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ASSESSMENT OF AGRICULTURAL
RESEARCH RESOURCES
IN THE SAHEL

VOLUME III
NATIONAL REPORT: THE GAMBIA

by

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RESEARCH RESOURCES
IN THE SAHEL

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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

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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.

LIST OF ACRONYMS AND ABBREVIATIONS

ADB	Agricultural Development Bank
ADRAO	Association pour le développement du riz en Afrique de l'Ouest (See Warda)
AVRDC	Asian Vegetable Research and Development Center
BIAO	International Bank for West Africa (Banque internationale pour l'Afrique occidentale)
BICI	International Bank for Commerce and Industry (Banque internationale pour le commerce et l'industrie)
CBG	Central Bank of The Gambia
CEDEAC	Communauté économique des états de l'Afrique de l'Ouest (See ECOWAS)
CTLSS	Permanent Inter-State Committee for Drought Control in the Sahel (Comité permanent inter-états de lutte contre la secheresse au Sahel)
CIMMYT	International Center for Maize and Wheat Improvement
DAHP	Department of Animal Health and Production
ECOWAS	Economic Community of West African States
FAO	Food and Agricultural Organization of the UN
GADB	The Gambia Commercial and Development Bank
GCU	Gambia Cooperative Union
GPMB	Gambia Produce Marketing Board
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IDRC	International Development Research Center (Canada)
IFDC	International Fertilizer Development Center
IITA	International Institute of Tropical Agriculture
INSAH	Institute of the Sahel (Institut du Sahel)
IRRI	International Rice Research Institute
LBA	Licensed Buying Agents
LMB	Livestock and Meat Board
OMVG	Gambia River Basin Commission (Organisation pour la mise en valeur du fleuve Gambie)
SAFGRAD	Semi-Arid Food Grains Research and Development
SGB	Standard Gambia Bank, Ltd.
SSHFC	Social Security and Housing Finance Corporation
UNESCO	United Nations Educational, Scientific and Cultural Organization
USAID	Agency for International Development
WARDA	West African Rice Development Association
WHO	World Health Organization

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INTRODUCTION

A. Background

The Agricultural Research Resources inventory and assessment for The Gambia was also conducted in the remaining seven countries of the Sahel (Cape Verde, Chad, 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. The eight national reports taken together comprise Volume III of this report. They are bound separately and are available from the United States Agency for International Development in Washington.¹

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

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

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

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

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

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

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

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

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

B. Methodology

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

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

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

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

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

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

The inventory and assessment were carried out from May 1983 to April 1984. The bulk of the data collection and the writing of the national reports were carried out from September to December 1983 by the National Coordinators and their consultants in cooperation with the VRES/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 regional projects and activities to carry out the strategy elements.

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

II. GENERAL INFORMATION ON THE GAMBIA

A. Geographical and Ecological Notes

The Gambia, which lies between latitudes 13°N and 14°N, forms a narrow belt on either side of the Gambia River, extending into the Republic of Senegal for some 500 km. (See Figure 1.) Total land area is estimated at 11,000 km². Boundaries are political and do not correspond to geographical features.

1. Climate

The Gambia has a Sahelo-Sudanian climate characterised by a long dry season and a short intense wet season. Near the coast, the climate changes to the Guinean-Casamance type which differs mainly in having more rainfall. Cocheme (1967) analyzed the climate of this part of West Africa, which is dominated by two influences: the north-easterly harmattan, a dry continental air mass coming from the Sahara; and the south-westerly monsoon, a humid oceanic air mass. They meet in the low pressure belt known as the intertropical convergence zone, where their interaction produces thick, low clouds and heavy rain with thunderstorms. The northward migration of this convergence zone brings rain to the area from June to October. In the winter months, the convergence zone moves southward, anticyclonic conditions prevail, and the area is mainly dry. The principal features of the climate are described below.

a. Temperature

Temperature varies considerably with small variations of a degree or less per minute. A daily sinusoidal pattern also exists with temperature rising during the day and falling during the night, as well as an annual cycle.

The annual temperatures follow the same pattern throughout The Gambia, although at the coast temperature varies less. (See Figure 2.) Daily minimum and maximum temperatures rise steadily from January to May and fall during the rainy season because of increasing cloud cover and cold air brought down by convectional shower activity, and later by the passage of easterly waves. At the end of the rainy season temperature decreases due to the southward movement of the inter-tropical convergence zone and inflow of cold north-easterly winds.

Table 1 shows the highest and lowest temperatures recorded for The Gambia.

b. Annual rainfall

During a normal year, rainfall generally diminishes from over 1000 mm in the South of Gambia to 800 mm or less in the north. (See Figure 3.) There are, however, local variations in this

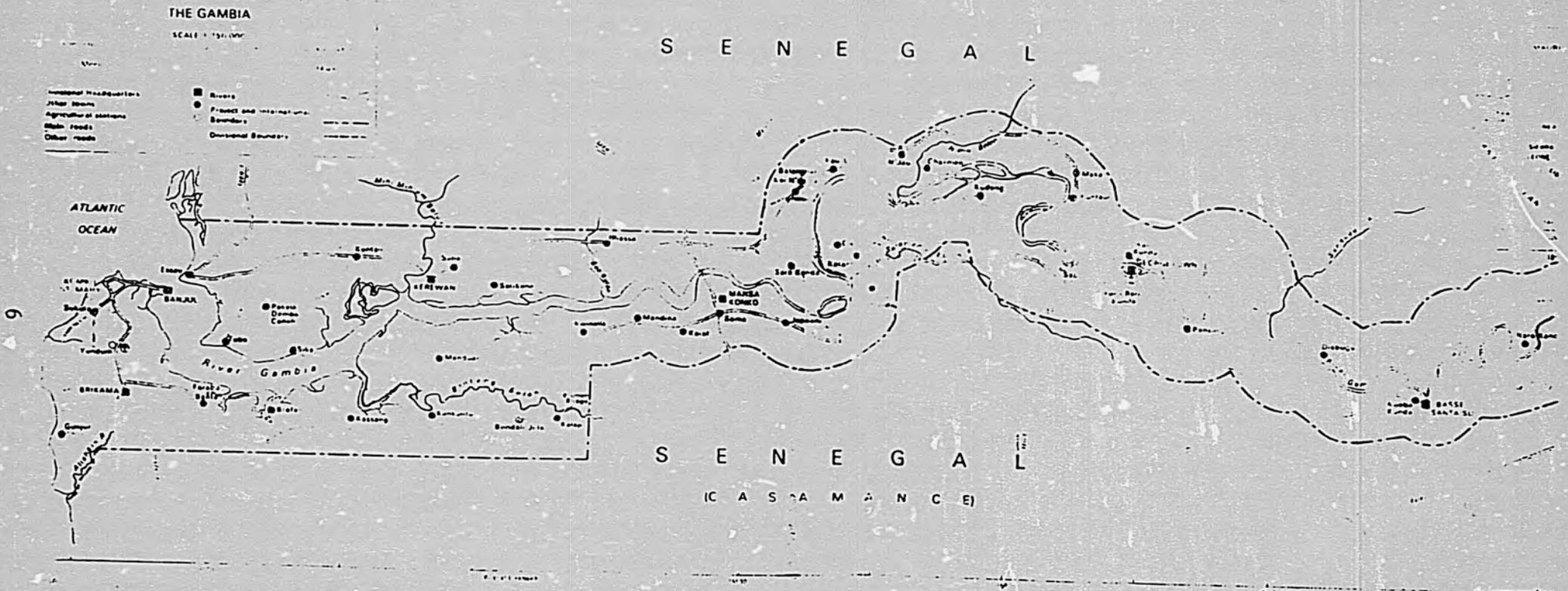


Figure 1: Map of The Gambia

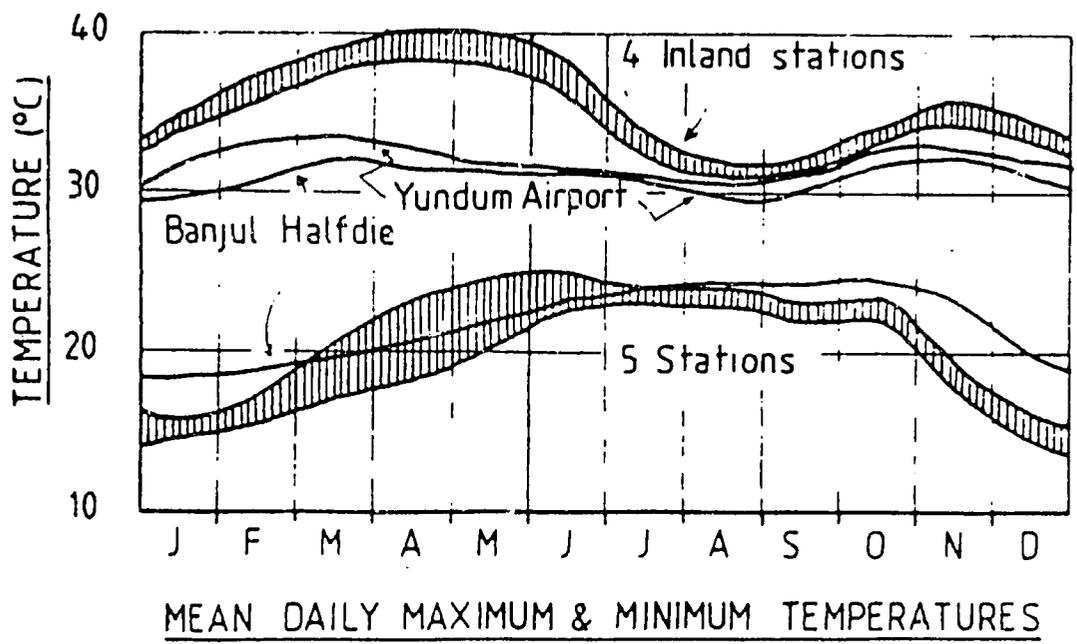


Figure 2: Variations in Temperature

Table 1: Highest and Lowest Temperatures Ever Recorded
(C°)

	<u>Yundum Airport</u>		<u>Banjul Halfdie</u>		<u>Sapu</u>		<u>Georgetown</u>		<u>Basse</u>	
	<u>Max.</u>	<u>Min.</u>	<u>Max.</u>	<u>Min.</u>	<u>Max.</u>	<u>Min.</u>	<u>Max.</u>	<u>Min.</u>	<u>Max.</u>	<u>Min.</u>
J	37.3	6.7	37.3	9.4	38.3	8.3	40.6	8.3	39.5	8.7
F	40.5	8.3	38.4	13.9	41.8	10.0	42.5	10.6	41.4	10.3
M	41.6	10.6	41.6	12.2	42.2	11.7	44.4	12.2	42.4	14.4
A	41.1	12.2	39.7	15.6	42.2	14.4	45.0	13.3	43.6	17.0
M	42.2	15.0	40.0	16.1	43.3	15.5	44.4	16.7	43.1	20.0
J	38.9	16.7	36.7	18.9	42.2	16.1	42.7	17.8	42.2	19.4
J	33.9	13.3	35.1	19.4	36.7	17.2	39.0	18.4	47.5	18.9
A	32.8	18.0	34.4	29.6	35.6	19.4	35.6	19.0	34.5	18.9
S	35.1	17.2	36.0	20.6	39.5	19.2	35.6	18.9	35.8	19.0
O	35.6	16.7	37.3	16.1	40.0	17.2	38.3	10.6	37.8	16.5
N	36.7	12.2	36.6	16.1	39.9	10.0	40.0	12.2	39.4	10.0
D	37.3	7.8	32.2	13.9	37.8	7.8	39.4	8.9	43.0	5.0
Yr	42.2	6.7	41.6	9.4	43.3	7.8	45.0	6.3	43.6	5.0

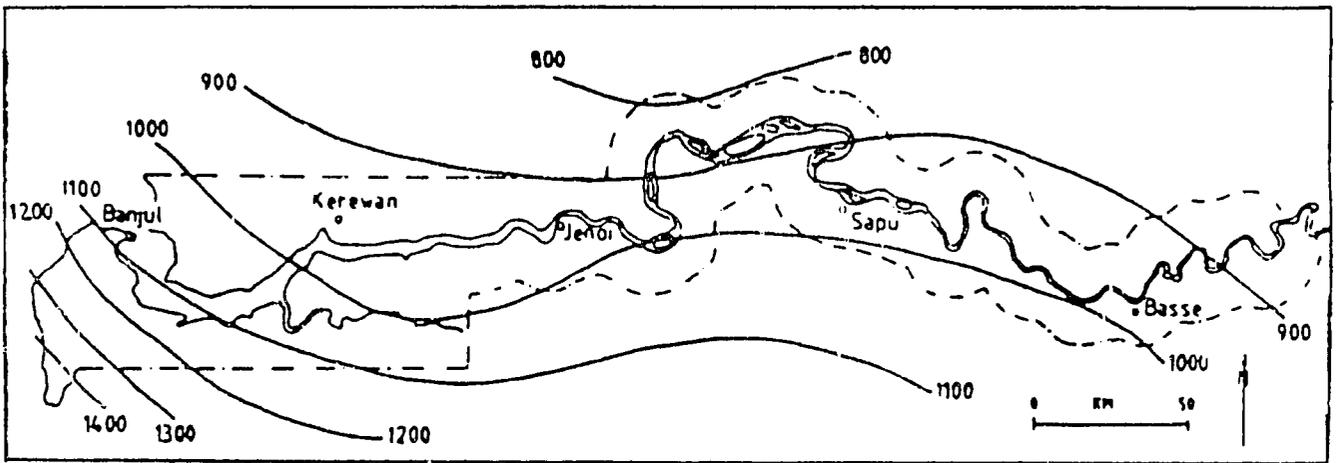


Figure 3: Mean Annual Rainfall, 1948-1977
(mm)

pattern, the most important being higher rainfall near the coast where the isohyets turn from west-east to northwest-southeast. This coastal increase has been attributed to the presence of a southwesterly air stream rather than to intensified easterly winds (Hutchinson 1983). In general however, rainfall is highly variable both in time and space so that it is unlikely that any one year will follow the normal pattern.

Recently the Sahelian drought has focused considerable interest on rainfall. Winstanly (quoted by Hutchinson 1983) has computed time series for The Gambia using data taken from random stations with varying recordkeeping times. His findings indicate that although there are large variations from year to year, there is an overall decrease of 15-20 percent in the amount of rainfall from 1886 to 1977. (See Figure 4.)

c. Changes in seasonal characteristics

Annual rainfall studies, although interesting, do not provide the most pertinent information to farmers and planners who use this data. They really need to know whether, apart from a general rainfall decline, the seasonal characteristics have changed. For example, is the normal midseason dry spell intensifying? Hutchinson (1983) calculated regressions on five rainy season months (June to October) for five stations. His findings, presented in Figure 5, show an alarming decrease in August rainfall at all stations. Moreover, August had traditionally been the wettest month. Obviously, a major change occurred in the middle rather than at the end of the season, but the length of the rainfall season was virtually unaltered. However, the growing season, as opposed to the rainfall season, has effectively been shortened due to a loss of soil moisture in September and October.

d. Hours of sunlight

The sun shines from an average of 5.4 hours per day in August to 10.1 hours in April. Sunlight hours increase from December to April as the days become longer. Increasing cloud cover associated with the advancing monsoon, means decreasing sunlight hours from May to August. However, total sunlight hours begin to rise as the monsoon retreats.

Note that even in the middle of the rainy season, over five hours of sunlight a day have been recorded.

2. Geomorphology

The Gambian landscape comprises four basic elements (Sompo-Ceesay, 1974):

Adjacent to the main river and its major tributaries are flat areas representing recent past or contemporary flood plains on which alluvial material was deposited during the Quaternary Period. Narrow bands, more recently deposited, occur in the depressions formed by the minor tributaries. These areas are normally filled with water.

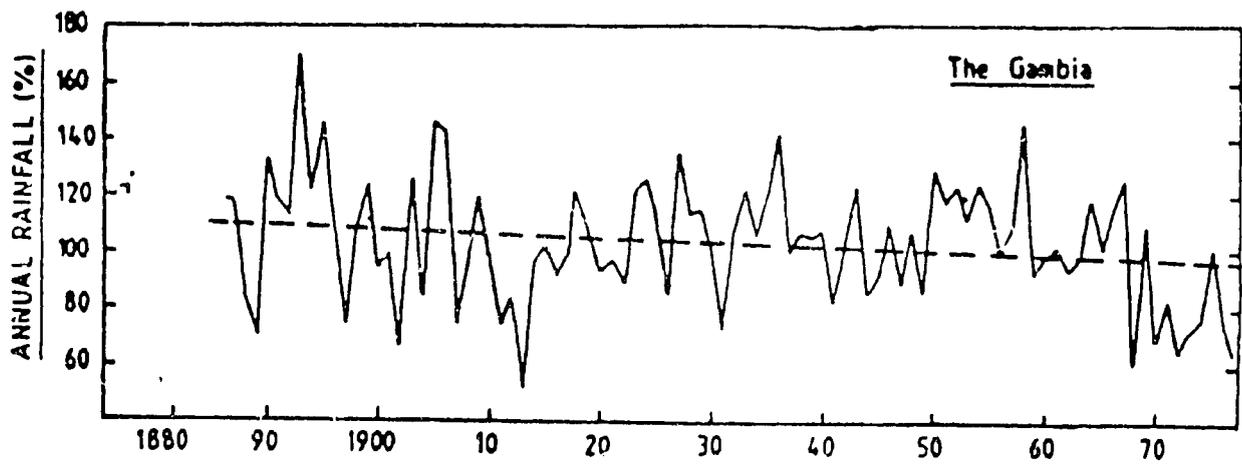


Figure 4: Annual Rainfall
(percentage)

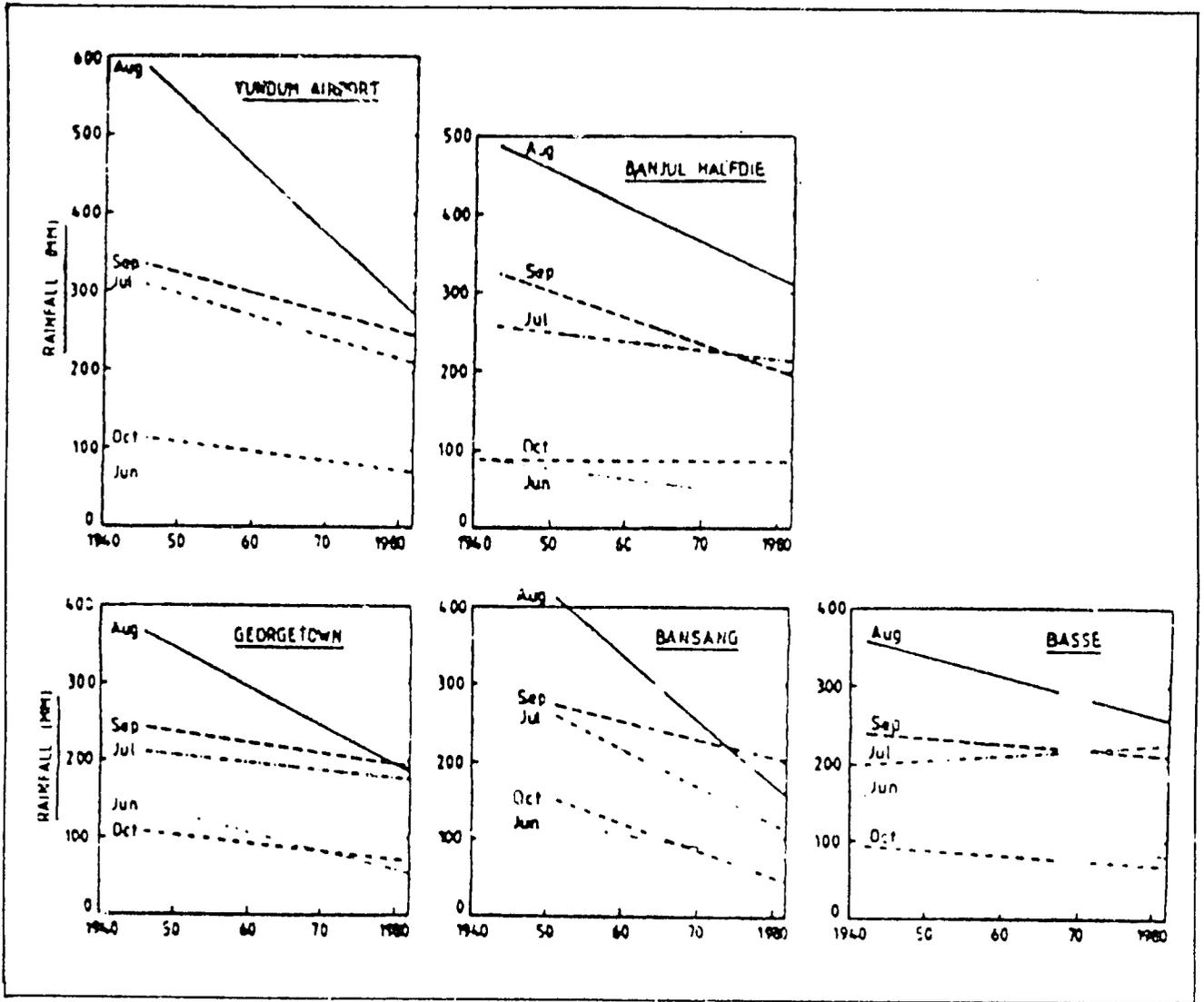


Figure 5: Monthly Rainfall at Five Gambian Stations
(Linear regressions)

Above the alluvial flats lie colluvial slopes, gently sloping areas covered by deposits of the eroded earth.

