The total file limit of 1000 spaces and consideration of the data storage needs required constraining the size of the fields. This constraint was imposed when the survey was almost completed; it was decided later to comply with the constraint by editing, which required a considerable amount of work, rather than by requiring the interviewers to limit the length of their remarks on the forms. It was often necessary to use logical abbreviations to fit the information to the field size.

Although it was not explicit in the questionnaire, there was also a limit on the number of fields available for the different entries. These limits were, to some extent, implied by the limited space available for the response in the questionnaire. For example, research programs were arbitrarily limited to having no more than six projects. In a few cases, where there were more than six projects, a second associated program was entered to obtain the space for entering the extra projects (title, CARIS codes, etc.).

In other cases, the interviewers entered what they considered to be activities within a project as individual projects. These had to be grouped and included in a common project. The section on collaborating institutions which was part of the inventory of research programs often included a large number of institutions (in one case filling a whole page). The reply entered into the data base was limited to six domestic and four foreign institutions.

Certain subjects, such as the linkages between extension and research, were considered so important that they were entered as written, using a word processing program.

Another task which was done during editing was to move the comments to their appropriate places on the form. For example, under "programs" there were two main descriptive elements in each of two questions:

- o Q1: "Title and brief description"
- o Q3: "Objectives and possible effects"

Each element was entered into its correct place and extraneous material was not entered.

Problems of a slightly different nature were also found. In some cases the consultant responsible for the survey delegated the work to someone else, perhaps by sending the form to the interviewee without sufficient instructions. This sometimes led to results that could not be used and which were not entered on the computer.

After the survey had been launched, it was decided to classify the two programs and projects using the FAO CARIS system, with a single letter (A or B) for subject and activity and a four-digit code. This coding was added to the completed questionnaires during editing.

Another problem arose when more than one unit was entered into one space or on one form, for example, entering three experimental farms together, with one ecological zone for all three farms. There was no choice but to enter these data as a single unit including the area and other particulars.

The above-mentioned problems and constraints notwithstanding, a large body of useful data has been computerized and is retrievable in useful formats.

3. Restrictions in the questionnaires

The questionnaires were intended to identify the different institutions and to inventory the different resources and activities. The fourth form was intended to provide an estimate of current production, to identify the major constraints to increasing production, and to identify the research and other actions that need to be taken in the short and long terms to eliminate the constraints. The survey was also designed to provide an estimate of the increase in production which would arise if the constraints, in the short and long terms, were eliminated.

D. Basic Survey Information

The content of the four documents (or questionnaires) used in the survey as entered in the Data Base is presented in the following outline.

1. Document I: Research

a. Research

(1) Name of the research institution

- a. Responsible ministry
- b. Director of institute
- c. Stations (names and addresses)
- d. Number of stations

(2) Research activities

- a. Subject
- b. Importance of effort

(3) Research programs

- a. Number of program, location, title
- b. Brief description
- c. Subject code, CARIS (up to 7 entries)
- d. Activity code, CARIS (up to 9 entries)
- e. Date of initiation and completion
- f. Objectives
- g. Methodology
- h. Results expected
- i. Number of person-years of researcher, technician, and others by program
- j. Collaborating institutions: domestic, international

(4) Projects

- a. Institution
- b. Number and title of program

- c. Title of project
- d. Subject code
- e. Activity code
- f. Funding agency
- b. Human resources
 - (1) Classification by responsibility
 - (2) Classification by nationality
 - (3) Classification by full- or part-time
 - (4) Conditions of service
 - (5) Classification by level of training
 - (6) Nationals in training (by level of training and gender)
 - (7) Personnel needs for the future
- c. Budgets
 - (1) Capital investment and operations (planned and expended)
 - (2) Source (national budget, donor, NGO, other)
- d. Infrastructure for each research station
 - (1) Area and use
 - (2) State of buildings, facilities and equipment
 - (3) Inventory of laboratory equipment valued at over 1,000,000 fCFA
 - (4) Inventory of programmable calculators and computers
 - (5) Number of library books, journals, and annual acquisitions
 - (6) Access to other libraries

