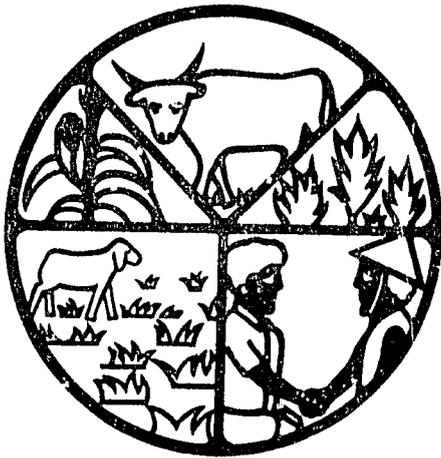


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Mixed Farming Administrative Report



GAMBIAN MIXED FARMING AND RESOURCE MANAGEMENT PROJECT

Ministry of Agriculture and
Natural Resources
Government of The Gambia
Consortium for International Development
Colorado State University

"NOBODY EVER SAID IT WAS GONNA BE EASY"

Final Report
of the

GAMBIAN MIXED FARMING AND
RESOURCE MANAGEMENT PROJECT

by

Glen D. Fulcher
Jerry B. Eckert
and the
Mixed Farming Team

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FINAL REPORT
of the
GAMBIAN MIXED FARMING AND
RESOURCE MANAGEMENT PROJECT

Project No. 635-0203

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DISCLAIMER

All expressed opinions, conclusions or recommendations are those of Dr. Fulcher or Dr. Eckert and do not necessarily reflect the views of the funding agency, the United States Government, the Government of The Gambia or others on the MFP team who contributed to earlier drafts.

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Resource Management Project

EXECUTIVE SUMMARY

The Gambian Mixed Farming and Resource Management Project (MFP) was contracted by the Government of The Gambia (GOTG) to the Consortium for International Development (CID) with support from a grant by the United States Agency for International Development (USAID). Colorado State University (CSU) led the project for CID. A field team varying from 6-9 scientists was in The Gambia from May 4, 1981 to June 14, 1986 [pp. 1-4].

For the first two years, MFP strove to follow rigorously the detailed assignments and scopes of work in the project paper [pp. 5-21]. At the end of the second year, an "Early Mid-Project Evaluation and Redesign" was completed [pp. 22-24]. Year Three was a year of transition. The composition of the field team was altered to accommodate new functions and the effort was redirected [pp. 25-27]. During the final two years, the MFP stressed more interdisciplinary interaction and a heavier focus on village level on-farm trials [pp. 27-54].

Since the project was initially focused on livestock and range, much of our initial village level contacts were with livestock owners associations (LOAs). Range/pasture improvement research initiated several activities, including: 1) demonstrating the potential of pasture improvement, 2) testing alternative means of establishing improved plant mixes, 3) seed multiplica-

tion, 4) range forage inventory, 5) livestock feeding trials, and 6) development of a research herbarium [pp. 5-10].

Forage research was a new idea in The Gambia and MFP's initial efforts concentrated on testing imported forage legumes. Additional research began to explore means of harvesting and storing crop residues to increase their effective value as cattle feed [pp. 10-14].

During the interrupted 1981 crop season, the maize thrust was able to complete performance tests on the research station and develop a preliminary package of practices built around the maize composite NCB. This package was taken to 156 farmer cooperators in 1982. Yields were excellent and farmer response enthusiastic. 2500 hectares were planted using the MFP technology in 1983. Poor yields due to drought were offset by a 200 percent increase in price during the six month period following harvest. Farmers remained enthusiastic and the basis for a major expansion in maize area was laid [pp. 14-16].

MFP social scientists began their field program with a nationwide baseline survey designed to provide overview statistics on farming and village life. This was followed in 1982/83 and 1983/84 with intensive village studies aimed at detailed data on farming systems [pp. 17-20].

In April 1984, the project went through a final planning exercise in order to streamline activities and ensure that desired final outputs were obtained. The workplan for the final two years achieved the following: 1) explicitly recognized certain limits within the environment in which we worked, 2) made a small but significant modification to the MFP goal statement, 3) consolidated the research program into three core areas, 4) designated the social scientists as supporting to the technical thrusts, 5) emphasized interdisciplinarity and 6) stressed integrated village testing [pp. 27-29].