The remainder of the terrain comprises a Tertiary plateau with two different levels. The upper plateau is the dominant element of the landscape in the eastern half of the country, but west of approximately Farafenni on the North Bank and Bwiam on the South Bank this sector occurs only rarely. The lower plateau is exposed to dissection and erosion of the higher plateau and forms the basic landscape of the North Bank and Western Division. Further east this segment of the landscape occurs in depressions formed by the main river. The distinction between the colluvial slopes and the lower plateau is often obscure in these situations as the levels may be only narrowly separated and the lower plateau may in places be mantled by the colluvium of the eroded upper plateau.

3. Soils

Soil distribution is closely related to the landscape and is described below within the broader context of landscapes.

a. Recent alluvial soils

The soils of the recent alluvium show a high degree of variability in both morphological and chemical characteristics, but they may be grouped into three categories:

Soils that are strongly influenced by the presence of mangroves is one category. The present mangrove soils are normally permanently saturated to the surface; they are finely textured clays and silty clays. They are very dark in colour and may develop a high degree of acidity upon drying out.

Throughout the McCarthy Island Division and extending for some way into the Upper River Division, the recent alluvial flats are separated from the river only by a shallow bank and are dissected by a network of small stream channels. They have a complex depositional history to which the soil type is related. The soils are fine textured clays, silty clays and clay loams. They have a relatively developed structure and are grey in colour, usually with a well marked pattern of ochreous mottles. They may be slightly acidic to neutral, and have a moderately high level of exchangeable bases and cation exchange capacity.

In most of the Upper River Division, the swamps are separated from the river by a high terrace; they are, therefore, considered as back swamps. These back swamps lack the stream channel network of the alluvial plains to the west but may be characterised by the occurrence of pond-like depressions. They are subject to irregular but often very severe flooding.

The intrinsic characteristics of the soils are essentially similar to those described as prevalent in MacCarthy Island Division though they may have an even more strongly developed structure.

b. Colluvial slope soils

The soil pattern on the colluvial slopes is closely related to topography. In the highest topographic position, there are deep, red soils with moderately deep (25 cm) or deep (50 cm) sandy soils overlying finer textured B horizons. North of the slope, the soils may incorporate laterite rubble. In the lower positions on the slope, the soils reflect the influence of the higher water table. The colours are yellowish or brownish and in the deeper layers there is mottling and sometimes the development of soft concretionary materials. The position of the various soils in the sequence depends on the slope. In fairly flat situations, the red soils are very extensive and may almost abut on the hydromorphic soils; where the slope is marked, the red soils are confined to narrow bands adjacent to the scarp while in the greater part of the colluvial slopes the soils are less brightly coloured.

Soils of the lower plateau are in general similar to those in higher topographic positions on the colluvial slopes.

c. Soils of the upper plateau

Where dissection and erosion have been active, the land surface may comprise outcropping, hard, massive laterite or a shallow, usually medium texture soil overlying this. Where there has been no active erosion, there are deep soils. These soils have only very shallow, coarsely textured surfaces or they may be medium textured up to the surface. Between these two extremes, the form of the soil is essentially a function of the depth up to the laterite.

d. Physical and chemical characteristics of the upland soils

On the colluvial slope and the lower plateau the soils are usually deep, deeper than 2 m, while many upper plateau soils are shallow with coarsely textured surfaces and relatively fine texture at the surface. Soils situated at higher levels also have a high silt content (29-53 percent); this, taken in conjunction with the low organic matter, explains the tendency of these soils to form hard compacted surfaces of low permeability and high erodibility. The soils of the lower plateau and colluvial slope, however, usually have deeper coarsely textured surface soil and a lower silt content than those of the upper plateau soils. Therefore, these soils are more permeable.

The soils are inherently fertile; the level of total exchangeable bases rarely exceeding 5 m. eq/100g. soil, while cation exchange capacity is usually lower than 6 m. eq/100g. soil. There appears to be a significant difference between the upper plateau and lower plateau colluvial slope (based on preliminary analysis of data). While on the upper plateau the base saturation is low (mean value 25 percent), on the lower plateau and colluvial slope it is high (mean value 72 percent). This is reflected in the sub-soil pH values; on the

upper plateau, 5.1, and the lower plateau/colluvial slope, 5.7. The organic carbon content of all surface horizons is low but that of the upper plateau with a mean 0.67 percent is significantly higher than that of the other upland soils at a mean 0.32 percent.

B. Demography

1. Population

The population of the Gambia is provisionally estimated to be 695,886 (1983 Census), giving a population density of 63 persons per square kilometer. Projections indicate that the population will grow to over one million people by the year 2000.

Analysis of the 1983 Census data has just begun and detailed information on population distribution is not yet available. The population distribution according to local Government area indicates that 78 percent of the population lives in rural areas.

The population composition by ethnic group (1973) is given in Table 3.

The main religious groups are, in order of size, Moslem (85 to 90 percent), Christian (10 to 15 percent) and traditional (1 percent).

2. Occupational patterns

The traditional occupation of the rural population is agriculture, while inhabitants in the urban areas are mainly civil servants, (largest group) businessmen or employees of commercial concerns. Unemployment and underemployment are serious social problems.

Migration from the rural to the urban areas is on the increase although no studies of the problem have been undertaken. (Note population increase for Kombo St. Mary, Table 2.)

Details of employment pattern, migration, etc. should become available when analysis of the 1983 Census data is complete.

C. Education

1. Formal education

The formal system of education in The Gambia is administered by the Ministry of Education.

The lower levels of the system are primary schools which admit students at the age of eight for a six-year course leading to the common entrance examinations. From the primary schools pupils with above average results enter the secondary schools while the others go to technical schools. The 16 technical secondary schools are designed to provide students with a four-year course of basic training in the skills and trades demanded by the job market. Students graduate from

Table 2: Percentage Increase of The Gambia Population, 1973-83

<u>Local Government Area</u>	<u>1973 Population</u>	<u>1983 Population</u>	<u>Percentage Increase</u>
Banjul	39,179	44,536	13.7
Kombo St. Mary	39,404	102,858	161.0
Brikama	91,013	138,504	52.2
Mansakonko	42,447	55,620	31.0
Kerewan	93,388	111,411	19.3
Kuntaur	47,669	58,830	23.4
Georgetown	54,232	71,211	31.3
Basse	86,167	112,916	31.0

Table 3: Percentage Distribution of The Gambia Population
by Ethnic Group (1973 data)¹

<u>Ethnic Group</u>	<u>Percentage</u>
Mandinka	42.3
Wollof	15.7
Serrahuli	8.7
Aku	1.0
Bambara	0.4
Fula	18.2
Jola	9.5
Serere	2.1
Manjago	1.3
Other	0.9

¹It can be assumed that no significant changes in these percentages will result from an analysis of the 1983 data.

Source: Population Census, 1973, Vol. 3 Gen. Report

the technical schools with a school leaving certificate. Those who do exceptionally well may be admitted to the high schools.

There are seven high schools in The Gambia offering a five-year course leading to the West African Examination Councils General Certificate of Education at Ordinary levels and two of the schools (The Gambia High School and Saint Augustines High School both located in Banjul) offer a two-year curriculum for the Council's Advanced level Certificate, which entitles students who pass to enter a University. Students wishing to enter University, however, must seek places in overseas institutions since there is no tertiary level education institution in The Gambia.

Tables 4,5 and 6 summarize the school enrollment data and project an increase up to school year 1985/86.

2. Adult education

Adult education was initiated by a group of volunteers who founded the National Adult Literacy Committee in 1976 to help Gambian farmers attain "a level of functional literacy." In 1980, the Government intervened and created the Department of Non-formal Education whose role was to develop a curriculum in orthography and to coordinate adult education programmes in the country. Today, farmers are taught to read and write in the three main languages of The Gambia: Mandika, Wolof and Fula.

D. Government

1. Government structure

The Gambian system of government is a multiparty democracy modeled on the British Parliamentary System. There are three main parties:

- o The People's Progressive Party - majority party;
- o The National Convention Party - opposition party; and
- o The United Party - not represented in Parliament.

The constitutional arrangements allow for a multiparty system in which the party that controls a majority in Parliament forms the Government. The three main branches of the Government are as follows.

a. Executive branch

This is composed essentially of a Cabinet presided over by a President. Cabinet members are all heads of Ministries and members of the Legislature. Functions of the executive branch include:

Table 4: Students and Retention Rates in Primary Schools by Grade and Sex, 1978/79-1985/86

	Sex	Students (Actual)			Retention rates		Students (projected)				
		1978/79	1979/80	1980/81	Actual	Projected	1981/82	1982/83	1983/84	1984/85	1985/86
					1978/81	1981/86					
Primary 1	M	4823	5396	5099							
	F	2613	3269	4185							
	T	7436	8665	10084			11400	12000	12700	13400	14100
Primary 2	M	3943	5138	5457							
	F	1953	2553	3029							
	T	5896	7691	8486	1.00	1.00	10100	11400	12000	12700	13400
Primary 3	M	3417	3879	4928							
	F	1500	1836	2476							
	T	4917	5715	7404	0.97	0.98	8300	9600	11200	11800	12400
Primary 4	M	3925	3382	3761							
	F	1498	1501	1621							
	T	5423	4883	5602	0.99	0.98	7300	8100	9700	10900	11500
Primary 5	M	2871	3163	3702							
	F	1314	1531	1601							
	T	4185	4694	5303	0.97	0.98	5500	7100	8000	9500	10700
Primary 6	M	3660	4169	4536							
	F	1603	1827	2035							
	T	5263	5996	6573	1.42	1.40-1.25 ^a	7400	7400	9200	10,000	11900
Total	M	21739	25127	28432							
	F	10481	12517	15147							
	T	32220	37644	43432			50000	55900	62800	68300	74000

^aDeclining from 1.40 (1980/81-1981/82), 1.35 (1981/82-1982/83), 1.30 (1982/83-1983/84) to 1.25 (1983/84-1985/86)

Table 5: Students and Retention Rates in Secondary Technical Schools by Form and Sex, 1978/79-1985/86

	Sex	Students (actual)			Retention rates		Students (projected)					
		1978/79	1979/80	1980/81	Actual 1978/81	Projected 1981/86	1981/82	1982/83	1983/84	1984/85	1985/86	
Form 1	M	1023	1059	1143								
	F	419	461	560								
	T	1442	1520	1703			1740	1780	1820	1860	1900	
Form 2	M	808	1002	1055								
	F	342	454	474								
	T	1150	1456	1529	1.01	1.00	1700	1740	1780	1820	1860	
Form 3	M	394	205	928								
	F	349	371	410								
	T	1143	1179	1338	0.97	1.00	1500	1700	1740	1780	1820	
Form 4	M	799	789	866								
	F	300	350	352								
	T	1099	1119	1218	1.01	1.00	1340	1550	1700	1740	1780	
Total	M	3424	3658	3992								
	F	1410	1616	1796								
	T	4834	5274	5788			6310	6750	7040	7200	7360	

Table 6: Students and Retention Rates in Secondary High Schools by Form and Sex, 1978/79-1985/86

Form	Sex	Students (actual)			Retention rates		Students (projected)				
		1978/79	1979/80	1980/81	Actual	Projected	1981/82	1982/83	1983/84	1984/85	1985/86
					1978/81	1981/86					
Form 1	M	370	411	426							
	F	170	183	182							
	T	540	594	608			640	670	700	730	760
Form 2	M	363	397	414							
	F	191	151	184							
	T	557	548	598	1.01	1.00	610	640	670	700	730
Form 3	M	384	413	427							
	F	211	207	177							
	T	595	620	604	1.11	1.06	630	650	680	710	740
Form 4	M	395	420	432							
	F	171	172	200							
	T	566	592	632	1.01	1.00	600	630	650	680	710
Form 5	M	230	441	462							
	F	91	154	162							
	T	321	595	624	1.05	1.00	630	600	630	650	680
Form 6	M	40	76	84							
	F	34	15	21							
	T	74	91	105	0.26		120	140	150	160	180
Total	M	1782	2158	2245							
	F	868	882	926							
	T	2650	3040	3171			3230	3330	3480	3630	3800

- o Final policy determination to be submitted to Parliament; and
- o Coordination and delimitation of the authority of the Ministries.

b. Legislative branch

This consists of elected representatives of the people. Its functions include:

- o Legitimitizing Government actions in so far as all bills must be passed by Parliament to become law; and
- o Acting as a forum for debate and examination of Government policy.

c. Judicial branch

This branch is headed by the Chief Justice of the Supreme Court who, under the provisions of the Constitution maintains complete independence of the Executive and Legislative branches. Together with the judges and magistrates under his jurisdiction, the Chief Justice interprets the Constitution.

d. Important Ministries

There are fourteen Ministries in The Gambia which fulfill the following major functions:

- o Office of the President: Responsible for Cabinet business, constitutional matters, defense, security, Public Service Commission and statutory agencies;
- o Office of the Vice President: Government affairs in Parliament, civil service matters, public records, cultural archives;
- o Ministry of External Affairs: Protocol, external relations with other countries and with international agencies;
- o Ministry of Finance and Trade: Banks and banking; balance of payments, customs and excise; exchange control policy; income tax; recurrent budget; national accounts; international and other overseas financial and trade organizations; etc.;
- o Ministry of Justice: Judicial administration, civil litigation, drafting legislation, prosecution, Registrar General Office;
- o Ministry of Labour, Health and Social Welfare: Labour matters, public health, hospitals, social welfare, trade unions, etc.;

- o Ministry of Agriculture: Agricultural administration, research, development and extension. Livestock development and research; crop protection, crop and livestock census;
- o Ministry of Information and Tourism: Information and broadcasting; tourism promotions; government publications;
- o Ministry of Economic Planning and Industrial Development: Central statistics, development budget, development planning and incentives, economic analysis, industrial development;
- o Ministry of Water Resources: Water resources administration, water research and development, hydrological services; development of the Gambia River Basin (OMVG); fisheries administration, research and development; forestry administration, environmental matters; wildlife protection, and conservation;
- o Ministry of the Interior: Maintenance of internal security and order, policy matters; probation, fire and civil defense services; immigration and nationality; passports, community relations;
- o Ministry of Public Works and Communications: airports; port authorities, communication, external and internal public transport; utilities; postal services; public buildings; river transport; roads and bridges; etc.;
- o Ministry of Education, Youth, Sports and Culture: Cultural affairs; education - administration, policy and planning; libraries; vocational and technical schools; youth affairs and cultural matters; and
- o Ministry of Local Government and Land: Area councils, state lands; district administration, land tenure - policy, geological surveys, physical planning including construction and land development projects.

2. National budget

The current budgetary system, as in the past, consists of the recurrent budget administered by the Ministry of Finance and the development budget administered by the Ministry of Economic Planning. Both budgets are presented concurrently to Parliament by the Minister of Finance on an annual basis. The fiscal year runs from July 1 to June 30.

The main sources of revenue are income taxes and domestic taxes on goods and services. Taxes on international trade and transactions are incorporated in the recurrent budget. The development budget details project expenditures by sector. Development budget financing depends on loans and grants from foreign donors while the government's contribution comes from the consolidated revenue fund in the form of transfers.

Currently the proposed expenditures stand at D151,827,480 for the recurrent budget and D119,400,000 for the development budget.

3. Government policy on agriculture

The overall goals and objectives of national development were outlined in the First Five Year Plan, 1976-1981. The plan initiated a comprehensive and intensive development effort aimed at transforming the Gambian economy from a very low production level dependent on the export of one cash crop (groundnuts), highly vulnerable to market fluctuations, and dependent upon external assistance to support its own development effort, to a diversified economy which will be progressively self-sufficient and capable of sustained economic and social progress through development of its own natural, human and material resources. The second Five Year Plan launched in 1981/82 will continue this process within the overall framework of the goals and objectives outlined in the First Plan.

The government recognizes that The Gambia will continue to depend heavily on the agricultural sector for growth and development and accordingly will continue to devote an increasing share of total resources to this sector. For the second plan period some 131 million Dalasi, representing approximately 25 percent of planned development expenditures, will be spent on the agricultural sector.

4. Membership in international organisations

The Gambia plays an active role in international affairs and is a member of the following international and inter-governmental organisations:

- o The United Nations (UN);
- o The Organisation of African Unity (OAU);
- o Economic Community of West African States (ECOWAS);
- o Food and Agriculture Organisation (FAO);
- o Permanent Inter-state Committee for Drought Control in the Sahel (CILSS);
- o Gambian River Basin Commission (OMVG);
- o World Health Organisation (WHO); and
- o United Nations Educational, Scientific and Cultural Organisation (UNESCO).