- (7) Three most frequently used periodicals
- (8) Publications in the last three years
- (9) Experimental farms
- (10) Use of the research installation by other services

e. Evaluation of the problems constraining the output of the institution as perceived by research workers and administrators

- (1) Capital and operating budgets
- (2) Foreign currency
- (3) Year-to-year continuity of budget
- (4) Qualifications and training of senior and junior research workers and service staff
- (5) Infrastructure

2. Document II: Training

a. Name of the teaching institution

- (1) Ministry responsible
- (2) Director of institution
- (3) Level of training given
- (4) Other training activities

b. Human resources

- (1) Classification by responsibility
- (2) Conditions of service
- (3) Nationals in training by level of training and gender
- (4) Personnel needs for the future

c. Characteristics of students

- (1) Rural or urban origin
- (2) Admission requirements for each level of training

- (3) Number of students admitted
- (4) Capacity of school
- (5) Problems
- (6) Financing of students
- (7) Agricultural plots for students' use
- d. Budgets
 - (1) Capital investment and operations (planned and expended)
 - (2) Source (national budget, donors, NGO, other)
- e. Infrastructure
 - (1) Number, size, capacity and state of buildings
 - (2) Number of library books, journals, and annual acquisitions
 - (3) Library audio-visual equipment
 - (4) Students access to library
- f. Linkages between the training institution and research and extension institutions
- g. Short courses offered to extension or research workers
- h. Output of the training institution
 - (1) Diplomas awarded annually for each training level
 - (2) Short courses taught
 - (3) Number of students
 - (4) Employment of students
 - (5) Government and private service in research, training and extension

i. Evaluation of the problems constraining the operation of the institution as perceived by administrators and staff:

- (1) Budgets
- (2) Qualifications of staff
- (3) Physical plant
- (4) Other

3. Document III: Extension

a. Name of the extension institution

- (1) Ministry responsible
- (2) Director of institution
- (3) Principal source of funds for NGO

b. Nature and importance of activities

- (1) Crop production (by crop)
- (2) Livestock
- (3) Systems of production (farming systems)
- (4) Geographic and ecological zones
- (5) Other activities

c. Human resources

- (1) Classssification by area of responsibility
- (2) Classification by nationality
- (3) Classification by full- or part-time
- (4) Conditions of service
- (5) Nationals in training by level and gender
- (6) Personnel needs for the future

d. Budgets

- (1) For capital investment and operations
(planned and expended)
- (2) Source (national budget, donors, NGO, others)

e. Output of extension

- (1) Publications
- (2) Meetings with farmers
- (3) Radio and TV programs
- (4) Articles in newspapers
- (5) Training of extension agents
- (6) Field demonstrations and trials
- (7) Other

f. Linkages between research and extension

Evaluation of the problems constraining the output of the institution as perceived by the administrators and staff.

4. Document IV: Constraints

Four different versions of this document were used, depending on the subsector involved: agriculture, livestock, fisheries, agroforestry. They were as similar as possible in content. The agricultural version contained the following information for each crop:

a. General information

- (1) Production (current)
- (2) Reference years
- (3) Area cultivated and yields
- (4) Ecological zone

b. Constraints

Constraints reducing yields, by three levels of importance.

c. Short-term production

(1) Possible level of production in the short-term
(3 - 5 years) if the best available technologies
were employed

(2) Yield and area

d. Long-term production

(1) Possible level of production in the long-term
(6 years and over) if the major constraints were
eliminated or reduced in their effect

(2) Yields

e. Types of activities

(1) Types of activities necessary in the short- and
long-term to overcome the constraints

(2) Research

(3) Other activities

f. Hypothetical constraints

The importance of certain hypotheses as constraints to
increased production in the short and long term:

(1) Price

(2) Land tenure

(3) Credit

(4) Input supply

(5) Labor supply

(6) Extension

(7) Markets

(8) Viability of themes promoted by extension

g. Human resources

Additional personnel needed to obtain the proposed
increases in production:

- (1) Administrators
- (2) Researchers
- (2) Extension agents

ANNEX 5

Current CDA Sponsored Agricultural Research Projects
(by Country and Type)

ANNEX 5

Current CDA Sponsored Agricultural Research Projects (by Country and Type)^a

<u>Country of Project</u>	<u>Project Title</u>	<u>CDA Donor</u>	<u>Project Type</u>				
			<u>Crops</u>	<u>Livestock</u>	<u>Agro-Forestry</u>	<u>Fisheries</u>	<u>General^b</u>
Cape Verde							
	Center for Agrarian Studies: Animal Pathology Laboratory	France		X			X
	Center for Agrarian Studies (equipment for food produc- tion analysis laboratory)	U.K.					X
	Center for Agrarian Studies: Headquarters	U.S.					X
	Center for Agrarian Studies (housing unit)	Italy					X
	Center for Agrarian Studies (laboratory for integrated pest control)	FRG	X				X
	Center for Agrarian Studies: Soil and Rock Mechanics Laboratory	U.S.					X
	Food Crop Production Improvement	FRG	X				X
	Food Crops Research Project	U.S.	X				X
	Hydrologic and Hydrographic Stations Installations	France U.S.					X

^aTwo points regarding the content of Annex 5 should be noted. First, Annex 5 was compiled from information provided by the CDA member countries in response to inquiries by USAID and Devres, and from the Sahel National Reports. The Annex's comprehensiveness, therefore, is limited to that of the sources. Second, for the sake of clarity, the projects listed are limited to those agricultural research projects or programs in Sahelian countries which receive direct assistance from a CDA member country. Furthermore, only those projects specified as being focused solely on research, or as having a specific research component, are listed. Therefore, CDA contributions such as those of Belgium, which are virtually all allocated through international organizations and are in the form of general agricultural development aid, are not included.

^bIncludes equipment, buildings, staff support and other infrastructural resources.

<u>Country of Project</u>	<u>Project Title</u>	<u>CDA Donor</u>	<u>Crops</u>	<u>Livestock</u>	<u>Agro-Forestry</u>	<u>Fisheries</u>	<u>General</u>
Cape Verde (cont.)	INIAAC (Fogo Center: applied research)	FRG	X				
	INIAAC (Fogo Center labor- atory and housing; Santo Antao Center laboratory, equipment and technical assistance)	U.S.					X
	Instrumentation of Three Sub-Basins	France					X
	Integrated Pest Management Project	FRG U.S.	X				X
	Integrated Pest Management Project: Center for Agrarian Studies residential center	U.S.					X
	Integrated Pest Management Project: Santo Antao Center Laboratory	U.S.					X
	Reforestation	U.S.			X		
	Soil Cartography of Faja, S. Nicolau and Irrigation Potential Map	France					X
	Stability Tests of Santiago Island Embankments	U.S.					X
Chad	Crop Production Research, Seed Multiplication and Grain Marketing	U.S.	X				
	DRA	France U.S.	X				X
	IRCT (crops, farming systems)	France	X				X
	Lake Chad Irrigated Agriculture	U.S.	X				
	Veterinary Research and Animal Husbandry Laboratory- Farcha	France		X			