Maize production made remarkable progress during the final years of the project. Hectarage expanded dramatically and yields remained high. The project was active in several supporting ways. Training of agricultural assistants remained important. Kafos were organized as a focal point for farm credit. Several means of controlling weeds were tested. Chemical herbicides proved effective and cheap. And the MFP multi-purpose cultivator showed considerable promise. Maize Growers Associations were developed with project encouragement and have been instrumental in affecting maize policy and fertilizer supply [pp. 29-33].

The maize production thrust was bolstered by several related activities which together became the MFP women's program. First, with growing supplies of maize grain being produced, project personnel mounted a sustained extension program designed to familiarize Gambian village women with nutritional maize recipes. Over 8000 women were reached. Second, hand and power grinders for maize were demonstrated widely and several prototypes were left in villages. Third, women's societies were trained in maize production. Finally, on-farm trials of maize intercropped with cowpeas were conducted on women's societies fields [pp. 33-35].

Considerable work was done testing various means of introducing legumes into cropping patterns. None were wholly successful but much was learned and the concept remains worth further investigation. The exotic Leucaena was tested in several ways as well [pp. 35-39].

Crop residue feeding trials established that livestock can maintain their weight and health through the dry season using only residues from existing crops provided crop residues are properly cared for and fed [pp. 39-41]. A rudimentary feeds analysis laboratory was established to assist with this research [p. 41]. When feeding of crop residues is coupled with bush

grazing and the use of deferred pastures, a considerable improvement in livestock condition is possible [pp. 41-44].

Other significant activities by MFP range scientists included: 1) a complete range inventory of the 485,000 hectares of range in MID and URD, 2) an expanded seed multiplication program, 3) demonstration of the feasibility of root transplanting for range improvement, 4) livestock accessways to the river for water and 5) an established herbarium [pp. 44-47].

The last two years for the social scientists included a wide range of activities. In the field of data collection, PPMU was assisted with the National Sample Survey and with evaluation surveys at Jahally Patchar. Further, the Gambian Agricultural Data System (GADS) was developed and used to collect and process detailed farm management data. Marketing activities included development of a marketing news service broadcast over Radio Gambia in English and local languages. A marketing short course was presented in Banjul by professors from CSU and MFP. Physiometric measurements were taken on 3000 marketed cattle and a means developed to estimate liveweight and carcass weight in the field. Livestock Owners Associations were studied for their effectiveness as development institutions. A handbook was issued to create a permanent record of agricultural prices by month for a number of crops. Finally, economic evaluations were made of various recommended technology packages [pp. 47-53].

The main report closes with a set of recommendations for future agricultural programs in The Gambia [pp. 55-59].

Training constituted a common thread across disciplines as well as one of the larger parts of the Mixed Farming program [Appendix B]. During the life of the project, nearly 150 government, USAID and contractor personnel participated directly in the project [Appendix D]. In addition, literally thousands of

Gambian farmers, both women and men, participated with their advice, collaboration and cooperation.

INTRODUCTION

Overview of The Gambia

The Gambia is the smallest country on the African continent, situated on the west coast between 13° and 14° N latitude and surrounded on three sides by Senegal. The Gambia consists of land on either side of the River Gambia, never more than 30 miles wide, and running east from the coast about 330 kilometers. Total area of the country is 10,400 square kilometers, with a total land area of just over one million hectares. The country is riverine, with swamplands, croplands, and upland forest. The highest elevation is 60 meters. The river is affected by tides throughout most of the length of the country. Salt intrudes about two-thirds of the distance up river during the late dry season making the water unsuitable for livestock or irrigation.

The dominant climatic feature is the division of the year into two distinct seasons. An intense rainy season usually begins in June and lasts until October. Historically, 1000-1200 mm of precipitation fell during these months, but in the few years before 1985, drought in Sub-Saharan Africa has reduced annual rainfall to 600-800 mm per annum. Little or no rain occurs during the rest of the year. The sharp dichotomy between rainy and dry seasons is the dominant feature of the agricultural environment.

The 1983 census estimated a total population of 696,000 with an annual increase of over 3 percent. While urban areas contain about one-third of the population and are growing at about 6.5 percent per year, more than two-thirds of the population is rural and makes its living largely from agriculture.

The national cattle herd has increased more than sevenfold over the past half-century from 40,000 to an estimated 300,000+

head. Ownership of cattle has become increasingly widespread during that same period. Cattle are predominantly of the N'Dama breed which is partially tolerant to trypanosomiasis. This disease limits the productivity of the N'Dama and effectively prevents introduction of other breeds. There are also an estimated 300,000 sheep and goats in The Gambia.