E. Economic Setting

1. Gross domestic product (GDP)

Tables 7 and 8 show the changes in GDP over the last three

Table 7: Gross Domestic Product, 1980/81-1982/83

	<u>1980/81</u>	<u>1981/82</u>	<u>1982/83</u>	<u>Annual Growth Rate</u>	
				<u>1980/81</u>	<u>1981/82</u>
	<u>----- (Million Dalasis) -----</u>			<u>--- (percentage) ---</u>	
<u>At Current Prices</u>					
GDP at Market Prices	399.7	464.3	512.4	13.2	10.4
GDP per capita (Dalasis)	626	702	749	9.2	6.7
GDP at factor cost	353.6	425.0	483.5	16.9	13.8
Indirect taxes ¹					
Less subsidies ¹	46.1	39.3	28.9	20.8	20.5
<u>At Constant 1980/81 Prices</u>					
GDP at Market Prices	399.7	430.6	469.9	8.4	9.1
GDP per capita (Dalasis)	626	651	686	4.7	5.4
GDP at factor cost	353.6	389.7	422.1	9.3	19.4
Indirect taxes ¹					
Less subsidies ¹	46.1	40.9	47.8	1.8	16.9
Mid-year population ²					
(000)	639	661.5	684.5	3.5	3.5

¹ Operating surplus in marketing and processing of groundnuts has been treated as indirect tax, or, if negative, as subsidy; in current prices the operating surplus for the three years amounted to D4.4 million, D16.5 million and D31.8 million respectively; in constant prices it amounted to D1.4 million and D2.5 million. Negative operating surplus in other parastatals has also been treated as subsidy.

² These population figures are derived by MEPID from preliminary results of the 1983 Census.

Source: Ministry of Economic Planning.

Table 8: Gross Domestic Product by Broad Industrial Origin
(Million Dalasis, 1980/81 Prices)

	<u>1980/81</u>	<u>1981/82</u>	<u>1982/83</u>
Agriculture ¹	88.5	126.1	148.9
Groundnuts	(19.8)	(45.4)	(63.8)

¹ Agriculture including groundnut production up to farmgate, Livestock, Forestry and Fishing. The Gross Domestic Product originating from the Fisheries sector has been very modest averaging D5.5 million per annum in the fiscal years under review, reflecting the under-utilization of these resources.

Source: Ministry of Economic Planning

years. The movement of GDP in The Gambia is determined to a large extent by the levels of groundnut and overall agricultural output. According to the data available, in Tables 7 and 8, and based on estimates from the Central Statistics Division and the Ministry of Economic Planning and Industrial Development, the GDP at constant 1980/81 prices increased from D430.6 million in 1981/82 to D469.9 million in 1982/83 and is projected at D500.4 million in 1983/84. This represents an increase in real terms of around 9.0 percent. This increase in GDP is tied to an increase in agricultural output, which more than compensated for setbacks in other important economic sectors, notably trade and tourism.

GDP in the agricultural sector is estimated to have increased by 40.6 percent. This increase, due entirely to high crop output, was shared by the export crops, groundnuts and cotton, and cereals. Output of groundnuts was 127,000 m/tons in 1982/83 compared to 82,000 m/tons in 1981/82. Cotton output increased to 2,500 tons and cereal output (including milled rice) increase to 105,700 tons in 1982/83 from 100,900 tons in 1981/82.

2. Foreign trade

a. Exports

The export value of groundnuts and other products is projected to increase from D82.6 million in 1981/82 to D121.0 million in 1983/84. Exports of fish products are projected to increase during the Second Plan period (1981/82-1985/86). Other exports consist of palm kernels and an increasing number of live cattle. Thus total domestic exports are projected to grow by 7.5 percent annually during the Second Five Year Plan. Groundnuts will remain the main cash crop accounting for an estimated 86.5 percent of the total value of domestic exports, despite efforts to diversify and make the economy less subject to world market price fluctuations for groundnuts.

Exports have increased rapidly during the past few years. (See Tables 10 and 11.) While trade has provided income and employment, and contributed tax revenues to government, it has also made possible clandestine capital export. Measures have already been taken during 1981-82 to discourage unrecorded border trade and further measures will be taken.

b. Imports

Imports are determined mainly by projected development in domestic demand and in re-exports. Since the scope for import substitutions is very limited, especially in the medium term, the growth of imports can be controlled by restraining domestic demand, particularly for imports for private consumption which account for nearly 40 percent of total imports. Based on changes in demand composition, and taking into account the effects of the economic stabilization measures, commodity imports cif decreased from D275.8 million in 1980/81 to D249.4 million in 1982/83. Table 9 provides information on significant imports in recent years.

Table 9: Selected Imports, 1980/81-1982/83
(Million Dalasis)

	<u>1980/81</u>	<u>1981/82</u>	<u>Preliminary Estimates 1982/83</u>
Food and live animals	63.7	74.8	50.5
Beverages and tobacco	9.7	14.3	13.2
Crude materials	6.0	4.7	3.7
Mineral fuels	39.3	44.4	44.0
Animal and vegetable oil and fats	2.1	0.5	2.3
Chemicals	14.0	16.7	17.3
Manufactured goods classified by:			
Materials	76.8	49.3	51.6
Machinery and transport equipment	50.2	33.0	44.3
Miscellaneous manufactured articles	13.2	15.7	17.1
Miscellaneous commodities	0.8	1.7	6.0
Total imports, c.i.f.	<u>275.8</u>	<u>255.1</u>	<u>249.4</u>

Source: Central Statistics Department.

Table 1C: Exports, 1981/82-1983/84
(Million Dalsis)

	<u>1981/82</u>	<u>1982/83</u>	<u>1983/84</u>
Exports (f.o.b.)	82.6	107.2	121.0
Other exports	n.a. ¹	40.0	42.0
Imports (c.i.f.)	255.1	249.4	278.2
	<hr/>	<hr/>	<hr/>
Trade Balance	<u>-172.5</u>	<u>-102.2</u>	<u>-115.2</u>

¹Not available.

Table 11: Exports of Six Principal Items by Order of Importance
(Volume and Value)

Estimates of Exports, 1981/1982

Merchandise Exports, f.o.b.

Groundnuts Productions (Delivered Purchases 82,000 mt)

Nuts	27,156 mt @ D813.9/mt	D22,120,268
Oil	4,713 mt @ 1599.4/mt	7,537,927
Cake	10,642 mt @ 393.7/mt	4,189,755
		<hr/>
Total Groundnut Products		33,829,995
		<hr/>
Palm Kernels and Palm Nuts	36 mt @ D1,555.6/mt	56,002
Fish and Fish Preparations	9,225 mt @ 507.3/mt	4,679,843
Others ¹		44,037,000
		<hr/>
Total Domestic/Merchandise Exports, f.o.b.		<u>82,602,800</u>

Services

Tourism (receipts only)	28,400,000
Private transfers (net)	4,000,000
Government transfers (net)	4,800,000
	<hr/>
Total Services and transfers	<u>37,200,000</u>

¹Includes re-exports recorded and unrecorded.

Source: Ministry of Economic Planning

Table 11: Exports of Six Principal Items by Order of Importance (cont.)
(Volume and Value)

Estimates of Exports, 1982/83

Merchandise Exports, f.o.b.

Groundnuts Products

Nuts	55,000 mt @ D766/mt	D42,107,400
HPS	2,700 mt @ 1200/mt	3,240,000
Oil	7,800 mt @ 1152/mt	8,895,600
Cake	12,100 mt @ 270/mt	3,267,000

Total Groundnut Products 57,600,000

Palm Kernels and Palm Nuts 600,000

Fish and Fish Preparations 4,000,000

Other 5,000,000

Total Domestic 67,200,000

Re-exports recorded and unrecorded 40,000,000

Total Merchandise Exports, f.o.b. 107,200,000

Services

Tourism (receipts only) 33,750,000

Private transfers (net) 6,000,000

Government transfers (net) 9,000,000

Total Services and Transfers 48,750,000

Table 11: Exports of Six Principal Items by Order of Importance (cont.)
(Volume and Value)

Estimates of Exports, 1983/84

Merchandise Exports, f.o.b.

Groundnuts Products (Delivered Purchases 120,000 mt)

Nuts	54,000 mt @ D804.3/mt	43,432,200
HPS	3,300 mt @ 1350.3/mt	4,455,990
Oil	11,700 mt @ 1335.6/mt	15,626,520
Cake	16,900 mt @ 285.6/mt	4,826,640

Total Groundnuts Products 68,341,350

Palm Kernels and Palm Nuts 650,000

Fish and Fish Preparations 5,000,000

Other 5,000,000

Total Domestic 78,991,350

Re-exports recorded and unrecorded 42,000,000

Total Merchandise Exports, f.o.b. 120,991,350

Services

Tourism (receipts only) 37,440,000

Private transfers 4,000,000

Government transfers 6,600,000

Total Services and Transfers 48,040,000

Despite an improvement in the terms of trade in 1980-81 from the low level of 1979-80, caused by an increase in the price of groundnuts and competing oil seeds on the world market, the terms of trade index for The Gambia remained well below the levels of the early seventies. World market prices for oil seeds fell in 1981, and the terms of trade index for 1981-82 was significantly lower than in 1982-83. The country will be especially sensitive to further increases in the price of petroleum products, which already account for about 10 percent of imports and are increasing rapidly.

c. Direction of trade

Trade direction is expected to change. Although groundnut exports are expected to continue to find their main market in Western Europe, a progressive increase in exports to neighboring West African countries is expected. The increasing fish and cattle exports to these countries will increase their share of The Gambia's exports.

The supply sources of imports are determined mainly by the specific requirements of goods to be imported, such as capital equipment, or by their customary sources of bulk supplies, such as mineral fuels and rice. In the case of capital equipment and supplies for projects receiving external funding, the source is often determined by the funding agency. Closer economic cooperation in West Africa will result in trade increases within the sub-region, especially for consumer goods.

3. Finance

a. Money

In The Gambia the currency unit used is the dalasi/butut; with 100 bututs equalling one dalasis.

The dalasi is pegged to the British pound sterling at the rate of D4.00 = one pound sterling.

The average exchange rate for the past six months has been one US dollar = D2.75.

The approximate annual cost of the public debt has increased significantly; this is a result of the maturity of most loans contracted during the First Plan 1974/75-1980/81, and the increase in interest payments. The debt servicing requirements have been greatly affected by the appreciation of the US dollar after the utilization of loan proceeds. Interest payments on external public debt were D1.6 million and repayments were D0.3 million in 1980-81. In 1981-82, the total interest payment was D4.2 million and the repayments D1.4 million. In 1982-83, interest payments equalled D6.3 million and repayments D8.3 million. For 1983-84, the total debt service is projected at D21.0 million.

b. Financial structures

In The Gambia the financial system consists of the following institutions: the Central Bank of The Gambia (CBG), The Gambia Commercial and Development Bank (GCDB), the Agricultural Development Bank (ADB), the Standard Bank Gambia Ltd (SGB) and the Post Office Savings Bank; these are all national banks. In addition, there is the Bank for West Africa (BIAO-Banque internationale pour l'Afrique Occidentale) and the International Bank for Commerce and Industry (BICI - Banque internationale pour le commerce et l'industrie), which are both foreign owned. Apart from the commercial banks, there are two insurance companies and a pension board. The Pension Board is incorporated under the Social Security and Housing Finance Corporation (SSHFC). This corporation serves quasi-governmental organisations and other employees in the private sector by providing pension while investing available funds in government bonds, treasury bills and savings deposits. The assets of the commercial banks are composed of treasury bills, other government incentives, loans, advances, discounts and other investments. Their liabilities are demand deposits, time and savings deposits and borrowings from the Central Bank. The operations of financial institutions are conditioned by monetary policies implemented by the Central Bank in pursuit of economic policy objectives.

4. Economic plans

The overall goals and objectives of national development were outlined in the First Plan 1974/75-1980/81. The plan initiated a comprehensive and intensive development effort aimed at transforming The Gambian economy from one dependent on the export of one crop (groundnuts), highly vulnerable to market fluctuations and external assistance to support the nation's development efforts, to a diversified economy which will be progressively self-sufficient and capable of sustained economic and social progress through development of its own natural, human and material resources. In pursuance of long-term economic development, the Second Five Year Plan 1981/82-1985/86 will continue the process within the overall framework of the goals and objectives of national development outlined in the First Plan. These approaches to development will be pursued within an appropriate economic policy framework to ensure balance and uninterrupted progress and to avoid financial and other crises.

The principal objectives of the policies are:

- o To achieve an adequate growth rate for GDP exceeding the growth rate of the population, with structural adjustments and diversification of the economy; the GDP is expected to increase at an average rate of 5.1 percent annually in real terms (constant prices) during 1981/82-1985/86. Since the population is estimated to increase by 2.6 percent annually, the actual growth rate from the latest census in April 1983, was 3.5 percent annually. This growth will allow an average increase of almost 2.5 percent annually in GDP per capita. The target may appear high in view of the

constraints on production expansion which are expected to continue during much of the Second Plan period. It should be considered, however, against the background of the decline in agricultural output and in total GDP during the latter part of the First Plan period. The average annual growth rate for the period 1974/75-1985/86, which covers both of the plans, is 3.6 percent for total GDP and 0.9 percent annually for GDP per capita;

- o To minimize the balance of payment deficits which are a serious constraint on development efforts. The aim is to reduce the deficit substantially by the end of the Second Plan period so that the need for a large balance of payment support is restricted to years of serious shortfall in export earnings caused by factors such as adverse weather, which are beyond the control of the Government;
- o To strengthen the Government's financial position and thus remove another major constraint on development efforts;
- o To maintain price stability and keep inflation under control; and
- o To maintain the system of free imports and payments, thus avoiding the occurrence of various economic distortions that result from restrictive measures and providing an appropriate environment for participation of private enterprises in economic development.

5. External aid including food aid

Most external aid is in the form of technical assistance, spare parts, and food aid.

According to available data, technical assistance increased from D1.5 million in 1974/75 to D22.5 million in 1982/83 and is projected to be D23.5 million in 1984/85.

Grants increased from D2.1 million in 1974/75 to D36.0 million in 1982/83 and are projected to reach D40 million in 1984/85. Food aid has also increased, mainly as a result of the drought. Food aid received from 1980 to 1982 and its sources are shown in Table 12.

F. Rural Sector

1. Agricultural land

The land resources study of The Gambia report (1976) gives the following data on land availability for agriculture. Four major land use categories are identified:

- o Cultivated land including plantations, fruit trees and oil pulses;

Table 12: Food Aid Received in The Gambia

<u>Donors</u>	<u>Commodities</u>	<u>Quantity</u>		
		<u>1980</u>	<u>1981</u>	<u>1982</u>
		------(t)-----		
WFP	Rice	2000	1010	940
U.K.	Rice			700
Canada	Rice			110
E.E.C.	Rice			1035
Japan	Rice			2964
France	Rice			700
UNDRO	Rice			80
Morocco	Rice			80
Cape Verde	Rice			50
WFP	Sorghum	4000	1230	
USAID	Sorghum	4000		
Saudi Arabia	Sorghum			900
EEC	Maize		2600	
WFP	Wheat	421	684	680
WFP	Wheat flour	140	390	150
EEC	Wheat flour	825		
Japan	Wheat flour			1400
France	Wheat flour			650
Cape Verde	Wheat flour			50
Cape Verde	Beans			100

- o Fallow land;
- o Uncultivated land showing no evidence of field boundaries or vegetation; and
- o Non-agricultural use, such as roads, settlements, etc.

Table 13 tabulates the area occupied by the four land use categories in each of the main geographical regions.

We note a national fallow-land to cultivated land ratio of 3.1:1 ranging between regions from 2.1:1 in North Bank to 4.8:1 in the Lower River Division. The study further distinguishes five suitable classes by evaluating soil characteristics based on their suitability for crop production (see Tables 14 and 15):

- o Unsuitable: Shallow soil near the edge of the plateau;
- o Marginal: Soils of the coastal strip, area of mixed shallow and deep soils on eroded interfluves, and outer zones of the plateau;
- o Suitable with qualifications;
- o Suitable; and
- o Suitable and irrigable.

Over the entire country, each category occupies the area and percentages indicated in Table 16.

a. Agricultural production units

Gambian agriculture is still based largely upon a traditional system of production characterised by shifting fallow cultivation and by the existence of a large number of small, independent farming units. It is estimated that in 1980-81, there were some 40,000 farming units (dabadas) each employing about 12 people practicing traditional farming on small plots of land averaging 0.5 ha per person. Despite recent progress, most farm work is still being done by hand. The use of animal drawn equipment, fertilizer and other agricultural inputs is not widespread.

Very few commercial farms and no government-owned farms exist in The Gambia.

b. Land tenure system

There is no individual or collective land ownership in The Gambia (outside of Banjul and Kombo St. Mary), in the sense that land is registered and title conferred. Villages and compounds have the right to use land which is held in trust by the District Council under the district Chief (Seyfolu). Customary rights of tenure that have evolved historically are protected under the 1966 Land

Table 13: Land Use by Geographical Region
(Area in ha and acres and percentage of regional total)

<u>Land Use Category</u>		<u>Western¹</u>	<u>Lower River</u>	<u>North Bank</u>	<u>Mid (North)</u>	<u>Mid (South)</u>	<u>Upper River (S)</u>	<u>Upper River (N)</u>	<u>Total</u>
1. Cultivated	ha	16,959	7,563	40,925	18,347	13,084	6,423	14,077	117,008
	(a)	(41,910)	(18,690)	(101,130)	(45,063)	(32,330)	(15,870)	(34,780)	(289,130)
	percent	10	5	19	12	9	7	13	11
2. Fallow	ha	56,650	37,703	90,116	54,675	49,246	25,764	37,222	351,347
	(a)	(139,980)	(93,160)	(222,680)	(135,101)	(121,690)	(63,662)	(91,980)	(868,400)
	percent	32	24	41	37	35	29	35	34
3. Uncultivated	ha	92,755	104,146	86,111	72,328	77,887	55,704	54,440	543,563
	(a)	(229,200)	(257,340)	(212,780)	(178,720)	(192,460)	(137,520)	(134,520)	(1343,144)
	percent	53	68	39	49	55	62	51	52
4. Non-Agricultural	ha	8,426	4,685	3,932	2,444	1,923	1,825	1,305	24,459
	(a)	(20,820)	(11,580)	(9,720)	(6,040)	(4,750)	(4,510)	(3,220)	(60,440)
	percent	5	3	2	2	1	2	1	2
Percentage of Total Area of The Gambia		17	15	21	14	14	9	10	100

¹ Figures for Western Division exclude Banjul and Kombo St. Mary.