<u>Country of Project</u>	<u>Project Title</u>	<u>CDA Donor</u>	<u>Crops</u>	<u>Livestock</u>	<u>Agro-Forestry</u>	<u>Fisheries</u>	<u>General</u>
The Gambia							
	Expansion of Rice-Growing Land Area to Increase Rice Production	FRG	X				
	Forestry Project	FRG			X		
	Mixed Farming and Resource Management Programme	U.S.		X			
	Uplands Crops Improvement Programme	U.K.	X				
Mali							
	Action Riz-Sorgho (establishment of field research station)	U.S.	X				X
	Center for Savannah Wood Technology	Canada			X		
	Central Veterinarian Laboratory	U.S.		X			X
	Cropping Methods-Phase II	Canada	X	X			
	Farming Systems (KAARTA)	Canada	X				
	Farming Systems Research and Extension (institutional capacity strengthening)	U.S.					X
	Fish Processing	Canada				X	
	Integrated Crop and Livestock Development in the Lake Zone	FRG	X	X			
	Land Resources Inventory Project	France U.S.					X
	Leguminous Food Crops- Phase II	Canada	X				
	Livestock Sector I (tsetse eradication)	U.S.		X			

<u>Country of Project</u>	<u>Project Title</u>	<u>CDA Donor</u>	<u>Crops</u>	<u>Livestock</u>	<u>Agro-Forestry</u>	<u>Fisheries</u>	<u>General</u>
Mali (cont.)	Livestock Sector II (animal health)	U.S.		X			
	Livestock Sector III (farm-level research on forage production)	U.S.		X			
	Operation Haute Vallee I and II (animal traction)	U.S.		X			
	Paper Workshop	Canada			X		
	Planting Irrigated Forests- Phase II	Canada			X		
	Research Station for Irrigated Forestry Plantations	Canada			X		
	San Pilot Fish Production (PVO) (fish culture)	U.S.				X	
	Semi-Arid Tropics Research I	U.S.	X				
	Semi-Arid Tropics Research II	U.S.	X				
	Study of Development of Mechanization and Cultivation of Rice	Italy	X				
	Threshing Machines	Canada	X				
Mauritania							
	Guidimaka Integrated Rural Development Project	U.S.	X	X			X
	Oases Development	U.S.	X				
	Rural Post-Harvest Rice Processing Centers	Canada	X				

<u>Country of Project</u>	<u>Project Title</u>	<u>CDA Donor</u>	<u>Crops</u>	<u>Livestock</u>	<u>Agro-Forestry</u>	<u>Fisheries</u>	<u>General</u>
Niger							
	Cereals Production	U.S.	X				
	Crop Protection	Canada	X				
	Niamey Department Rural Development II	U.S.	X				
	Niger Cereals Research (institutional capacity development; establishment of agricultural economic research division)	U.S.	X				X
	Study of Breeding for Central Eastern Region	Italy	X				
	Wood for Village Use- Phase II	Canada			X		
Senegal							
	AGRIS (agricultural information dissemination)	Canada					X
	Back-up Research for the Autonomous Reforestation Project of the Bandie Suburban Forest	U.S.			X		
	Casamance Regional Development (development of technical packages)	U.S.	X				
	Cereals Production I (establishment of research unit)	U.S.	X				X
	Cereals Production II (support of research)	U.S.	X				
	Field Trials in Bas Saloum	FRG	X				
	Forestry Support Research	France			X		
	Genetic Improvement of Fast Growing Plants and of Certain Local Species	France			X		

<u>Country of Project</u>	<u>Project Title</u>	<u>CDA Donor</u>	<u>Crops</u>	<u>Livestock</u>	<u>Agro-Forestry</u>	<u>Fisheries</u>	<u>General</u>
Senegal (cont.)	Gum Arabic and Reforestation of Pasturelands--Phase II	Canada	X		X		
	ISRA (crop production/ production systems research) ^a	France	X				
	ISRA: Added Research in the North Zone	France	X				
	ISRA: Additional Research: North Zone	U.S.	X				
	ISRA: Agricultural Evalua- tion of the Natural Resources for Crop Production	France	X				
	ISRA: Coastal Fishing	Canada France U.S.				X	
	ISRA: Commercialization of Fruits, Vegetables and Cereals in the Casamance	U.S.	X				
	ISRA: Deep Sea Fishing	Canada France				X	
	ISRA: Demersal Fishing	Canada France				X	
	ISRA: Natural Forestry and Reforestation Studies for the Casamance	France U.S.			X		
	ISRA: Pluridisciplinary Program for Fruit Production	U.S.	X				
	ISRA: Pluridisciplinary Program for Rainfed and Swamp Rice	U.S.	X				
	ISRA: Post-Harvest Technologies	Canada	X				
	ISRA: Small-Scale Fishing	Canada France				X	