Project Rationale

The Gambia Mixed Farming and Resource Management Project was conceived by the Gambian Government in cooperation with the U.S. Agency for International Development primarily due to the growing pressure of both human and livestock populations on Gambia's limited land resource base. As more and more land was being placed under cultivation for human food, especially swamp lands that were the major dry season grazing areas for livestock, conflict between food production for humans versus feed for livestock intensified. As livestock numbers increased and available grazing areas decreased, range lands became seriously over grazed, with a rapid decline in range forage condition. With reduction of the quantity and quality of range forage available, livestock weight losses continued to increase and reproduction rates continued to decline. It was increasingly evident that if livestock were to have an adequate forage supply, a more intensified integration of crop and livestock production was needed within existing Gambian farming systems.

Overall Project Goal

The goal of the Project was "to increase the economic well being of the rural people of The Gambia." This goal was to be accomplished through fostering "intensification and integration of crop and livestock enterprises within existing Gambian farming

systems so as to contribute to increasing net rural family incomes on an ecologically sound and sustained yield basis." ¹

Project Conception

The Project was originally conceived in 1977, a project paper was prepared, and recommended for approval by AID's Executive Committee for Project Review (ECPR) on December 7, 1978. Prior to this approval the Government of The Gambia (GOTG) had reviewed and approved project modifications from the original project paper. The project was designed as a host country contract and released for bids from the Title XII community.

The Consortium for International Development (CID) comprised of eleven universities in the western states was awarded the contract. Colorado State University (CSU) became the lead institution under CID with responsibility for implementation management, and the contract between GOTG and CID was signed in Banjul on February 4, 1981. The Chief of Party and the Rural Sociologist arrived in Banjul 90 days later on May 4, 1981. The Agricultural Economist arrived May 11th, followed by the Maize Agronomist and Range Ecologist in June. The Project was thus well underway with the start of the 1981 rainy season.

On July 30, 1981, there was an attempted overthrow of the Government. This caused a temporary cessation of the program while MFP team members and their families spent ten days at the U.S. Ambassador's residence before being evacuated to Dakar. After nineteen days, the situation in The Gambia had normalized and the team returned to Banjul to continue the program. The Forage Agronomist, who had delayed his arrival in The Gambia due

¹. United States Agency for International Development, 1979 Project Paper. Gambia Mixed Farming and Resource Management Project, Part II, page 1.

to the attempted coup, arrived in early September to complete the initial MFP team.

Initial Scope of Work

The Project was initially conceived as a first phase of a long-term program to promote intensification and integration of crop and livestock production within existing Gambian farming systems. It was to consist of six components to be implemented over a five year period. The components were : (1) land resources and use evaluation, classification and cartography; (2) grazing areas development and management; (3) improved crop and forage production and management; (4) improved rural technology; (5) strengthening ministry planning and evaluation capacity; and (6) agricultural skills training and communications.

The Ministry of Agriculture and Natural Resources was to be the principal agency for design and implementation of the project. Within the Ministry, the various components were to be implemented within the Department of Animal Health and Production (DAHP), Department of Agriculture (DOA), and the Program Planning and Monitoring Unit (PPMU). The Project Coordinating Committee, chaired by the Permanent Secretary of Agriculture, and the PPMU were to have been the two vehicles for planning and coordination of project activities. However, during the first three years of the Project the PPMU could not be involved as planned. The Project Coordinating Committee was non-functional shortly after commencement of the Project. Meetings in the early months of the Project involving the Permanent Secretary, Department Directors, AID Representatives and the Mixed Farming team and counterparts provided some project coordination and problem solving at the outset

THE FIRST TWO YEARS

Specifically, the project paper directed the MFP team to concentrate its activities on the bushlands and upland rainfed agriculture, to the exclusion irrigated land. Team members were to work with farmers and livestock owners to determine how an adequate year-around supply of forage for their livestock could be produced.

A major initial effort was a series of meetings held with Livestock Owners Associations (LOAs) to find out what they thought were the most serious problems in providing forage requirements for their livestock and how they could best be resolved. With the information gathered, and in conformance with the original project description for each activity, the initial two year program proceeded with socio/economic studies, agronomic research, livestock feeding trials, maize trials and seed multiplication. There was a need for physical scientists to determine what was physically feasible through various research and demonstration trials. Results could then be evaluated to see if they were economically feasible and practical for possible use in Gambian farming systems.