Table 14: Soil Suitability Groups by Geographical Region
 (Area in ha and acres and percentage of regional total)

Soil Suitability Group		Western	Lower River	North Bank	Mid (North)	Mid (South)	Upper (North)	Upper (South)
1. Unsuitable	ha	31,981	79,795	81,811	52,485	39,389	34,679	36,197
	(a)	(79,025)	(197,175)	(202,155)	(129,690)	(97,330)	(85,690)	(89,440)
	percent	18	52	37	35	28	39	34
2. Marginal	ha	25,348	18,225	14,790	30,638	16,312	13,409	7,239
	(a)	(62,635)	(45,035)	(36,545)	(75,705)	(40,305)	(33,135)	(17,890)
	percent	15	12	7	21	11	15	7
3. Suitable with Qualifications	ha	39,117	21,693	30,731	8,681	23,661	11,253	12,278
	(a)	(96,660)	(53,605)	(75,935)	(21,450)	(53,465)	(29,805)	(30,340)
	percent	22	14	14	6	17	12	11
4. Suitable	ha	78,340	34,085	93,676	40,740	33,860	15,476	30,780
	(a)	(193,580)	(84,225)	(231,475)	(100,670)	(83,670)	(38,240)	(76,055)
	percent	45	22	42	28	24	17	29
5. Suitable and Irrigable	ha	0	0	0	15,065	28,917	14,809	20,592
	(a)				(37,225)	(71,455)	(36,595)	(50,880)
	percent				10	20	17	19
Percentage Totals of 3, 4, and 5		67	36	56	44	61	46	59

Table 15: National Land Use by Soil Suitability Groups
(Area in ha and acres and percentage of total)

Soil Suitability Group		Land Use Category				
		Cultivated	Fallow	Uncultivated	Non-Agricultural	Total
1. Unsuitable	ha	6,655	59,212	279,027	10,221	355,115
	(a)	(16,445)	(146,310)	(689,475)	(25,255)	(877,490)
	percent	2	17	78	3	100
2. Marginal	ha	5,685	38,913	80,383	1,147	126,127
	(a)	(14,045)	(96,155)	(198,625)	(2,835)	(311,660)
	percent	4	31	64	1	100
3. Suitable with Qualifications	ha	27,018	68,789	48,531	3,335	147,781
	(a)	(66,760)	(169,980)	(119,920)	(8,240)	(365,165)
	percent	18	4	33	2	100
4. Suitable	ha	71,877	172,796	72,956	8,715	326,344
	(a)	(177,610)	(426,978)	(180,275)	(21,535)	(806,395)
	percent	22	53	22	3	100
5. Suitable and Irrigable	ha	5,791	11,727	62,665	932,933	81,116
	(a)	(14,310)	(28,980)	(154,845)	(2,305)	(200,435)
	percent	7	15	77	1	100

Table 16: Area and Percentage of Each Soil Suitability Group

<u>Soil Group</u>	<u>Area (ha)</u>	<u>Percentage</u>
1. Unsuitable	355,115	34
2. Marginal	126,127	12
3. Suitable with Qualifications	147,781	14
4. Suitable	236,344	32
5. Suitable and Irrigable	81,116	8

(Provinces) Act. Customary law does not allow land to be sold, mortgaged, or pledged against loans.

Each village has an identifiable area of land falling within the jurisdiction of its own chief (Alkalo) who has the authority to allocate land to new immigrants.

Furthermore, any compound head has the right to clear land outside the village jurisdiction if it is unclaimed by any other person or community and to attach it to the land used by the compound. This particular piece of land is held in perpetuity by the members of the compound who clear it.

Only compound heads have the right to allocate any compound land to outside individuals. Such allocations are frequent, usually done on a yearly basis, under fairly long-term arrangements of 5-15 years. It is common for land to be returned on request if needed, especially because of population increase within the lending compound.

c. Major crops

Table 17 lists the major crops, with the area under cultivation, yield per ha and total production for the last years.

Producer prices (farm gate) are as follows (Nov. 1983):

- o Groundnuts D560/Ton;
- o Maize D390/Ton; and
- o Rice (Paddy) D520/Ton.

No official market exists for millet and sorghum and the price fluctuates widely with supply and demand, particularly in the neighboring provinces of Senegal. Farm gate prices as high as D800/Ton have been recorded for millet.

2. Animal production

The most important livestock in The Gambia are cattle, sheep, goats, poultry and to a lesser degree, pigs.

While animal husbandry is an important economic activity in The Gambia, its full potential has not been realized.

Sheep and goats are believed to number between 200,000 and 300,000 with a ratio of 3:5 (sheep/goats). They are commonly kept near the village and are frequently brought into the owner's compound at night. During the rainy season, they are taken out and herded on roadsides and fallow land or they are looked after by children.

Poultry is kept on a free range basis except for improved strains which are commercially exploited by "urban farmers" for eggs and broiler production using improved technologies.

Table 17: Area, Yield and Production of Principal Crops in The Gambia, 1974/1975-1981/82^a

<u>Crop</u>	<u>1974/75</u>	<u>1975/76</u>	<u>1976/77</u>	<u>1977/78</u>	<u>1978/79</u>	<u>1979/80</u>	<u>1980/81</u>	<u>1981/82</u>	<u>1982/83</u>
FINDO:									
Area	2.7	3.0	2.5	2.4	2.1	0.4	2.1	3.2	1.5
Yield	560	413	364	263	757	591	609	687	783
Production	1.5	1.2	0.9	0.6	1.6	0.2	1.3	2.2	1.2
EARLY MILLET (SUNO):									
Area	5.9	6.5	4.6	6.4	10.0	1.7	6.0	11.4	13.6
Yield	1,135	561	660	688	954	941	898	1,270	1,241
Production	6.7	3.6	3.0	4.4	9.6	1.6	5.4	14.4	16.9
LATE MILLET (SANYO):									
Area	16.4	15.8	10.3	13.0	15.3	9.3	11.6	11.6	16.0
Yield	710	591	791	494	671	752	853	1,271	1,050
Production	11.7	9.3	8.1	6.4	10.3	7.0	9.9	14.8	16.8
SORGHUM (KINTO & BASSO):									
Area	11.4	9.7	10.9	14.6	13.9	11.6	14.3	11.9	16.3
Yield	697	766	883	672	876	759	958	1,079	965
Production	7.9	7.4	9.6	9.8	12.2	8.8	13.7	12.8	15.7
MAIZE:									
Area	5.4	4.4	4.0	6.2	6.8	5.4	5.9	7.6	9.4
Yield	2,004	1,104	1,129	1,131	1,396	1,228	1,068	1,645	1,800
Production	10.8	4.9	4.5	7.0	9.6	6.6	6.3	12.5	17.0

Table 17: Area, Yield and Production of Principal Crops in The Gambia, 1974/75-1981/82 (cont.)

<u>Crop</u>	<u>1974/75</u>	<u>1975/76</u>	<u>1976/77</u>	<u>1977/78</u>	<u>1978/79</u>	<u>1979/80</u>	<u>1980/83</u>	<u>1981/82</u>	<u>1982/83</u>
UPLAND RICE:									
Area	7.4	7.5	7.6	7.0	4.0	4.9	1.5	4.1	4.3
Yield	545	534	373	387	904	537	1,200	1,129	969
Production	4.0	4.0	2.8	4.2	3.7	2.6	1.8	4.7	4.1
SWAMP RICE:									
Area	13.4	13.6	13.7	12.0	13.0	10.3	17.3	22.4	22.8
Yield	818	771	765	803	1,998	1,699	1,462	1,262	1,296
Production	10.9	10.5	10.5	14.8	25.9	17.5	25.3	27.9	29.6
IRRIGATED RICE:									
Area	0.6	0.5	2.0	0.7	1.3	2.0	3.7	2.4	1.1
Yield	4,410	4,680	4,160	5,080	4,920	5,010	4,760	5,690	4,605
Production	2.5	2.4	8.2	3.5	6.3	10.0	17.6	13.8	5.1
GROUNDNUT: ¹									
Area	104.8	98.8	107.6	105.4	106.2	67.8	68.9	80.7	95.0
Yield	1,385	1,429	1,329	949	1,256	986	874	1,349	1,593
Production	145.2	141.3	143.2	100.0	133.4	66.9	60.2	108.9	151.3
COTTON:									
Area	-	0.5	1.0	2.3	1.7	1.0	2.3	2.6	2.8
Yield	-	650	735	500	506	904	608	1,034	873
Production	-	0.3	0.8	1.2	0.9	0.9	1.4	2.6	2.4

^aArea in thousand hectares; yield in kilograms per hectare; production in thousand tonnes.
The 1974/1975 to 1978/79 estimates are based on planted area; the rest are based on harvested area.

¹Groundnut is reported in undecorticated form, other cereals in grain form.

Sources: Central Statistics Department (CSD) for years 1974/75 to 1978/79; PPMU, Ministry of Agriculture for years 1979/80 to 1981/82

By far the most important livestock species is cattle. The most important breed is the N'Dama breed that Mason (quoted by Dunsmore, 1976) described as a small humpless type, usually fawn-coloured, also light-red or dun; another breed is a larger type with long lyre-shaped horns and there is also a shorter type with lyre or crescent horns. Cattle in The Gambia are primarily a form of savings; they are also valued as a means of transferring fertility from grazing areas to arable land and as a source of milk. In general, cattle are grazed on ranges. From July to November there is an abundance of natural fodder although expanded farming activity both on the uplands and the swamps is steadily encroaching on grazing areas or preventing access to them. During the dry season, the herd sustains itself on crop residues, flood plains, swamp grazing and brush. It is, however, difficult to determine the contribution made by each of these. A concerted effort to improve animal nutrition has been undertaken by the Government through the USAID-funded Mixed Farming Project.

Blair Rains (1976) has estimated the calving rate at 41 percent with an offtake rate of 6 percent per year.

It is generally thought that the genetic potential of the N'Dama as a producer of milk and meat is limited. The growth pattern in most local herds is a liveweight gain of 400-450 gram per day per cow for approximately five months of the year, and either no increase in weight or more frequently a loss of weight, during the remaining months of the year (Blair Rains, 1976). The result of this pattern is an average net weight gain of not more than 180 g per day. Fully grown male animals reach a liveweight of 340-385 kg with a killing-out percentage averaging 50 percent of liveweight.

3. Fisheries

Three major ecological zones are recognized within the fisheries sector:

- o Atlantic marine coast stratum;
- o Lower river stratum, marine and brackish waters; and
- o Upper river stratum, predominately fresh water.

Fisheries resources are exploited by both artisanal and industrial fisherman. Fishing activities by both categories are found only along the Atlantic marine coast stratum. A semi-industrial venture concentrating on artisanal shrimp fishing exists along the lower river stratum but normally only artisanal fishermen operate within the lower and upper river strata.

a. Artisanal fisheries

Artisanal fishing activity was previously concentrated along the Atlantic marine coast stratum but a survey conducted in 1983 by the Fisheries Department showed an unexpected decline in the number

of artisanal fishermen operating along the Atlantic marine coast and a significant increase in the lower river stratum. Previously, foreign fishermen dominated this sector but a survey conducted by the Fisheries Department in 1981 (to determine the total number of fishermen by nationality and to determine the structural aspects of the fisheries industry) showed for the first time more Gambian than foreign participation in the artisanal sector (51 percent of 1,054 fishermen). The 1983 survey shows the number of artisanal fishermen as 1,319; of these, 780 were Gambians, 502 Senegalese, nine from Guinea Conakry, five from Guinea Bissau, 18 from Mali, four from Ghana and one from Mauritania. Further, there are currently more full-time than part-time fishermen (1,011 out of 1,319); more than half (666 out of 1,319) of them do not change their bases of operations during the course of the year.

Artisanal fishermen employ surrounding nets, gill nets, beach seiners, hooks and lines, hard lines, stow and cast nets in their fishing operations. However, surrounding and gill nets are the most frequently employed.

b. Industrial fisheries

Over the years, only two companies have managed to establish themselves as viable fishing companies.

One is a joint venture (Ghanian-Gambian Governments) primarily involved in sardinella fishing, with shore facilities for freezing, processing and storage. The company operates a fleet of purse-seiners in its fishing operations and uses fish carriers for shipment to Ghana. The catch has been declining since 1978 when over 14,000 tons were landed. The decline has been attributed to an old fleet of boats which frequently break down.

The other is a privately-owned Gambian Semi-Industrial Company. Since its establishment, the company has been primarily engaged in buying and exporting the shrimp catch of artisanal fishermen. The company has recently finished building a modern processing plant and has started using licensed trawlers (foreign-owned) in its fishing operations.

The Second National Development Plan emphasizes the accelerated development of the fisheries sector. The objectives are to:

- o Effect a national long-term utilization of marine and inland fishery resources;
- o Use fish as a means of improving nutritional standards of the population; and
- o Expand the participation of private Gambian entrepreneurs in the fishing industry.

4. Forestry

Forestry in The Gambia consists largely of the exploitation of woodland and savannah trees for local use as timber poles and fuel. This usage tends to be destructive and wasteful and, with a rising population, indigenous wood resources are becoming insufficient. Timber is produced locally by pit-sawyers, the Forestry Department and villagers. It is estimated that timber production by pit-sawyers was 269 m³, by the Forestry Department 646 m³, and by villagers 2,350 m³ (Openshaw, 1973).

Very extensive use is made of palm (*Borassus aethiopum*) and bamboo (*Oxytenanthera abyssinica*) for housing construction. Openshaw (1973) estimates that the consumption of the two in 1972-73 was 14,200 m³ and 8,500 m³, respectively.

a. Forest parks and management

In its early years the Forestry Department (then a division of the Department of Agriculture) was engaged in creating a forest estate which led to the opening of 66 forest parks (Laws of The Gambia, cap 103) with the following divisions:

- o 12 palm forests: 618 ha;
- o 14 timber forests: 4,014 ha;
- o 6 bamboo forests: 7,068 ha; and
- o 34 protection forests: 22,239 ha.

The total area under forestation was thus 34,029 ha. Following the handover of these parks to area councils, considerable encroachment by clearance for farming has taken place. Further data on the degree of encroachment will become available upon the completion of the Country Land Use Map undertaken by the German-assisted Forestry Project.

A plantation scheme, begun in 1959 in the contiguous forest park of Bamba, Kabatita and Nyambai in the Western Division has resulted in the planting of approximately 890 ha consisting of *Gmelina arborea* with a small area of teak, *Tectona granais*.

b. Legislation

No specific forest law exists, but provision is made for the protection and management of forests throughout the country. Wood resources are covered under Section six of the Lands (Provinces) Act, cap. 103.

This section of the Act authorizes the Government to:

- o Declare any land to be a forest park and to make regulations for its protection, control and management;

- o Prescribe species of trees to be protected in part or all of the provinces, and prohibit or otherwise regulate their felling, cutting, removal, and marking;
- o Prohibit or regulate the sale or exposure for sale, purchase or export of any timber, rubber, gum or other forest products; and
- o Declare trees to be protected species: Khaya Senegalensis, Chlorophora regia, and Borassus Aethiolum.

It is illegal to fell protected species anywhere in the country, whether living or dead, without a permit. Further, no trees may be cut in a forest park, but unprotected species can be cut for domestic purposes. Felling of trees for trading purposes requires a permit.

With the ever increasing population and demand for fuel wood, the Government is now giving serious attention to the management and conservation of forest resources. The Second Five Year Plan, 1981/82-1985/86, proposes the following objectives and strategies for the forestry sector:

c. Objectives

Following are the objectives:

- o To maintain, preserve and rationally exploit natural forest resources so as to minimize soil dessication and movement caused by water or wind erosion; to stabilise the river banks; to provide an adequate supply of wood and forest products for domestic and industrial use, and consistent with the above, to maximise government earnings; and
- o To encourage the economic use of forest products by local industry.

d. Strategy

In pursuance of the above objectives, the development strategy will be:

- o To ensure protection of national forest resources through public education campaigns against the destruction of natural woodlands, and through the promotion of the National Tree Planting Programme;
- o To establish a research programme for determining suitable species for introduction and cultivation, and to support the manufacture and introduction of economical wood-burning stoves;
- o To undertake adequate programmes of reforestation, especially for economically valuable species and to establish village woodlots;

- o To expand and improve beekeeping activities at village level; and
- o To maintain a forestry service staffed with trained personnel to administer the Gambian forest resources in accordance with national policy.

5. Agricultural marketing systems

a. Groundnuts

The marketing of groundnuts falls under the legal monopoly of the Gambian Produce Marketing Board (GPMB) whose responsibility covers all activities associated with the movement of groundnuts from farm to export market. The Board buys groundnuts from farmers through licensed buying agents (LBAs). Currently there are six buying agents, including the Gambia Cooperative Union (GCU), which handles over 80 percent of total groundnut purchases. LBAs in turn buy the crop from farmers through licensed agents approved by the GPMB. In the case of the GCU, 50 primary Cooperative societies act as agents. The bulk of the produce is exchanged at legally specified buying centres known as seccos. Buying agents are responsible for financing their marketing activities; in fact, financial strength is one of the criteria used by GPMB in granting licenses to LBAs. The GCU, however, gets a Government guaranteed seasonal credit to finance crop purchases and other marketing activities.

Groundnuts collected from farmers are delivered at GPMB depots from which they are dispatched to three independent processing chains where unshelled groundnuts are transformed into one of three final products:

- o Decorticated nuts;
- o Groundnut oil and cake; and
- o Confectionary nuts.

Nuts are generally exported by the GPMB as confectionary nuts, oil or cake.

b. Rice

Rice is the preferred and most important cereal, accounting for over half of cereal consumption. Half to two thirds of the total rice supply is imported, the GPMB being the sole importer of rice. Purchase of rice from farmers, again by the GPMB, follows the same procedure used in groundnut collection. There are about 20 buying agents of which 12 are private traders. The others are the primary cooperative societies. The high participation of private traders is due to the fact that cooperatives, because of their heavy involvement with the groundnut crop, handle only a small part of the rice crop.

Paddy purchased by buying agents is delivered to the GPMB rice mill at Kuntaur. From there most of the polished rice is delivered to Banjul for distribution to urban customers.

c. Sorghum and millet

There is no public intervention in the marketing of these crops, consequently not much is known about it. Probably not more than 10 percent of total production is sold off the farm and most of this is for local trade. Marketing is carried out mostly by private traders whose number are not known.

d. Maize

Up to three years ago, the marketing of maize was similar to that of sorghum and millet. However, with the development of the poultry industry, the GPMB started buying maize directly from farmers for processing into poultry feed. As of this year, LBAs will license traders to buy the maize crop from farmers in the same manner as for groundnuts and rice.

e. Cotton

Cotton is purchased directly from farmers by the GPMB for processing at its gin at Basse. The cotton lint is then exported.

f. Livestock

There are no regular markets for cattle in The Gambia although small stock are traded weekly at six centres. Cattle buying in production areas is by direct negotiation between owners and visiting traders or representatives of the Livestock Marketing Board (LMB). The LMB is a statutory authority set up under the Livestock Marketing Act (1975) to "maintain regular and sufficient supplies of livestock for marketing to The Gambia and promote an export trade in such livestock as are surplus to the requirements of The Gambia."