^a75% of ISRA's funding in 1983 came from two donors (France, the World Bank) and the GOS: World Bank, 24.06%; France, 24.13%; GOS, 24.72%.

<u>Country of Project</u>	<u>Project Title</u>	<u>CDA Donor</u>	<u>Crops</u>	<u>Livestock</u>	<u>Agro-Forestry</u>	<u>Fisheries</u>	<u>General</u>
Senegal (cont.)	ISRA: Sociology and Economy of Fishing in Senegal	France U.S.				X	
	ISRA: Statistical and Informational Procedure	Canada France U.S.					X
	ISRA: Study on Ocean Environment	France U.S.				X	
	ISRA: Upgrading of Natural Resources for Cattle Feeding (LNERV/Dakar)	France		X			
	ITA: Cereal Programs	FRG U.S.	X				
	ITA: Dairy Product Programs	France Canada		X			
	ITA: Fish and Fish Product Programs	U.S.				X	
	ITA: Programs on Fruits and Vegetables	Italy	X				
	Millet Processing (research and development)	U.S.	X				
	Natural Forestry and Re- forestation Studies for the Groundnut Basin	France			X		
	ORSTOM	France				X	
	ORSTOM: Agrosystems	France	X				
	ORSTOM: Interaction Between Plant and Soil Microorganisms	France	X				
	ORSTOM: Physical Oceanography	France				X	
	ORSTOM: Research on Human and Animal Nutrition	France		X			
	ORSTOM: Structures and Basic Mechanisms of the Sea Environment	France				X	
	Plant Reproduction	Canada			X		

<u>Country of Project</u>	<u>Project Title</u>	<u>CDA Donor</u>	<u>Crops</u>	<u>Livestock</u>	<u>Agro-Forestry</u>	<u>Fisheries</u>	<u>General</u>
Senegal (cont.)	Reforestation in the North	FRG			X		
	Research on Species with Non-ligneous Character	France			X		
	Study on Agro-Livestock Unit for Theis and Diourbel Regions	Italy		X			
Upper Volta							
	Agricultural Development Support (farming systems research)	U.S.	X				
	Cowpeas Improvement	Canada	X				
	Cowpeas Storage--Phase II	Canada	X				
	Crop Protection	Canada	X				
	Farming Systems Unit of the University of Purdue	U.S.	X				
	ICRISAT	Canada U.S.	X				X
	Integrated Control Project of the National Service of Plant Protection	U.S.	X				X
	Leguminous Food Crops- Phase III	Canada	X				
	National Seed Service (laboratories)	U.S.					X
	National Service of Plant Protection: Plant Protection Laboratory	Canada	X				X
	ORSTOM	France	X	X			X
	Striga Control in Upper Volta	Canada	X				
	Village Livestock Development	U.S.		X			

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Upper Volta (cont.)	Voltaic Institute of Agricultural and Animal Husbandry Research (IVRAZ)	France	X	X			
Sahel Regional							
	Integrated Pest Management Project	U.S.	X				
	ISNAR	U.K.					X
	OHVS: Agronomic Research (development of cropping systems and improved varieties)	U.S.	X				X
	OHVS: Agronomic Research II (institutional capacity strengthening)	U.S.	X				X
	Regional Food Crop Protection--IPM (establishment of 7 laboratories)	U.S.	X				X
	Regional Food Crop Protection II (support of laboratories)	U.S.	X				X
	West Africa Major Cereals Research	U.S.	X				

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