Briefly, activities for components 1-6 of the Project up to time of the mid-project evaluation in March and April of 1983 were as follows:²

2. Specific component responsibilities are contained in the Project Paper.

Component No. 1:
Land Resources and Use Evaluation.

The first component of the project as detailed in the Project Paper was "Land Resources and Use Evaluation, Classification and Cartography". The objective was to provide the Gambian Government with land use maps showing current land use patterns as a basis for developing national land use and resource allocation policies.

The bulk of the responsibility for carrying out the component was to be through contracts to provide aerial photos and detailed large scale (1:25,000) land classification maps for each of the five administrative divisions of the country.

Aerial photos and mapping requirements for this component were to be accomplished through other contracts with U.S. firms as agreed to by AID and the GOTG. It was expected that these activities would be completed within two years from signing of contracts. The Mixed Farming Project personnel were not involved in carrying out this portion of the component and it was not an MFP responsibility to assure it was accomplished.

Black and white and infra-red aerial photos at a scale of 1:25,000 were completed in early 1981 by outside contract. The black and white photos were of poor quality and a contract was let to enhance the photos from the infra-red pictures. These pictures were used by range ecologists and pasture assistants in the forage inventory in McCarthy Island and Upper River Divisions. However, the separate contract for the cartography to develop land use classification maps at a scale of 1:25,000 was never let by AID, for a variety of reasons, during the five year duration of the Project. Since maps are still to be developed, the Mixed Farming Project, to meet its commitment of compiling the range forage inventory information, recorded data on the

black and white aerial photos. In the last three months of the Project a short term consultant in cartography was hired by MFP to develop sufficient overlay maps from 1:25,000 aerial photo quads obtained from the Gambia River Basin Commission (OMVG). Range inventory data was then transferred to these overlay maps to be made available to the GOTG and AID when final land use classification maps are completed. The separate mapping contract was finally awarded on May 1, 1986 and The Gambia will eventually have completed land use maps.

Component No. 2:

Grazing Area Development and Management.

The purposes of this component were to: 1) support the GOTG in developing and managing controlled grazing areas designed to provide improved nutrition for large and small ruminants; 2) attempt to bring animal units into balance within the carrying capacity of range resources and, 3) produce basic data necessary for the GOTG to develop resource management and land use policies. The design team members realized just how extremely difficult it is to measure benefits of renewable natural resource management in a short period of time. They stated that it is not unreasonable to expect only limited improvements in grazing land during the first twenty years of a project.

Early in the Project it was decided to begin the program in two divisions only; the McCarthy Island Division (MID) and the Upper River Division (URD). This decision was based on several considerations. First, a shortage of trained personnel prevented covering the total country. Second, some sixty percent of the national cattle population was in these two Divisions. Lastly, these two Divisions contained 20 Livestock Owners Associations (LOAs) representing 2503 members which could serve as points of contact for MFP activities.

Working through Divisional Commissioners, DAHP personnel and LOA officers, two general meetings were held with each of 20 LOAs. Eighteen LOAs indicated a desire to participate in a forage improvement program. Each subsequently constructed a two hectare range/pasture management demonstration plot. One hectare of each was fenced and one was not. Fire lanes were cleared, seed beds prepared and seeded and the shrub material cut back to ground level in the fenced portion. Plots were seeded with both native and introduced grass and legume species. All labor for installation and seeding was contributed by LOA members.

A range/pasture technical workshop was conducted and an LOA coordinating committee was established. The committee was composed of representatives of all projects and organizations which were working with LOAs. It was chaired by the Acting Director of DAHP. The purpose was to try to eliminate confusion in the field and look at all livestock projects as a DAHP function.

An initial effort was made to work with the Livestock Marketing Board (LMB) to assist in pasture development at the 175 hectare Kabakor holding grounds. A one-half hectare demonstration plot was fenced and seeded to determine potential. The seeding was a success after the second rainy season and a five hectare area was fenced off for expanded production. Gamba grass was root transplanted from plants brought from the Yundum airport area. Plant survival was satisfactory and this promised to be a good demonstration area. However, due to a hot range fire that scorched the area and a change in personnel at LMB, interest in continuing the project ended.