Capital problems have hampered the functioning of the LMB. It has been reported (PPMU 1981) that private traders have handled about 80 percent of total marketed livestock. Trading operations are carried out by agents who purchase animals individually on the basis of visual appraisal, never on the basis of weight. Traders usually sell on credit to butchers. The LMB on the other hand, buys cattle after having weighed it on its own scales situated at established purchasing points; seventy-five percent of its purchases are normally from its licensed dealers, the remainder being bought directly by its own officers.

g. Fish

The marketing of fish and fish products in The Gambia has long been limited to the artisanal sector; recently, however, industrial companies have started operating in the sector. Fish caught by artisanal fishermen have traditionally been sold to middlemen who transport it to local markets for public sale. This marketing

system has its problems; the main one being that these middlemen transport the fish on bicycles. By the time it reaches the local markets, part of the catch is usually spoiled. Nor is there a systematic local pricing system for fish and fish products. At times when fish is scarce, middlemen may double or triple prices. There are a few small-scale fishing businesses which purchase fish products such as smoked fish, dried, salted fish, shark fins, shrimp and lobsters from artisanal fishermen for export to neighboring African and some Asian countries.

Until recently, the exportation of fresh or frozen fish to international markets was not extensive. There are now two industrial companies operating in The Gambia specializing in fish exportation. FOB prices for export of fish are determined by the Ministry of Finance and Trade. Current prices can be found in Table 18.

The establishment of two new fishing companies should boost fish marketing both locally and internationally.

6. Agricultural inputs

The following are the main agricultural inputs -- seeds, fertilizers, crop protection chemicals, drugs for livestock, and boats, nets, etc. for fishermen.

In general, farmers are encouraged to keep their own seed except vegetable seeds, which they buy on the open market or from the Department of Agriculture, Horticulture Unit. Those farmers who are unable to keep their seed for one reason or the other can buy seeds from the seed multiplication unit of the Department.

Fertilizers are made available to farmers either on a cash basis or through credit from the GCU. Fertilizer prices are subsidized by the Government. Gambian farmers have responded well to the opportunities presented by the use of fertilizers; current consumption is at about 5-6000 tons/year.

Crop production chemicals are provided free to farmers except seed dressing chemicals which are sold at a subsidized price.

Drugs for livestock are provided free to livestock owners by the Government.

Fishermen have to buy their own boats, nets and other inputs.

7. Ministries responsible for agriculture

The Agricultural sector is regulated by two Ministries, the Ministry of Agriculture and the Ministry of Water Resources and the Environment. Both are headed by a Cabinet Minister assisted by a Permanent Secretary acting as Chief Executive. A Planning Programme and Monitoring Unit is responsible for monitoring all programmes executed by the two Ministries. The organisational chart for the two Ministries is on the following page.

Table 18: Export Prices for Fish, f.o.b.

<u>Fish</u>	<u>Price per Ton</u> (Dalasis)
Cernia	1800
Croakers and Red Snapper.	600
Cuttle Fish	1200
Cranx, Barracuda	700
Catfish, Jortoh, Snakefish, Tharob fins and Cassava Fish	600
Herrings	280
Lobsters	12300
Shrimp	7000
Shark Fins	5000

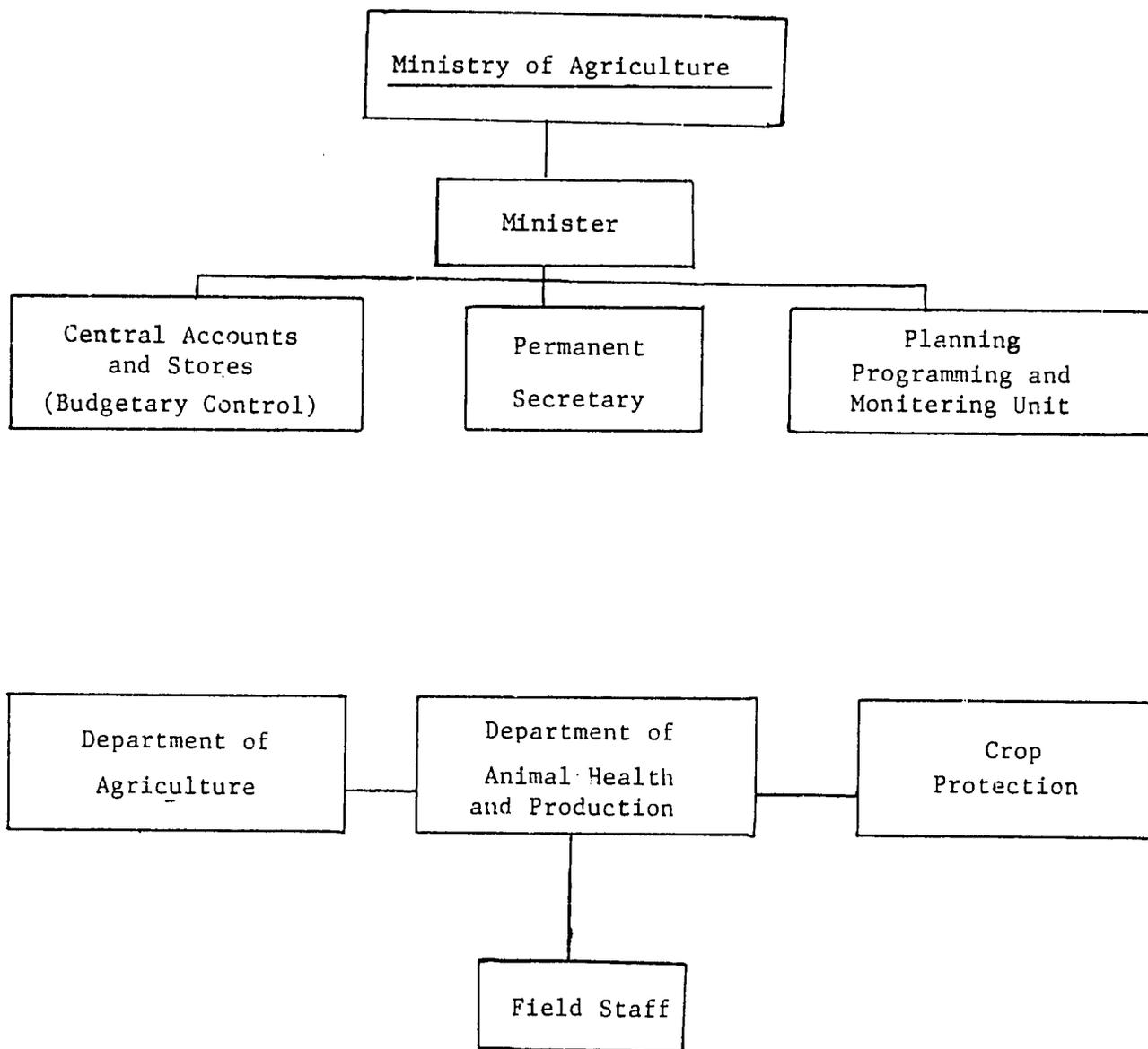


Figure 6: Organisational Chart of the Ministry of Agriculture

Ministry of Water Resources and the Environment

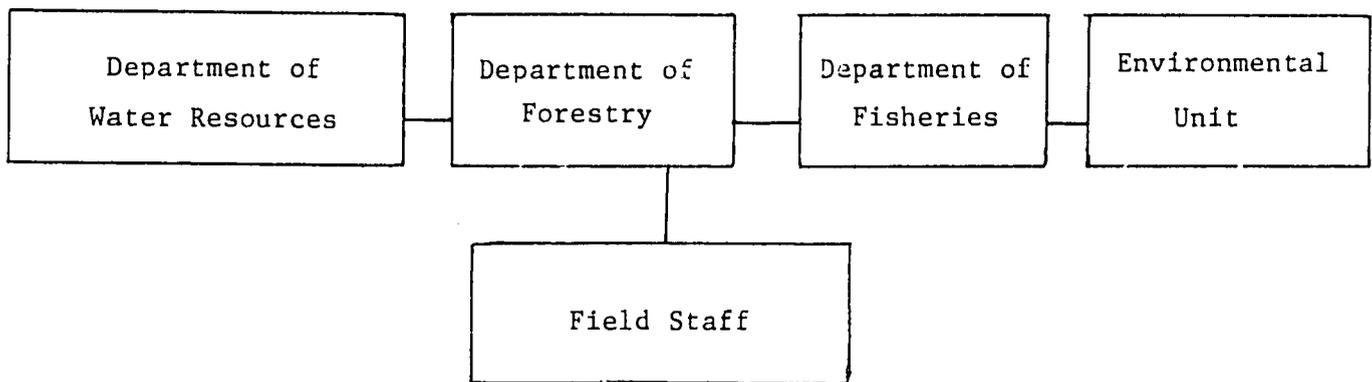
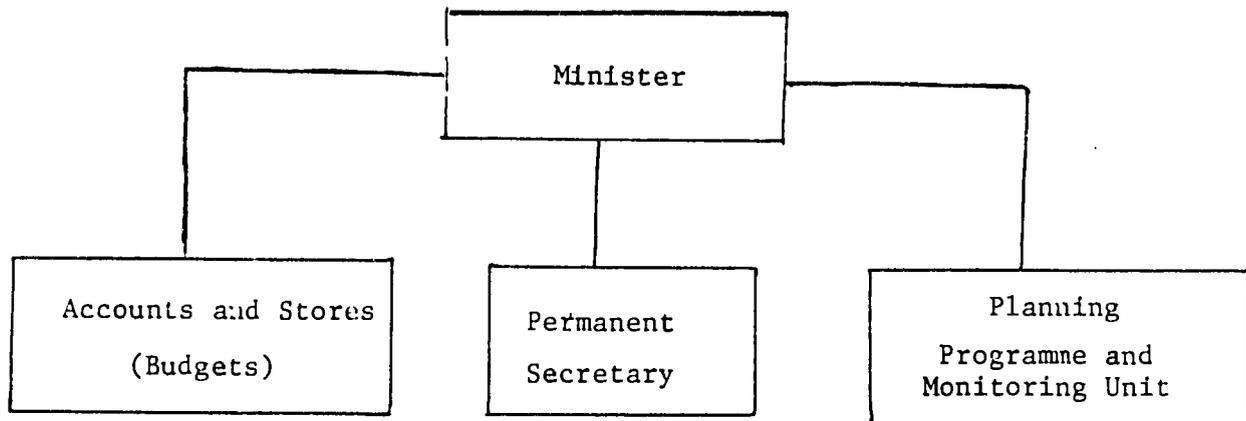


Figure 7: Organisational Chart of the Ministry of Water Resources and the Environment

8. Food balance sheet

Despite the growing importance of rice, sorghum and millet remain the principal foodstuffs in the Gambia.

Food self-sufficiency could be achieved sooner if some rural farmers would concentrate on cultivating food crops instead of groundnuts which are grown primarily for export.

Table 19 indicates the anticipated grain requirements for The Gambia and the Sahel as a whole in 1990 and in the year 2000.

9. Agricultural credit

Agricultural credit is important for increased agricultural productions. The following forms of credit are now available to farmers.

a. Subsistence credit

This is a cash credit given only by the Cooperative Societies to their members to help them buy inputs and food during the growing season, with repayment scheduled at harvest time. Unfortunately, funding is insufficient and generally arrives too late in the season to be used for input purchases. Farmers usually buy food or other needed items with the credit instead.

b. Production credit

The first attempt at production credit for farmers was initiated during the Rural Development Project (1976 - 1978). Farmers had to provide some form of collateral for the loans, which carried an interest charge of about 15 percent and were repayable over a three year period. Only farmers within the project area were entitled to this credit.

Conscious of the problems associated with credit arrangements for farmers, the government established an Agricultural Development Bank in 1981. This new bank was designed to handle the agricultural sector's financial needs. The bank provides short, medium and long-term loans to individual farmers, either directly or through Co-operative Societies, for the development of agriculture, forestry, fishing, or animal husbandry and for marketing, transport, storage and processing of agricultural produce. The bank also mobilizes rural savings and coordinates the activities of various institutions engaged in agricultural credit operations.

10. Institutions conducting agricultural research

The following institutions have agricultural research mandates:

- o Department of Agriculture -- Crop research;

Table 19: Anticipated Grain Requirements
(000 t)

<u>Grain</u>	1990		2000	
	<u>The Gambia</u>	<u>Sahel</u>	<u>The Gambia</u>	<u>Sahel</u>
Millet/Sorghum	57	6,588	77	8,854
Rice	69	818	93	1,099
Maize	8	432	11	581
Wheat	6	415	8	557
Others	-	111	-	149
Total	<u>140</u>	<u>8,364</u>	<u>189</u>	<u>11,240</u>

¹Calculated on the basis of an annual population growth of 3 percent.

Source: Grain Policy in the Sahelian Countries, Nouakchott, July 1979.

- o Department of Animal Health and Production -- Animal research;
- o Department of Fisheries -- Fisheries; and
- o Department of Forestry -- Forest Resources.

These institutions are discussed under Sections III, IV, and V except for Fisheries and Forestry which are treated in a separate chapter.

III. AGRICULTURAL RESEARCH INSTITUTIONS

The following institutions undertake research related to agricultural development:

- o Department of Agriculture, Agricultural Research Services; and
- o Department of Animal Health and Production.

A. Department of Agriculture/Agricultural Research Services

Located within the Ministry of Agriculture, Agricultural Research Services are responsible for all research related to crop production (with the exception of research on protection research). These services are headed by an assistant director who reports to the Director of Agriculture. Research is focused on five programme areas:

- o Upland crops improvement;
- o Agronomy and farming systems research for upland crops;
- o Farm mechanisation;
- o Horticultural research; and
- o Rice research.

1. Upland crops improvement program

This programme was initiated in 1977 with funding both from local sources, including the Gambian government, and from the British government, through its contribution to the World Bank Coordinated Rural Development Project. The programme's major objectives are:

- o To screen and select varieties of both domestic and imported crops for their adaptability to Gambian conditions; and
- o To produce foundation seeds of those selected varieties for multiplication and distribution to farmers by the seed multiplication programme.

In the selection of varieties, the programme especially seeks those which have stability and high yield, resistance to pests and diseases, and acceptability to farmers as determined by multilocational testing.

The major projects currently ongoing within the program are:

- o Cereal and cowpeas improvement co-ordinated by the Sahel Institute (INSAH-Institut du Sahel) with funding from the European Economic Community (EEC);

THE DEPARTMENT OF AGRICULTURAL RESEARCH SERVICES

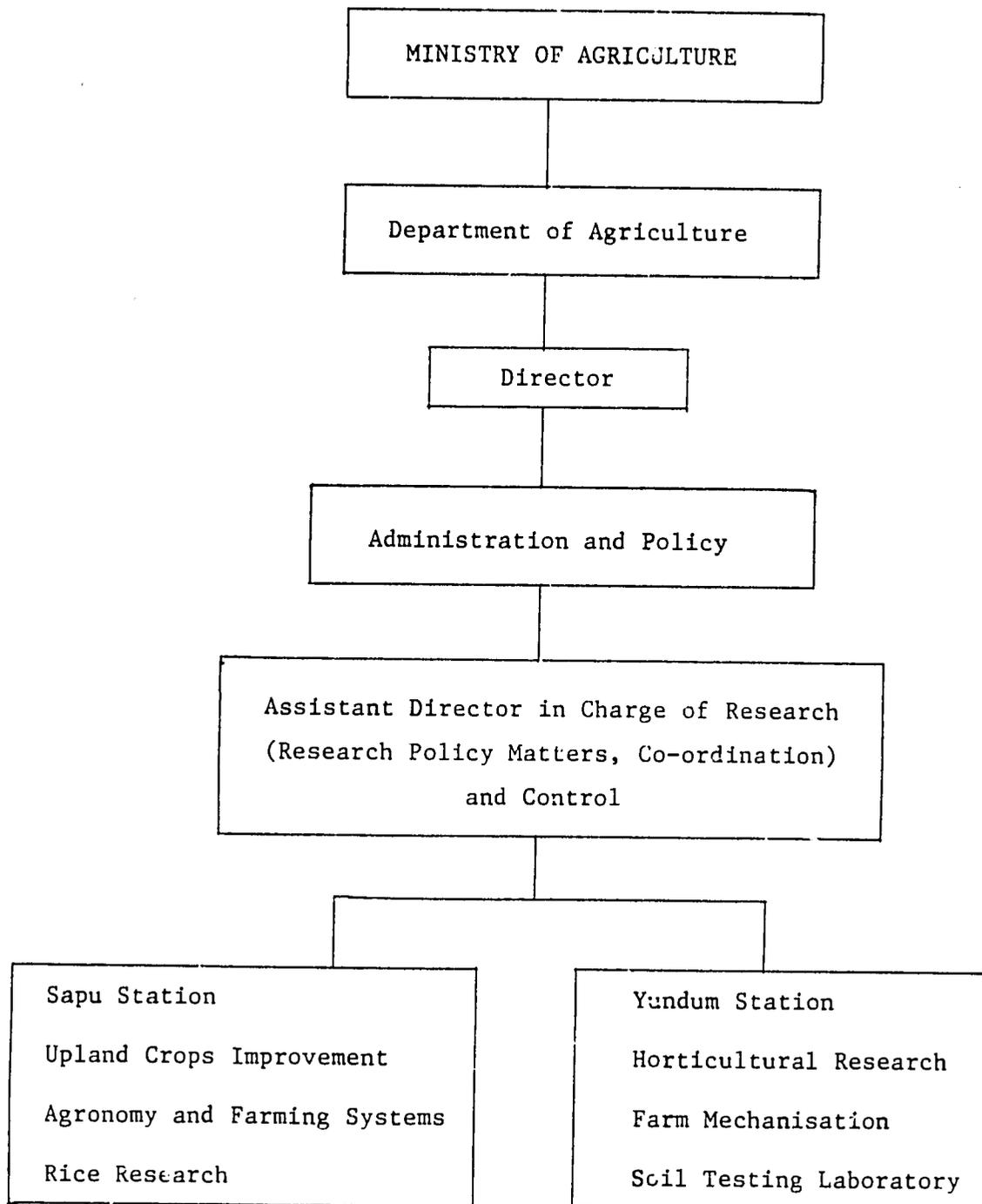


Figure 8: Organisational Chart of the Department of Agricultural Research Services

- o Groundnut improvement with local funding; and
- o Maize and cowpea varietal testing, coordinated by SAFGRAD, with local funding.

The research workers collaborate with the International Institute for Tropical Agriculture (IITA), the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), and the International Center for Maize and Wheat Improvement (CIMMYT).

The programme is currently staffed by one principal agronomist and four technicians supported by field workers and labourers who are recruited as necessary. A specialist in sorghum and millet breeding will join the group in December. A grain legume agronomist is currently pursuing a higher degree programme at the University of the West Indies.

2. Agronomy and farming systems programme

Like the Upland Crops Improvement Programme, this programme, in its present form, was initiated in 1977, with the same funding sources. The programme's major objectives are:

- o To determine factors of the environment (physical, social and economic) limiting crop yields; and
- o To develop appropriate technologies through applied research for increasing and stabilising the yields obtained by farmers.