The DAHP had started two range forage seed multiplication plots in the mid-1970s; a 1.2 hectare plot at Yoro Beri Kunda (YBK) in MID, and a .5 hectare plot at the mixed farming center of Giroba Kunda in URD. The MFP range ecologist immediately set

out to up-grade these plots by refencing and expanding the YBK plot to 3 hectares and the Giroba Kunda plot to .8 hectares. Before the end of the Project the YBK plot was again expanded to 6.6 ha. and Giroba Kunda to 1.2 ha. The objective was to increase production of legume and grass seed as rapidly as possible to reduce dependency on expensive imported seed from Australia and other countries. The effort concentrated on increasing seed and root stock supplies of Gamba grass (Andropogon gayanus), buffel grass (Cenchrus ciliaris) and legumes Stylosanthes hamata and scabra.

In addition to seed multiplication, permission was received from authorities at Yundum International Airport for MFP to collect Gamba grass plants along the security fence. Nineteen Bedford truck loads and 12 1/2 Land Rover loads were hauled to ten different sites for root transplanting. The major planting effort was at Boiram and Kabakor. There were numerous problems such as differences in rainfall patterns, lack of trained labor, fuel shortages, etc. Eventually 6.8 hectares were transplanted. Survival was expected to exceed 50 percent but that percentage was not achieved. However, much was learned about mass transplanting of Gamba grass as a pasture improvement technique. This knowledge was utilized later in the project with greater survival success in subsequent transplantings.

One of the requirements in the Project Paper for the range/pasture component was to conduct a range forage inventory to determine species composition, productivity and resultant carrying capacities of different range types. With limited personnel and collecting time available, it was decided to confine the inventory to MID and URD. The forage production phase of the inventory could be carried out only between late October at the end of the rainy season and early January before vegetation became too dry or grazed off for adequate collection of production weights and accurate plant identification.

The second phase of the inventory was carried out in April and May to determine forage biomass still available at that time of year. During both phases of the inventory, other information was recorded such as grazing intensity, burning, extent of soil erosion, livestock watering sources and alternatives, cattle concentrations and possible sites for livestock accessways to the river. By end of May 1983, phase one and two inventories had been completed on 106,430 hectares and 120 individual plant specimens had been collected, identified and mounted for the herbarium.

At the village of Boiram, a livestock feeding trial was developed in cooperation with livestock owners of the Fulla Bantang Livestock Owners Association to be carried out for the remaining three years of the Project. The trial was designed to test a feeding program involving 1) bush grazing from late June through December, 2) feeding of farm crop residues (maize and sorghum stover) in January and February, 3) use of deferred pasture in March and April, and 4) groundnut hay from May until start of the rains in June.

A ten hectare deferred pasture and a crop residue holding area were fenced. All labor was provided by the members of the LOA from six villages in the Boiram and Njoben areas. Crop residues were harvested and hauled to the holding site. Forty heifers were included in the trial, twenty on the feeding program and twenty to remain with the home herd as control animals and grazed in the traditional manner. Animals were weighed every 14 days. This was to be a test to determine how fed animals fared in terms of weight, condition and fertility compared to the control animals during the dry season.

Component No. 3:

Improved Crop and Forage Production and Management.

This component was composed of forage agronomy and maize agronomy. The major objective was to increase livestock feed. The forage agronomist concentrated on improved systems of forage production while the maize agronomist concentrated on increased production of maize as grain for human consumption, utilizing maize stover for livestock feed.

Forage agronomy was a new program for The Gambia and had to be established without benefit of prior work. The forage agronomist used his prior experience in Nigeria to develop a work plan which involved active collaboration of the departments of Agriculture and Animal Health and Production.

Five objectives spelled out in the original design of the Mixed Farming Project were used as a guide in initiation of the forage program. These were: 1) introduce adapted legume cultivars for use on fallow lands; 2) promote better use of crop residues through improved harvesting, storage and feeding; 3) evaluate crop residues and promising legumes through feeding and grazing trials; 4) multiply seeds of promising cultivars in collaboration with the Seed Multiplication Unit at Sapu; 5) train Ministry personnel to deliver improved technology in forage production to farmers and livestock operators.

Initially, 15 accessions were planted in locations representing three major soil associations in The Gambia. Sites were Yundum, Sapu and YBK. The first two are on Agricultural Department land and the third on an Animal Health and Production station. Seed sources were drawn from Australia, South America, Philippines and two West African countries - Nigeria and Cameroon.

In 1982, seedings of legume cultivars were made in early July with stand and height measurements taken until plant maturity which started in September for early maturing varieties and extended into late December 1982 and early 1983. Two cultivars, Stylosanthes scabra and S. sympodialis, remained green until April at Yundum. South American cultivars (three species of Stylosanthes) out performed Australian commercial seed about 2 to 1 in yield and were substantially taller at the end of the first growing season. Leucaena leucocephala stayed green the year 'round except for a brief wilting period at YBK in May. Leucaena performed better at YBK and Sapu than at Yundum but young plants of the Philippine seed source which survived heavy grazing by hares at Yundum grew well in the 1983 season.

In 1983, seedings were expanded into locations representing each administrative division in The Gambia. Because of unfavorable weather conditions, such as severe drought in July at most sites, responses were disappointing. However, seedlings from 1982 did well in their second season during this difficult period for most crop plants.

Harvesting, drying and storing of crop residues was begun in the fall of 1981 and has continued throughout the project. It was found that maize and sorghum stovers should be cut immediately after grain harvest and bundled and left standing with butts down until transported to an area where they can be stored on racks off the ground until fed. Groundnuts should be wind-rowed immediately after lifting to preserve green color and prevent leaf shattering until threshing. Traditional hay made in this way by reconstituting leaves and stems after threshing retains its nutritional value.

Silage was made from both maize and sorghum in 1982. The resulting product was palatable and nutritious to both young and

older animals. However, since it requires heavy machinery during harvesting and chopping, it is not practical for individual small farmers. Cooperatives and LOAs, with a larger financial base, might find silage an attractive feed source. A trench or an above ground stack with sidewalls of wood or concrete have proved satisfactory in The Gambia for silage.

Livestock feeding trials with crop residues were initiated in 1982 and conducted throughout the life of the Project. Trials in 1982 and 1983 used groundnut hay, gamba grass hay, rice straw, maize and sorghum stovers, and maize and sorghum silage. All residues with the exception of the two stovers enabled two-year old and one-year old heifers to maintain their weights. Chemical analyses indicated groundnut hay mixed with stovers would probably prevent weight losses that would otherwise occur. Plans were made to conduct feeding trials using mixed rations of farm crop residues for 1984-85.

Seed was multiplied from the CIAT accessions in order to provide enough for planting at Sapu, YBK and six other locations in The Gambia. Project forage agronomists collaborated with the Seed Multiplication Unit at Sapu in harvesting 1982-83 plantings and in preparing to establish a five-hectare block at Sapu for forage seed increase in 1984.

Training Ministry of Agriculture personnel was a major objective of the forage program. Training was begun by having two counterparts assigned, one each from the Department of Agriculture and the Department of Animal Health and Production. The expatriate counterpart played an active role in training two agricultural assistants and in designing a comprehensive training program embracing the two departments. Briefly, this program includes three categories of trainees: 1) station officers in charge of division extension activities in Agriculture and Animal Health and Production; 2) agricultural, pasture, livestock assis-

tants and agricultural demonstrators through in-service training courses, and 3) inclusion of forage agronomy in the curriculum of agricultural assistant students at Gambia College.

Farmer training was planned to be conducted at Mixed Farming Centers (MFCs) and the village site at Boiram. Three types of training were designed: 1) In the first, a "do-it-all-by-yourself" experience, farmers conducted all forage activities from establishing legume plantings to harvesting, storing and feeding crop residues combined with efficient use of arable land to alleviate nutritional problems of bush grazing in the dry season; A second form of farmer training involved organized field tours of MFC demonstration plots. Finally, field days were organized where farmers are brought to MFCs for lectures and demonstrations of forage agronomy technology in practice. However, this package of farmer training programs was only partially carried out due to departure of the first expatriate agronomist at completion of his two year assignment and the simultaneous departure of his Gambian counterpart for two years for a BS degree at Colorado State University. The follow-on agronomist and her counterpart shifted emphasis more to livestock feeding trials and plot trials on experiment stations.

Upon departure, the first forage agronomist recommended, based on results to date, a year around cattle grazing and feeding program to maintain adequate nutrition in the dry season. This was eventually the program started in Boiram in 1984 in conjunction with the range ecologist. He also recommended a number of additional studies. The follow-on agronomist carefully evaluated these suggestions in carrying out the forage agronomy components program for the final three years.