There are currently four operational projects within the programme:

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

The programme has links with the Semi-Arid Food Grains Research and Development (SAFGRAD), International Fertilizer Development Cooperation (IFDC, for soil fertility and fertilizer use efficiency), ICRISAT, and IITA (agronomy), and with the Department of Water Resources (climatology in relation to time of planting). The programme is currently staffed by two agronomists, one soil scientist and one expatriate production economist. There are ten technicians within the programme; farm labour is recruited as necessary. It is anticipated that staff currently on leave for training will rejoin the programme on completion of their studies.

3. Rice research programme

This programme is designed to study the different problems in the five ecosystems of The Gambia: upland rice, hydromorphic (Bantafaro) rice, deep flooded swamp rice, mangrove swamp rice and irrigated rice. The major activities of the programme are:

- o To screen varieties, selecting those with high yields; and
- o To develop appropriate production techniques for rice-growing in the different ecosystems.

These two activities constitute the only projects within the programme. The rice research programme also uses information from the rural farm management studies in perfecting its cultural agronomy experiments.

The varietal improvement component of the programme receives funding from the West African Rice Development Association (WARDA) with which the programme has very strong links. The cultural agronomy component is financed entirely from local funds.

The programme is currently staffed by two agronomists and ten technicians.

4. Horticultural research programme

The programme was initiated in 1976 with the mandate to develop appropriate production techniques for the major horticultural crops, both domestic and imported to help farmers increase their productivity.

The following projects are included within the programme; all are locally funded.

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

The programme has links with the Asian Vegetable Research and Development Centre (AVRDC) and IITA (for cassava and sweet potatoes).

Currently the programme is staffed by one agronomist, seven technicians, and five field workers (gardeners).

5. Farm mechanisation programme

This programme is designed to mechanise those farm operations which have not yet been mechanised. The main objective is

to ensure that packages of implements appropriate to all the systems of farming being practised in the country are introduced for use by farmers.

The major projects within the programme are:

- o Development of a ridge planter and ridging attachments;
- o Improved harnessing methods development for animals used in traction;
- o Development of processing equipment;
- o Use of draught animals for rice cultivation; and
- o Improvement of village-level crop storage systems.

The programme links with IDRC (in Dakar), the Intermediate Technology Research and Development group of the Commonwealth Secretariat, and the Engineering Faculty at Fourah Bay College, Sierra Leone.

Currently the programme is staffed by one research officer, two senior technicians and three junior technicians (mechanics).

6. Sapu Agricultural Station

Situated 280 km from Banjul, this station serves as the headquarters for the Upland Crops Improvement Programme, the Agronomy and Farming System Programme, and Rice Research Programmes. The station lies in the 800-900 mm rainfall zone and the dominant soils are of the 'ferruginous tropical' type. 120 ha of land is available for upland crops research, of which only 90 ha have been developed, and 30 ha of irrigated land is available for rice research, of which only 15 ha have been developed. The physical plant and equipment at the station is summarized below:

- o One laboratory of 50 m² for use by the agronomists;
- o One office of 127 m² for use by research scientists and technicians;
- o Drying floor - 6 bays of 640 m² each for produce processing; and
- o Two workshops, one of 320 m², for repair of tractors and power tillers, the other, of 712 m², for repair of motor vehicles.

The station has no library, no greenhouse, and no shadehouse. There is no data processing equipment--research personnel use personal calculators. Communication with the station is only by road or river because it has neither telephone nor telex.

7. Yundum Experimental Station

Situated 22 km from Banjul, this station serves as the headquarters for the Horticultural Research Programme and the Farm Mechanisation Research Programmes. It also houses the main soil laboratory. One of the agronomists working in the Agronomy and Farming System Programme is stationed there. The station lies in the 1000-1200 mm rainfall zone and the dominant soil type is ferralitic. Total land area is approximately 400 ha of which only 30 ha are used for research. Two of these 30 ha have been developed for irrigation. The physical plant and equipment at the station is summarized below:

- o Three laboratories: one of 50 m² for horticulture, in poor condition; one of 138 m² for soil analysis, in fairly good condition; one of 72 m² for agronomy in fairly good condition;
- o Five office blocks for use by various sections, particularly extension, farm mechanisation, horticulture and agronomy;
- o Two workshops, one of 583 m² for use of the Farm Mechanisation Programme, the other, of 922 m² for vehicle repair and maintenance;
- o A library, in very poor condition; and
- o Two shadehouses are under construction for use by the Horticultural Research Programme.

8. Human resources

As already indicated when discussing the different programmes, the total human resources of Agricultural Research Services consist of one research director, ten research scientists and 41 technicians. There are no vacant posts. Seven students are now in training and can be expected to join the service providing funding can be found to pay their salaries.

9. Training

The policy on training is to have scientists take academic training to the M.Sc level, followed by in-service training at one of the international agricultural research centers (e.g. ICRISAT, IITA and IRRI). The purpose is to offer them the opportunity of working with experienced research scientists and to expose them to modern research techniques. For technicians, training is given on the job and, as opportunity arises they are sent on the short courses organised by the international agricultural research centers.

10. Problems identified by research personnel

The survey of problems by research personnel reveals that both the junior and senior technical staff seem to feel that research

in its present form is not adequately staffed and equipped to fully execute its mandate. The following facts are highlighted:

- o The junior staff feel they have not been adequately trained in agricultural research techniques. They feel in particular that they have not been given sufficient opportunity for in-service training;
- o The lack of what can be called a truly national research center. Both Sapu and Yundum are multipurpose agricultural stations and lack adequate crop drying and storage facilities, suitable and reliable cold storage to house the national germplasm collection, and irrigation facilities in the upland areas, especially for the Crop Improvement Programme;
- o Poor support service--inadequate supply of fuel and spare parts, postal and telephone service for Sapu, and absence of an efficient system for ordering and obtaining supplies; and
- o Lack of sufficient housing for research personnel.

B. Department of Animal Health and Production (DAHP)

Within the Ministry of Agriculture, this Department came into existence in 1975 following the merger of the animal production units of the Department of Agriculture and Veterinary Department. It has the mandates for research on all problems related to animal health and production and for development of production. Currently, it operates only one major research programme, the Mixed Farming and Resources Management Programme, which is funded by USAID and the Gambian government. The major objective of the programme is to improve rural farm income through the provision of a year-round supply of adequate forage for livestock. The projects within the programme are:

- o Range ecology and management studies;
- o Maize agronomy;
- o Forage agronomy; and
- o Socio-economic surveys of livestock system.

The programme has 12 researchers, six expatriates and six Gambian, 40 technicians and 12 support staff. In-country, the programme has functional linkages within the Agricultural Research Services. Externally there is an informal cooperation and exchange of ideas with agricultural and livestock research programmes in Senegal and northern Nigeria.

The programme is based at Abuko, the headquarters of the Department of Animal Health and Production, where it has a ten-room office block. It maintains an up-country rest house for its field staff. It has a collection of periodicals and research papers but has

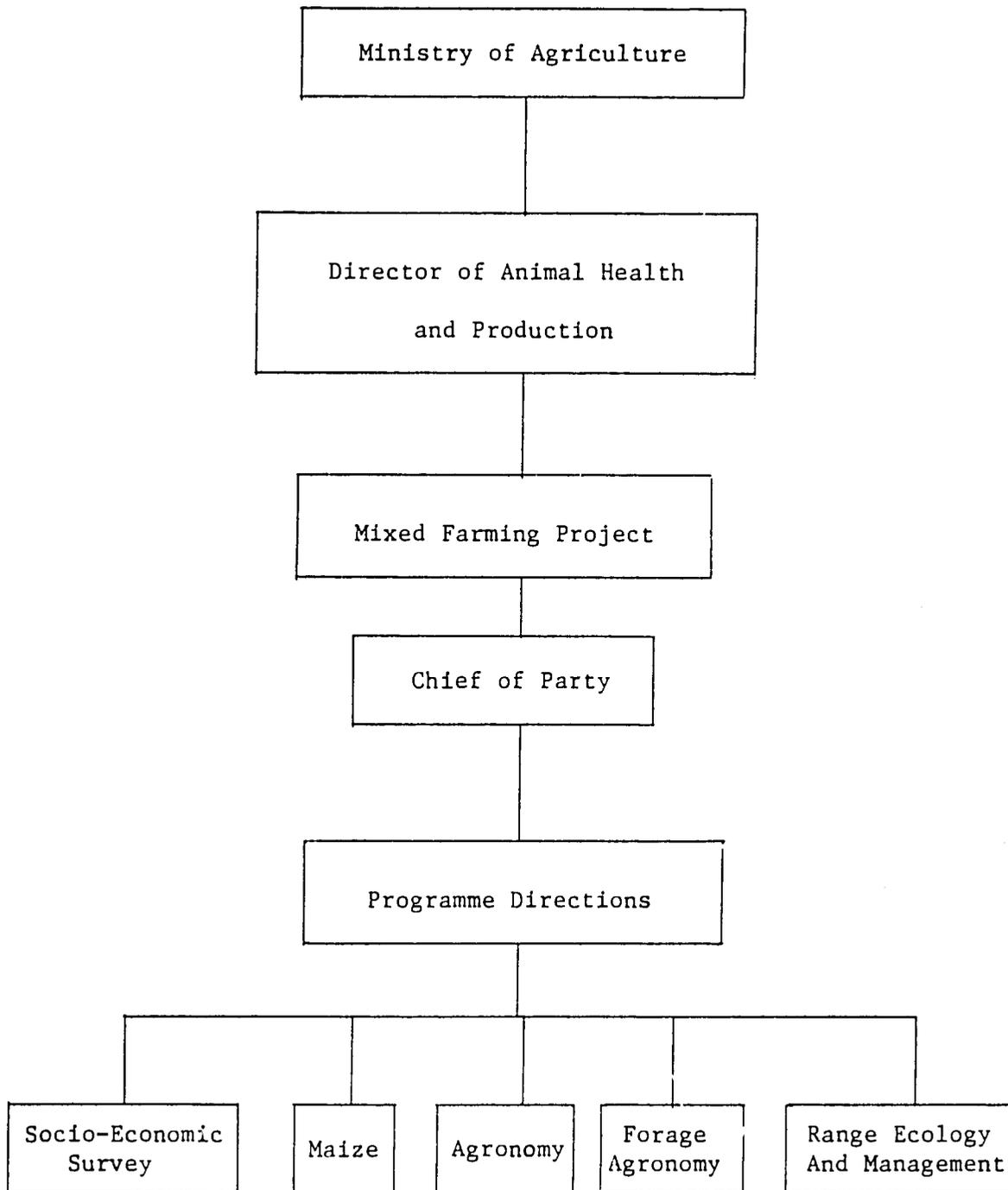


Figure 9: Organisational Chart for the Animal Health and Production Research Programme

no intention of establishing a library. It has ordered three IBM microcomputers for in-house data processing.

The programme maintains 20 hectares of land for forage research and seed multiplication and 100 hectares for range management studies and grazing trials.

The government was committed to co-financing the programme but budget constraints have prevented meeting this obligation. This has affected programme development.

The local staff attached to the programme complain of poor incentives to stay on the job.

C. Sectoral Analysis

1. Agricultural research

The current programmes are well planned and should give answers to the critical problems confronting agricultural productivity at this time. However, the shortage of resources and manpower seriously hinders the ability of the research sector to function. As regards the varieties, the current approach of screening and selecting from both domestic and imported material seems a prudent approach, given the current resource constraints. While this approach has been fairly successful for the rice programme, it has not been very successful for the millets and sorghums. No import has yet been found to perform better than any of the domestic varieties. It may therefore be appropriate to institute a research programme to improve the local materials.

As regards horticultural crops, the situation is rather serious. The programme currently lacks basic irrigation facilities to carry out its work; very little research is being done on fruit trees. Urgent assistance is required for the programme if it is to achieve its objectives.

2. Livestock research

In the livestock sector, aside from the Mixed Farming Programme, no research is being undertaken. Clearly this is an undesirable situation. Research on diseases and pests (ticks and tsetse fly) should be undertaken as a matter of urgency as these seriously affect the productivity of livestock. The major problem with livestock research is the lack of financial and material resources.

3. Fisheries and forestry

Very little research is currently being undertaken in fisheries and forestry. The Departments of Fisheries and Forestry are both working to establish research divisions. They currently lack the human and material resources to undertake any research programme.

D. Proposals for Research projects

As mentioned above, there is a clear need for urgent assistance to the research sector if solutions are to be found to the numerous problems confronting agricultural productivity. Although a modest start has been made, more effort is needed. The following projects are proposed for immediate action:

1. Crop research

a. Project to strengthen the agricultural research capability of the Department of Agriculture

(1) Justification and brief description

A strong agricultural research base is recognised as being essential for development in agriculture. The Department of Agriculture has a well designed research programme for addressing the problems confronting agriculture in the country. Unfortunately, lack of resources prevents it from effectively implementing the programme. This project is designed to help the Department to begin such implementation.

The project will improve the research capability of the Department of Agriculture through manpower training, provision of infrastructure, and technical assistance personnel as needed.

(2) Duration

The estimated duration of the project is five years.

(3) Expected results

Development of improved production techniques based on a better understanding of the socio-economic factors operating at the farm level through a farming systems type research, for use by small farmers.

b. Development of a root and tuber research and development project

(1) Justification and brief description

Root and tuber crops (cassava and sweet potatoes) are very important in the diets of most Gambians, because they assure a supply of carbohydrates during drought years, when the main staples are in short supply. The main constraints to root and tuber productivity are diseases, notably cassava mosaic and bacterial blight, and insect pests, specifically the mealy bug.

The project is designed to help the Gambian government to develop a research programme on these problems and to help develop adequate production techniques for use by small farmers.

(2) Needs

The project will need technical assistance, in the form of one entomologist-pathologist, training of Gambians in these disciplines, and materials and equipment.

(3) Expected results

The results expected from the project are improved planting materials tolerant to cassava mosaic, bacterial blight and the mealy bug; improved storage and handling to reduce post-harvest losses; and improved marketing by the producers.

2. Livestock research

a. Control of ticks and tick-borne disease in The Gambia

(1) Organisation

The organisations responsible for the project are the Ministry of Agriculture and the Department of Animal Health and Production.

(2) Justification

Ticks occur worldwide and in this country are numerous during the rainy season (July-October). They are responsible for some of the many factors hindering better livestock production. Ticks are important either as vectors of important diseases, such as babesiosis and anaplasmosis of cattle, or directly causing damage to the hides and skins of their hosts and attracting screw worms (myiasis). Damage to the hides effects the quality of the products made from them, for example, by the proposed tannery.

(3) Modus operandi

Identifying and studying the tick vectors would permit determination of the best approach to tick control. For example, control of a one-host tick would require different control methods from that of a three-host tick. Laboratory testing is necessary to determine the most effective insecticide. Control will be accomplished by spraying; farmers will have to be trained in the use of insecticide and sprayers (dilution, etc.). Operation will be on a divisional basis.

(4) Needs

The anticipated needs are:

- o Insecticide (e.g. Delnav, Bacdip, etc.);
- o 100 knapsack sprayers;

- o Five Land Rovers and 25 motorcycles;
- o Three dissecting microscopes;
- o Automatic syringes and Microspore needles to dispense about 0.01 ml of solutions; and
- o Personnel (to be employed by the Department of Animal Health and Production).

(5) Budget

The estimated budget is US\$150,000 for 3 years.

b. Rural poultry development

This project will be organised by the Ministry of Agriculture and the Department of Animal Health and Production, and will take place at the following sites: Abuko, Mansakanko, Y.B.K., Basse and Kerwan. The estimated duration is five years, at a cost of US\$102,000.

(1) Background and justification

To date much of the work of the Poultry Unit of the department has been concentrated in the urban areas and has been commercially-oriented. The current village poultry improvement programme has failed to produce the expected results simply due to the lack of the necessary infrastructure for its success.

Furthermore, the major objectives of the second five-year plan for livestock include diversification of agriculture through improvement of the livestock sector, better fulfillment of dietary requirements, and maximization of foreign exchange earnings. One of the strategies to achieve these is to encourage large-scale production and distribution of poultry breeding stock through the village poultry improvement scheme.

(2) Objectives

The project objectives are to:

- o Increase the productivity of the local poultry through crossing with the imported Rhode Island Red breed;
- o Eliminate or minimize the incidence of Newcastle disease and Fowl Fox through a mass vaccination campaign in the villages; and
- o Use of local products for poultry feed.

(3) Description

The activities will include the building of small hatcheries at Mansakonko, Y.B.K., Basse and Kerewan and the development of breeding units in these stations for the production of breeding stock for use in the village poultry improvement programme.

(4) Estimated costs

Costs are estimated to be:

- o Building four hatcheries which cost US\$10,000 each;
- o Four incubators;
- o Four candler/graders;
- o Waterers--US\$5,000;
- o Feeding troughs--US\$10,000;
- o Vaccines and drugs--US\$20,000;
- o Two Peugeot 504 Camionnettes--US\$25,000;
- o Miscellaneous--US\$2,000; and
- o Total--US\$102,000.

c. Survey of tsetse distribution/infestation and trypanosomiasis in The Gambia

(1) Background and justification

The actual distribution of Glossina in The Gambia has never been mapped other than at the reconnaissance level. Information on details of habitat relationships, seasonal fluctuations in density and distribution and other aspects of Glossina ecology are unknown. There is no information on infection rates. Important and revealing studies on trypanosomiasis in cattle remain incomplete because of the absence of detailed information relating to circumstances of transmission.

A small local facility established with the assistance of an experienced glossinologist could easily map the distribution of tsetse flies in the course of two years. This could provide the basis for any necessary action against the vectors. This project is designed to establish such a facility.

(2) Description

The broad outlines of the project are as follows:

- o Needs: Technical assistance, vehicles, and equipment;

- o Duration: 2 years; and
- o Budget: US\$ 100,000
- 3. Fisheries sector: Provision of a laboratory for fisheries research

Since laboratory research is considered to be a prominent feature in the development and implementation of a fisheries programme, and since the Department of Fisheries presently has no laboratory facilities, materials or equipment, it is proposed that a fully equipped laboratory be constructed. The staff of the laboratory would undertake research into several aspects of fish production, fish preservation and related areas.

Research will be undertaken into the following:

- o Causes and prevention of spoilage in traditionally cured fish and fish products;
- o Effectiveness of various processing methods (evaluated through basic biochemical and microbiological analysis);
- o Utilisation of unconventional species as food sources;
- o Utilisation of fish waste as a source of animal feed;
- o Use of cold-storage with chilled sea water; and
- o Identification of all commercially important species available within both the marine and inland sectors.

The anticipated duration of the project is one year, for construction work and installation of equipment. The budget totals US\$350,000; the projected needs include technical assistance and buildings and equipment.

The results anticipated are:

- o Improvement of traditional methods of curing fish;
- o Development of an inspection and quality control scheme for commercially important fish species; and
- o Better information for fishermen.

4. Other projects

Aside from the above described programmes, the following projects are currently in progress:

- o Seed multiplication programme designed to provide high-quality seeds of proven varieties to farmers;

- o Soil conservation programme designed to combat serious erosion problems at the farm level through farmer education; and
- o The Organisation for the Development of the Gambia River Basin is engaged in sociological, agricultural engineering and environmental studies related to the construction of the bridge/barrage on the Gambia River.

IV. AGRICULTURAL TRAINING INSTITUTIONS

At present only two institutions undertake the training of agricultural personnel in the country--The Gambia College and the Livestock Training School.

A. The Gambia College: School of Agriculture

This College was established in 1975 to train staff for the education, health and agricultural sectors. Its activities are controlled by an independent board of governors. At the national level, the three Ministries, Education, Health, and Agriculture, are responsible for it and provide the bulk of its operating funds. Funds for its construction were provided by the EEC. The College has four schools: Education, Public Health, Nursing and Agriculture. Only the School of Agriculture is discussed here.

The College awards a Certificate in Agriculture to graduating students after a three year course. Currently the capacity of the school is limited to an intake of 25 students a year. Students are expected to have passed two GCE "O" Level examinations or to have passed the college entrance examination in order to qualify for admission to the college. Ninety percent of the students come from a rural background; the other 10 percent come from urban or semi-urban areas.

There are currently no students in training because the government decided two years ago to suspend the activities of the school following student unrest. It is anticipated that the school will start operating again in the 1984-85 academic year.

1. Budget

As previously indicated, the operational budget for the school comes from the Gambian government through the Ministry of Agriculture.

2. Principal assets

The school has 72.08 m² of lecture rooms, a 7.44 m² projection room for audio visual aids, a 338.78 m² assembly hall, a staff common room of 27.04 m² and a student common room of 90.76 m², all in very good condition, two teaching laboratories in excellent condition, and a library.

The library has approximately 12,000 books, and 76 periodicals and scientific journals. Acquisition averages 126 volumes per year. Visual aid equipment includes one overhead projector, eight and 16 mm film projectors, charts and graphs.

Students have easy access to the library daily from 8:30 to 10:00 pm on weekdays and from 8:30 am to 1:00 pm on Saturdays. They can borrow up to two books at a time for home study.

The school also has a four ha farm for demonstration projects as part of its practical training programme.

3. Human resources

The school currently has only the principal and support staff, other staff having resigned their appointment. However, plans are being made to recruit new staff members.

No students are currently in training. The full teaching staff complement is estimated at seven.

4. Major problems identified by the teaching staff

The principal, who is the only staff member currently employed, has identified the following major constraints affecting the school:

- o Not enough funds for effectively running the school;
- o Lack of trained teaching staff, both senior and junior;
- o Insufficient teaching equipment (for example, audio visual production equipment) and delays in purchasing needed chemicals and equipment for the teaching laboratories; and
- o Lack of transport for field work and lack of adequate inputs and proper research facilities (especially land at the institution).

5. Relationships between the College and research and extension institutions

The linkages between the College and the research institution are currently very weak. Information generated by the research institutions is used by teaching staff in teaching courses.

Linkage with the extension services is stronger. In fact, graduates of the College are recruited directly by the agricultural extension service. Furthermore, the College offers in-service training and refresher courses for field extension personnel.

6. Comments and recommendations

It is obvious that staff training is a crucial ingredient in the development of an effective research or extension service. The School of Agriculture of the Gambia College is a welcome development in the government field services. However, for the school to provide this important service of training the required manpower, it must be given the necessary resources. Despite the suspension of the school during the last two years, it has still not been possible to recruit the necessary teaching staff; nor does the school have adequate land to develop a teaching farm. It will not be desirable to graduate

agricultural field workers who do not themselves have any field experience in crop production.

Therefore, over the next 10 years, a critical period for the school, it would be desirable to:

- o Ensure that the full complement of the staff is in place, either by recruiting experienced and qualified Gambians or seeking technical assistance from other countries. In the event that the second option is adopted (possibly the only alternative, given the current manpower constraints) suitable Gambians should be identified for training to replace the technical assistance personnel;
- o Broaden the curricula of the school to graduate students in Forestry, Livestock and Fisheries;
- o Increase dormitory facilities to permit an increase in the number of students; and
- o Strengthen the linkage between the school and the national research institutions. It would be desirable for the school to complement the research efforts of the national research institutions.

B. The Livestock Training School

This school is run by the Department of Animal Health and Production (DAHP) on behalf of the Ministry of Agriculture and offers graduates a certificate in livestock production. It is entirely funded by the Gambian Government and graduating students are employed by the DAHP. Students seeking entry to the livestock assistants course must have passed the GCE "O" Level examinations. The capacity of the school is 35 students per year. Seventy percent of students normally come from rural background; the other 30 percent come from urban or semi-urban areas.

The school has 50 m² of classrooms, and has access to the diagnostic laboratory of the Department of Animal Health and Production. Both are in very good condition and the laboratory is fairly well-equipped.

The library has 350 books and 250 periodicals and scientific journals. As regards audio visual equipment, the school has only one slide projector.

Currently there are 27 students in training at the school.

1. Human resources

One full time training officer manages and directs the school. He is supported by ten part-time teachers who are all employees of the DAHP. There are plans to train more staff members

since it is proposed to merge this institution with the Gambia College.

2. Major problems identified by the teaching staff

The training officer identified the following major constraints:

- o A budget that is grossly inadequate to meet the basic and the clinical needs of the institution;
- o A lack of support staff to help with field demonstrations;
- o A lack of sufficient classrooms and of a teaching laboratory; and
- o A lack of books and other teaching aids.

3. Linkages to research and extension institutions

There is a functional linkage between the school and the Mixed Farming Research Programme already described in the fields of range management and pasture agronomy.

The linkage with the extension programme of the DAHP is through the participation of livestock students in practical field training, within the Department. In addition, the central slaughterhouse at Abuko and the central diagnostic laboratory offer practical training.

Furthermore, the institution offers a three-month in-service training course to field extension workers of the Department of Animal Health and Production.

4. Comments and recommendations

While the Livestock Training School has been successful in training manpower for the extension services of the DAHP, it currently lacks the necessary resources, both human and infrastructural, to do its job properly. It is recommended that the plans to integrate the Livestock Training School into the Gambia College be pursued with the utmost vigour.

V. AGRICULTURAL EXTENSION INSTITUTIONS

The Departments of Agriculture, Animal Health and Production, and Fisheries and the Crop Protection Services all undertake extension activities in their various fields of competence.

A. Department of Agriculture Extension Services

Within the Ministry of Agriculture, this institution is responsible for all extension work related to crop production nationwide. The organisational chart of the institution is given in Figure 10.

1. Mission and organisation

The Service is headed by an assistant director based at agricultural headquarters. He is assisted by a principal agricultural officer, an agricultural officer and an agricultural superintendent.

The country is divided in eastern and western administrative regions by the extension service. Stations are maintained at Yundum, Jenoi, Kerewan, Sapu, and Basse, which correspond to the main administrative divisions of the country. At the district level, 25 Mixed Farming Centers are used as sites for farmer training and demonstrations. At the village level, agricultural demonstrators are posted, and officers are in direct contact with farmers.

Current staff disposition is as follows:

- o Four Principal Agricultural Officers;
- o One Senior Agricultural Officer;
- o 11 Agricultural Officers;
- o 20 Agricultural Superintendents;
- o 11 Assistant Agricultural Superintendents;
- o 15 Senior Agricultural Assistants;
- o 75 Agricultural Assistants;
- o 300 Agricultural Demonstrators; and
- o 50 Mixed Farming Centre Instructors.

Two of the Superintendents and six of the Agricultural Assitants are female, as are 20 percent of the demonstrators. The Agricultural Officers have a B.Sc or M.Sc degree. Superintendents have Diplomas and Agricultural Assistants have a Certificate of Agriculture.

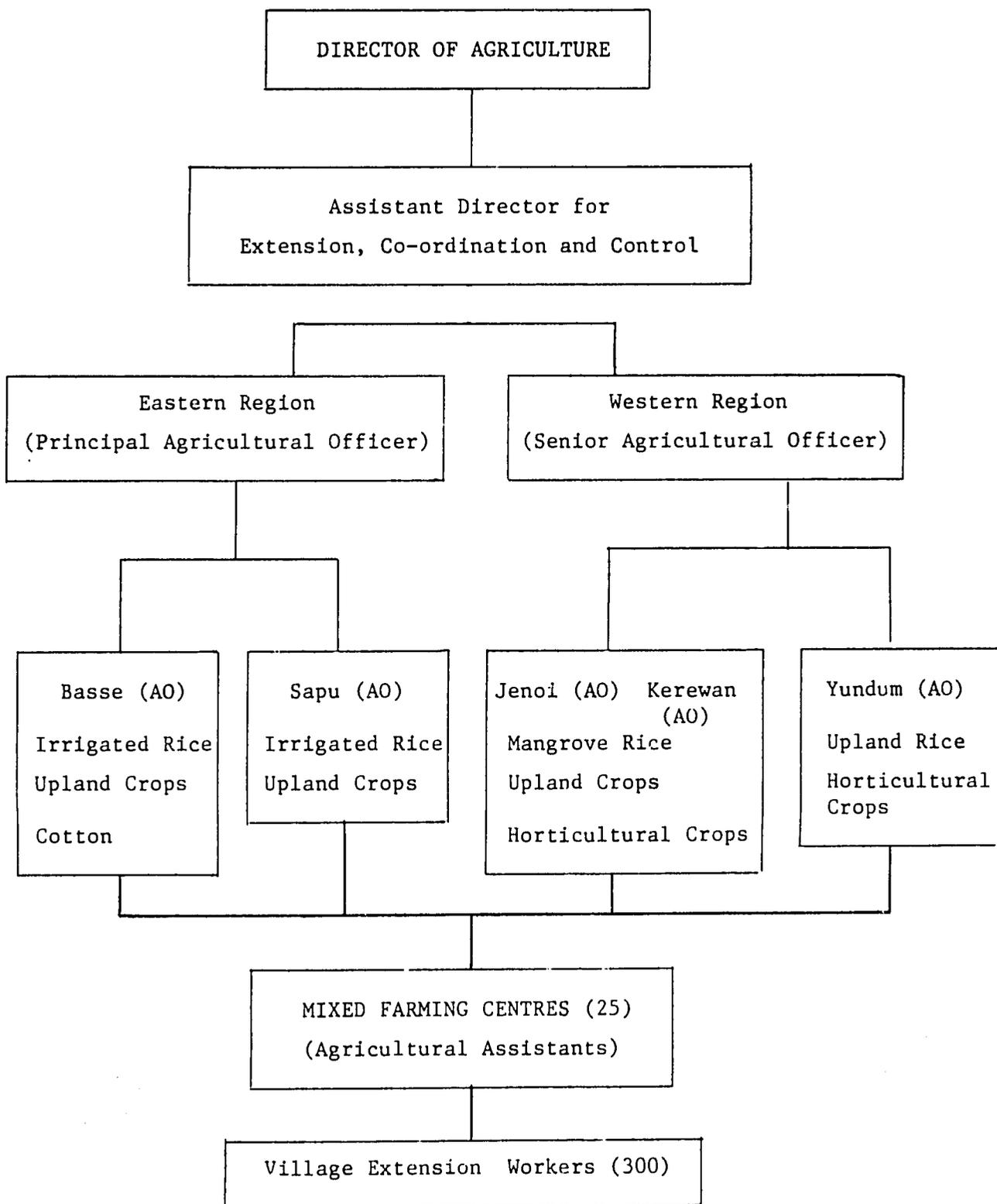


Figure 10: Organisational Chart of the Department of Agriculture Extension Services

Currently, one officer is in training for his M.Sc, ten are in B.Sc training and 14, of whom two are women, are in Diploma training.

The Extension Services have been successful in raising farmers' awareness of government, agricultural policies and in promoting increased use of inputs. A particular success of the service has been in the promotion of ox-drawn equipment for land preparation, sowing and weeding.

Extension activity is through farm demonstrations, farmers' meetings and twice-weekly broadcasts over Radio Gambia.

Currently the extension budget stands at D2,957,970 of which D2,070,130 is for salaries.

2. Problems identified by personnel

Personnel have identified the following problems:

- o In general most officers expressed concern at the lack of sufficient funds to pay supplemental allowances and to provide agents with motorcycles or bicycles for mobility;
- o Lack of a strong liaison between extension and research;
- o Lateness and unavailability of inputs to farmers, which can lead to farmers losing confidence in extension advice and may cause farmers to have negative attitudes towards innovations; and
- o Pricing and subsidy policies. Farmers never know the prices for their produce until after harvest. Subsidies on inputs should be changed and their value replaced by higher prices for their output.

B. Department of Animal Health and Production Extension Service

Within the Ministry of Agriculture, this institution is responsible for all extension activity related to animal health and production. Its efforts are concentrated on nationwide cattle, sheep, goats, and poultry production.

Total manpower is distributed as follows:

- o 12 veterinarians with Masters degrees, all male;
- o 11 male and one female B.Sc in Animal Husbandry;
- o Eight male and five female Diploma holders;
- o 130 male and 20 female Certificate holders; and
- o 100 male and 17 female non-Certificate staff.

Currently 35 people are in training--one man for a B.Sc degree in Tropical Veterinary Medicine, three males for the B.Sc in Animal Production, two males and two females for the Diploma in Animal Production, and 22 males and five females for the Certificate in Animal Production.

It is estimated that another 120 people, mostly junior staff, should be trained within the next five years to satisfy the manpower needs of the service.

Currently the budget for the service stands at one million dalasis.

Extension activity is through farmer meetings, of which 84 were held during 1982-83 and through weekly radio broadcasts aimed at livestock owners. Also, newspaper articles are contributed by senior staff to the field workers' magazine SENELA in hope that the information will reach the livestock owners.

The Department also conducts in-service training sessions for livestock extension workers to bring them up to date on the latest developments.

1. Linkages with research institutions

The mixed farming research project executed by the DAHP has strong links with the extension division of the Department and the livestock owners associations, through which it demonstrates improved technologies both in crop residue management for supplementary feed, and in improved forage and range development.

2. Problems identified by staff members

The staff, through their Director, report that the budget is inadequate. In particular, funds are not available to provide vehicles, motorcycles, or bicycles for field extension workers, nor for the purchase of drugs for treating sick animals. We note that because of the mobility problems, in 1982-83 only 84 meetings could be held with livestock farmers.

As regards training, it is felt that there is a need to train more people, especially at the middle and lower levels. Senior officers should be offered the opportunity for postgraduate training.

Since very little research is currently ongoing within the Department because of lack of resources, information used in extension is based on information from available literature (not on research).

All services are provided gratis to the members of the livestock owners associations.

C. Crop Protection Services

Within the Ministry of Agriculture, this service is responsible for all extension activity related to crop protection. Its major activities are to survey crop farms for pests and diseases, to spray if deemed necessary, and to advise farmers on farm practices and other crop protection measures. Currently there are 170 agents of whom 158 are crop protection specialists. Of these, four have B.Sc degrees, five have Diplomas and 15 are Certificate holders. The rest have been given on-the-job training. There are currently two people in training for the M.Sc degree and one for the B.Sc degree. It is proposed to provide in service training for 66 other people in order to increase the capability of the institution--three at B.Sc level, three at Diploma level and the other 60 at Certificate level.

The current budget is D723,760 of which D366,500 is for salaries.

Extension activity is carried out through publication of the monthly crop protection bulletin, farmers' meetings and training (9,000 farmers were trained in 1982), radio broadcasts, and in-service training for extension personnel. In addition, the service operates a plant quarantine service.

D. Proposals for the Improvement of the Extension Services

An effective extension service, able to deliver useful information in a simple, adaptable way, is essential to increased productivity at the farm level. We have seen that in numerical terms, The Gambia enjoys a high extension worker/farmer ratio. However, the services lack the resources, both financial and human, to do the job entrusted to them. Therefore, to improve the effectiveness of the extension services, it is recommended that:

- o A regular and intensive training programme be instituted for all cadres, especially for village-based extension workers, combined with regular visits by them to farmers;
- o Extension workers make use of the traditional structure of communications in the rural areas;
- o The extension services of the Departments of Agriculture and Animal Health and Production and the Crop Protection Services be integrated for better advice to the farmer who produces both crops and livestock;
- o The links between research and extension services be intensified;
- o Sufficient resources be provided to the field staff to increase their effectiveness, especially the extension worker, who must be mobile in order to maintain regular contact with his contract group; and

- o Use be made of a group of subject matter specialists for necessary technical backstopping of the general extension worker.

E. Relations between Research, Extension and Training Institutions

In The Gambia, it is fortunate that the research and extension services for each of the sectors are within the same departments. For example, agricultural research and agricultural extension are within the same department and report to the same director. This theoretically allows for coordination of effort, but as noted under the section on agriculture, most extension personnel consider this coordination of effort poor. There is clearly a need for better coordination by the different services. Attempts are being made to create a coordination board within the Department of Agriculture that will include senior research and extension personnel, in the hope that programmes can be better coordinated.

While the Agricultural Training School is an autonomous institution, strong links exist between it and the Department of Agriculture (which founded the school). In addition, the Director of the Department of Agriculture sits on the board of governors of the school. The other departments are more integrated.

VI. FISHERIES AND FORESTRY SECTOR

A. Department of Fisheries

The Fisheries Department is comprised of various units--the Statistics Unit, Biological Research Unit, Aquaculture Unit, Gear Technology Unit, Fish Processing and Mechanical Units. All of these units are under the Directorate, which is responsible for running the entire department.

Apart from the Statistics Unit, all other units are in their initial stages and have been developing gradually. The department is predominantly engaged in work dealing with artisanal fisheries, but has also been active in the management and regulation of the industrial sector.

The organisational chart of the department appears in Figure 11.

1. Research and development

Research and development activities have not yet been fully implemented because the department is deficient in the facilities and funds needed to undertake a major research programme. However, efforts are constantly being made to improve existing facilities and to acquire the additional ones needed to initiate sound research programmes for the development of the fisheries sector as a whole.

The Biological Research Unit, which was established very recently, is engaged in studies on the prevention of losses of cured fish by improved methods of processing, and in some laboratory experiments. The unit has also begun experiments on solar tent drying with a view to investigating its potential in the commercial production of dried fish and fishery products.

The Aquaculture Unit started out as a joint venture between the department and the U.S. Peace Corps in 1979. It subsequently was terminated after encountering technical and logistical constraints, but the department retained two fish ponds for experiments on the potential of fish farming as a means of subsistence farming.

Plans are underway to improve these two ponds, and to extend the programme to other areas upcountry where freshwater regimes dominate. The species being produced are Tilapia sp. and Heterotis sp. Investigations have also begun on the possible establishment of an oyster culture.

The Fish Processing Unit is mainly engaged in field work to promote and analyze the application of improved processing methods in the traditional fish processing sector.

MINISTRY OF WATER RESOURCES
AND THE ENVIRONMENT
DEPARTMENT OF FISHERIES

Directorate and Administration

- 1 Director
- 1 Senior Fisheries Officer
- 5 Clerks
- 9 Support Staff

Development and Research

- 1 Senior Scientific Officer
- 2 Fisheries Officers
- 2 Scientific Officers
- 3 Senior F. Field Assistants
- 7 Fisheries Field Assistants
- 2 REF. Mechanics
- 3 F. F. Inspectors
- 1 Driver

Biological Research

Aquaculture Unit

Fish Processing Unit

Statistics Unit

Gear Technology

Mechanical Unit

Extension

- 1 Senior Fisheries Officer
- 4 Fisheries Officers
- 6 Senior F. F. Assistants
- 10 Mechanics
- 8 Fisheries Assistants
- 12 Fisheries Field Inspectors
- 5 Fisheries Instructors
- 2 Drivers

TOTAL IN DEPT. = 85 PERSONS

Figure 11: Staff of the Ministry of Water Resources and the Environment

2. Extension programmes

The Statistics Unit does all the collection and processing of catch data from the artisanal and industrial sectors. Recently, it has been developing the capacity to also study the current and possible future trends of trade in fish and fish products.

The Gear Technology Unit deals with studies on traditional and industrial fishing methods using different gear. Research on the appropriate fishing gear for various fishing methods is carried out by this unit, which also makes recommendations on the gear.

The Mechanical Unit deals with the repair of and instruction on the outboard motors used by artisanal fishermen.

3. Human resources

The department is headed by a Director, who is assisted by two Senior Fisheries Officers and a Senior Scientific Officer. There are eight Fisheries Officers, nine Senior Fisheries Field Assistants, 15 Fisheries Field Assistants, 15 Fisheries Field Inspectors, and five Fishing Instructors, clerical staff, drivers, watchmen, and a messenger.

Currently, there are three Fisheries Officers in postgraduate training and a Senior Fisheries Field Assistant studying for a B.Sc in Fisheries Science. In the 1983/84 financial year there were no vacancies in the department, even though more field staff are needed to strengthen the activities of the various units mentioned above.

For the past four years, the department has had only one expatriate, a Fisheries Advisor working in the EEC-sponsored Artisanal Fisheries Development Project.

There is no organised library in the department; attempts made to establish one have failed. Assistance is needed to set up a library to procure more up-to-date literature and to employ trained personnel to staff and maintain it.

4. Principal problems affecting the capacity of the institution

There are constraints in manpower, transportation, laboratory facilities, deficiency of materials (mainly field equipment) and lack of funds to undertake research in various aspects of fisheries.

a. Manpower

The Department needs more staff than that allowed by the budget. It has a serious shortage of qualified manpower. More people should be formally trained, particularly at the middle level. These people are the immediate assistants to the Fisheries Officers, who coordinate projects.

b. Transportation

The transportation network of the department is poor and needs reinforcement. Most vehicles presently in use are old, and the number is small. Jeeps, pick-ups, and motorcycles are needed to strengthen the transportation network and to make the extension programme more effective.

c. Laboratory facilities

A laboratory is badly needed for research. The department has no laboratory, nor any equipment; it has been using facilities at the central laboratory at Abuko which serves the Departments of Agriculture and Water Resources.

d. Shortage of materials

There is an acute shortage of field equipment, resulting in limitations to the amount of work the various units of the department can perform.

The equipment most needed is:

- o Spring balances and beam scales for statistical purposes;
- o Measuring boards for length frequency distributions;
- o Plankton nets for biological sampling;
- o Fishing canoes and gear for experimental fishing and for training; and
- o Tools for repair and maintenance of outboard motor engines.

5. Current projects

a. Continental fisheries

Projects in the inland fisheries sector are few in number in comparison with the Atlantic coast region. However there is an aquaculture project in the upper river region. The department embarked on the production of Tilapia in 1979 with funding from the Catholic Relief Service and technical assistance by the Peace Corps Volunteers. At the moment, trials are under way on the production of Heterotis niloticus specifically for control of the population of Tilapia. Preliminary studies on production of the West African mangrove oyster are being carried out.

There is also a training project for fishermen in the inland sector. The fishing instructors of the Fish Gear Technology Unit are given the responsibility for training in the artisanal fisheries sector.

An ice plant with a ten tonne daily capacity has been constructed at Pakalinding to improve fish distribution in the rural areas.

The Statistics Unit is also active in the inland sector, with duty stations at Albreda, Kerewan, Salikene, Tendabe, Bamatenda, Kaur, Kuntaur, Georgetown and Bansang.

b. Marine fisheries

The Artisanal Fisheries Development Project is the main project of the department. Funds for this development project were provided by the EEC and the Japanese Government.

The six million dalasi project has various components--technical assistance, training, a revolving loan fund for artisanal fishermen, construction of 25 km of roads linking fishing villages to fish landing sites along the Atlantic coast, the rehabilitation of the Tanji bridge, construction of an ice plant with a 10 tonne daily capacity, and the construction of a multipurpose fisheries complex at Gunjur for processing and storage.

The 2.7 million-dalasi Japanese Grant-In-Aid provided the following--an ice making plant constructed in the lower river region, four fishing vessels, six motor vehicles, 50 outboard engines for canoes, fishing gear and related equipment, plus tools and spare parts. The department is using one of the fishing vessels in its training and experimental fishing project, the other vessels are to be used by the government's industrial fishing company. The outboard engines, nets and other equipment were issued to Gambian artisanal fishermen on a hire-purchase basis at subsidized prices.

6. Stations and equipment

Both ice plants are relatively new and in good condition. The Brikama Ice Plant is much more active than the one at Pakalinding because fishing activity is greater on the coast, and fishermen, fishmongers and merchants have seen the need for ice in fisheries and are making good use of the facility. The Pakalinding Ice Plant is little used, as activity is slight in the inland sector; catches are usually too small and fishermen have not yet seen the need to make use of the plant and cold storage room. However, efforts are being made to encourage fishermen in this area to use the facility and cooperatives and other associations are being formed.

B. Department of Forestry

This Department was established in 1976 as a division of the Ministry of Agriculture. In 1981 it was transferred to the Ministry of Water Resources and the Environment. Its mandate is to protect and ensure a rational use of the forest resources of the country.

The organizational chart of the department is given in Figure 12.

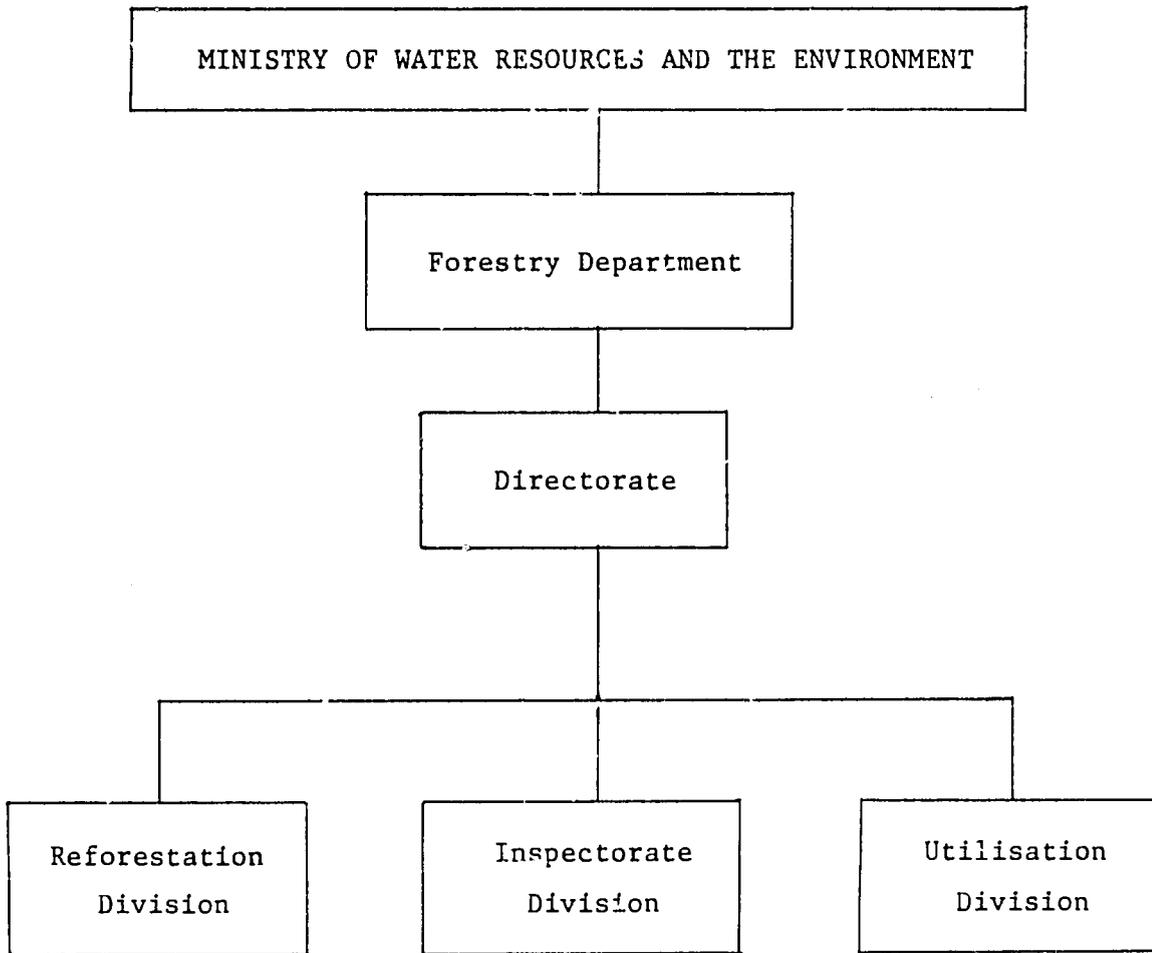


Figure 12: Organisational Chart for the Forestry Department

1. Directorate

The department is headed by a director with an assistant director. These two officers are the only professional foresters in the department. They are responsible for policy matters and general direction and control.

2. Reforestation division

This division is headed by a supervisor who holds a Diploma in Forest Resources. He is assisted by ten forest rangers and 17 forest guards. The main function of the division is to establish forest parks and ensure their proper management.

3. Inspection division

This division is headed by a senior supervisor with training in forest conservation. He is assisted by 12 forest rangers and 77 forest guards. The main functions of the division are to protect the forest resources of the country and to ensure their rational use by the rural populace. It also enforces the Forest Act.

4. Utilisation division

This division is headed by a supervisor trained as a "saw doctor." He is assisted by five forest rangers and 12 forest guards. The main function of this division is the commercial exploitation of forest resources, mainly for timber and fencing. It also produces honey for sale through local distributors.

5. Current projects

a. Reforestation project

This project, financed by USAID at a cost of US\$1,575,000 over five years (1979-1984) is designed to establish 1,300 ha of plantation for service wood, fuel and fencing materials and to establish ten village woodlots of five ha each to produce fuel.

b. Forestry development

This project is financed by the West German Agency for Technical Assistance and Cooperation at a cost of 1.6 million Deutsche Marks over two years (1981-83). The project is designed to provide an updated land use map, forest management plans, a national forest inventory, and a species/site trials programme. It is anticipated that a second phase of the project will start in November, 1983.

In addition the department has begun a tree-planting campaign. Support for this programme totals US\$100,000 from the Arab Bank for Economic Development in Africa and from FAO.

VII. CONSTRAINTS TO AGRICULTURAL PRODUCTIVITY

A. Agricultural Crops

The survey on constraints to increased crop production reveals the following results.

1. Environment

a. Climatic factors

Almost all farmers and extension personnel interviewed considered climatic factors, especially insufficient rainfall, to be a serious constraint. Most farmers worry more about the frequency and distribution of rainfall than the amount.

b. Soils

The major constraint is maintaining soil fertility through the use of fertilizers. Most farmers complain that fertilizers are too expensive even though they are government subsidized.

c. Pest and diseases

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

d. Varieties

These are not considered a serious constraint.

2. Economic factors

a. Pricing

Most farmers and extension workers considered pricing to be a constraint. Pricing policy is so unclear and so ad hoc that at planting time, the farmer has no means of forecasting what price he can expect for his produce at harvest. If the farmers could know the prices before planting, it would help them decide which crops to grow.

b. Marketing

While markets exist for rice, groundnuts, and maize, most farmers complain that they are unable to sell their harvest when they are ready. Usually, the official market does not commence operation when farmers are ready to sell.

c. Credit

The shortage of both short and long-term credit is considered to be a serious constraint. Short-term credit is available

mainly as a subsistence cash loan to help farmers buy inputs and food during the so-called "hungry season" in August and September before crops are harvested. Most farmers complain that they would rather have this loan in June or July so they can buy needed inputs instead of in August when the credit is often given. Because of the need to provide collateral the farmer is not often able to get long-term credit. Furthermore, interest charges are considered high; medium term loans during the first rural development project carried an interest rate of 15 percent.

3. Rural traditions

Some farmers consider land tenure a serious constraint and farm labour is generally considered a serious constraint.

Respondents indicated that yields can be increased by using the superior technology now available. The yield increases which can be attained are listed by crop in Table 20.

In general, respondents felt that research and extension effort should be intensified in order to find solutions to the problems identified.

The types of research can be summarized as follows--intensified search for better varieties and production systems, and farming systems research.

Respondents also felt that local market prices must be high enough to cover production costs that farmers must have access to short and medium-term credit; and that farm inputs must be available on a timely basis if productivity is to increase. Further, farmers must have labour when needed and access to useful extension information and to markets.

B. Livestock

The survey revealed the following constraints.

1. Cattle

a. Physical factors

Insufficient rainfall, watering points, supply of natural or other types of forage, and diseases are all considered important constraints.

b. Social and traditional factors

Herd management, use of range lands and the leaders' lack of technical knowledge are considered important constraints.

Table 20: Yield Increases Based on Use of
Technology Presently Available
(tons)

<u>Crop</u>	<u>Short-term Increase</u>	<u>Long-term Increase</u>
Rainfed Rice	1.6	2.9
Groundnuts	1.3	2.4
Millet	0.9	1.5
Sorghum	1.3	2.0
Maize	2.0	4.5
Cotton	1.0	2.0

c. Economic factors

Marketing is considered the most important economic constraint. Inputs like drugs are free of charge so that prices are not considered important constraints.

2. Sheep and goats

a. Physical factors

Rainfall and supply of natural forage are considered serious constraints. Access to water supply, diseases and lack of curative health facilities are also important constraints.

b. Social and traditional factors

Herd management and range land use are considered to be important constraints.

c. Economic factors

Marketing is the most serious constraint since no marketing system exists for sheep and goats.

3. Poultry

a. Physical factors

Insufficient rainfall is considered a serious constraint as is lack of forage.

b. Social and traditional factors

Flock management is a serious constraint due to the lack of breeding knowledge.

c. Economic factors

The cost of inputs is a serious constraint.

4. Animal production

The present level of natural production for the various types of livestock are as follows:

- o Cattle: Meat production is high, milk is low (81,000,000 litres/year), hides and skins are low (21,000/year);
- o Sheep and goats: Meat production is high, milk low and hides and skins medium (90,000/year); and
- o Poultry: In 1982 production was at 684,000 eggs and 16,900 broilers (meat).

Productivity could probably be increased by 20-30 percent if constraints were removed.

5. Recommendations

Respondents felt that the following research projects should be undertaken:

- o Cattle: Research into pasture development, research into the diseases of cattle in The Gambia, forage conservation methods, and studies of herding practices and their effects on productivity;
- o Sheep and goats: Pasture development and animal management research, and genetic improvement; and
- o Poultry: Use of local products and by-products for poultry feed.

Respondents felt that market prices should be sufficient to cover the production costs; producers should have access to credit; and inputs should be available in a timely fashion if productivity is to be increased. Similarly, productivity would increase if there were qualified workers to advise producers and if the farmers had access to markets and information.

C. Fisheries

The following constraints were reported in the fisheries survey.

Fish supply and staff and training for fishermen are considered to be serious constraints. Losses after catching and hydroclimatology are also important.

Access to credit and availability of inputs, product selling price, and distribution problems, especially the lack of refrigerated trucks, are considered very important constraints.

The 1982 production of 17,081 metric tons of fish could probably be increased by 15-20 percent in the short-term, if the above noted constraints were removed.

To overcome the above constraints the following types of research must be undertaken:

- o Studies on post-harvest losses and their prevention;
- o Methods of curing fish including the possibility of solar tent drying;
- o Improvement of fishing gear and the development of adaptable gear; and
- o Market surveys to understand the dynamics of the fish market.

For increased productivity both in the short and long term the following actions must be taken immediately:

- o Market price should at least cover the cost of production;
- o Access to credit for investment and increasing productivity should be available to producers;
- o Inputs should be available on time and skilled workers should be available to work when needed;
- o Fishermen should have access to markets using local transportation; and
- o Extension advise should be available to producers.

D. Forestry

The following constraints apply:

- o Physical factors: Insufficient rainfall and soils are important constraints;
- o Socio-cultural factors: Lack of useful and adaptable information, labour shortages, lack of short and long-term investment capital for foresters and insecurity of land tenure and access are important constraints; and
- o Economic factors: Pricing policies and inadequate infrastructure are important constraints.

Production possible in the short term, assuming that improved technology is used, is estimated at 10 m³/ha/year. In the long term it is estimated at 15 m³/ha/year.

The research needed to overcome the above constraints is associated with the species grown. Therefore species/site trials should be undertaken as a priority matter. In the long-term, genetic improvement should be undertaken.

In order to increase productivity, there must also be an increase in market prices to cover production costs, as well as increased confidence in the security of land tenure and access to land, credit and information.

E. Comments on the Constraints

1. Economic factors

a. Pricing

In general, pricing is a serious constraint. As already indicated, pricing policy is so unclear and ad hoc that the

producer has no means of knowing what price he can expect until the product reaches the market. If it were possible for the producer to know in advance the price that he would get for his produce, he could better organise his production system to maximise his profits.

b. Credit

This is perhaps the greatest single constraint on the producer's productivity, apart from environmental factors. To produce, he must invest; to invest, he needs credit. The unavailability of long-term credit to the producer is a serious disincentive for him to improve on his operations. The Agricultural Development Bank may be able to help to remedy the situation.

2. Social factors

a. Land tenure

While the security of tenure itself is not yet a problem, there is a need for rural land reform. A farmer having parcels of land at different locations, sometimes too far apart, will find it difficult to be efficient. Furthermore landless farmers are at the mercy of land owners; the ancestral ownership of land should therefore be reviewed. For example, a family of ten might control 500 ha of land, most of which they cannot farm. Part of the land might be loaned to others to farm, but the temporary owners have no interest in investing in the development of the land.

b. Farm labour

This is a serious problem caused by rural-urban migration. There is clearly a need to investigate the causes of this phenomenon with a view to checking the migration. Failure to act now will result in the able-bodied men leaving the rural areas, with serious consequences for agricultural productivity.

3. Physical factors

Very little can be done about these factors except perhaps to try to understand the dynamics of the environment with a view to improving its effects.