Maize Agronomy

(Part of Component No. 3)

The purpose of this component was to increase production of maize as a grain crop for human consumption and maize stover as a dry season livestock feed. Specifically this was to be accomplished by: 1) developing a package of improved production practices; 2) collaborating with local agronomists in maize cultivar testing; 3) collaborating with the Ministry Seed Multiplication Officer in seed increase programs for suitable high yield maize varieties, and 4) demonstrating potential of maize for human consumption and residual stover for livestock feed by assisting in training of extension personnel in delivery of the technological package to farmers.

Maize is not a new crop to The Gambia. It has been grown for many years as a backyard or garden crop. Also it has been a principal cereal food crop for Serahules, the largest ethnic group of URD. However, increased interest in production of maize developed in 1977 when the Department of Agriculture introduced a Cereal Package Deal Program throughout all upland districts of The Gambia. The emphasis of the program was to increase production of all cereal crops and maize was included as a national crop with export potential.

The MFP maize agronomist arrived in The Gambia in June 1981 just at the start of the rainy season. Two varieties of yellow maize [Jeka and a Nigerian selection, Nigerian Composite B (NCB)] had been tested previously for a number of years on experiment stations at Yundum and Sapu. The variety NCB was selected as the most promising and further testing at experiment stations and two Mixed Farming Centers was carried out in 1981. Results from these trials were later to form part of the Maize Production Technology Package finally adopted by the DOA extension service and by maize farmers.

The maize package was composed of several improved farm management practices designed to increase maize yields. Training

seminars were held for extensionists concerning maize technology. Within their areas of responsibility, extensionists selected 156 farmers to produce maize in a 1982 introductory program. The 156 farmers represented 65 villages and planted 91 hectares of maize. Many farmers harvested more than three tons per hectare and the average was around 2.5 tons. Some seed planted in 1982 was of foundation quality from which certified seed could be grown. Twenty-two tons were purchased by the Gambia Cooperative Union (GCU) for seed to be used in the 1983 national maize program.

Farmers were impressed with results of the 1982 maize demonstrations. In 1983 there were 3,425 farmers from 299 villages who wanted to grow over 4,200 hectares of maize. Because of credit worthiness problems the actual number of farmers provided credit to grow maize ultimately was reduced to 3,257 who represented 216 villages and 2,987 hectares. However, delay in fertilizer delivery by as much as 30 days caused farmers to have to adjust their plans and only 2500 hectares were finally planted.

The 1983 maize harvest was poor due to severe drought during August and September. Average yield was around 1.5 tons per acre. However, other crops also had poor yields which caused increased prices on the limited supply of all cereals. Maize at harvest sold on the open market for D62.50 per 100 kg. bag. By end of the year the price was D80 and by June 1, 1984, prices had risen to D130.00 per 100 kg. bag. These prices were impressive to farmers and a large demand for seed to increase maize production in 1984 developed. Maize was rapidly shifting from a small backyard crop to commercial production (TR-3).

Component No. 4:
Improved Rural Technology

This component was included in the MFP Project Paper by the design team after discussions with the International Bank for Reconstruction and Development (IBRD) about the objectives of their Rural Development Project (RDP). One objective of RDP was to increase supply of animal traction equipment available to Gambian farmers. Through compromise it was agreed RDP would concentrate on equipment directly related to cropping activities and MFP would concentrate on farm carts for transport of farm crops and farm crop residues.

The major objective under this component was to establish a revolving commodity credit fund for farmers to use to purchase farm carts. This was to have been accomplished in collaboration with the Gambian Cooperative Union (GCU).

Although demand for carts was high among farmers, attempts to arrange credit with the Agricultural Development Bank failed to materialize and it was deemed impractical to try to handle credit through the Gambian Cooperative Union in view of credit difficulties it had encountered.

The mid-term evaluation concluded that this project component was diversionary, taking significant resources from other core efforts. It also appeared that there was little chance of successful progress. The MFP team took the position that instead of getting into credit problems and revolving funds, it could best assist by encouraging more effective utilization of carts already available in the villages. The mid-term evaluation team recommended the cart program with its credit scheme be dropped from consideration under the project and this was agreed to by GOTG and AID.

Component No. 5:**Strengthening Ministry Planning and Evaluation Capacity.**

To accomplish this component the Project Paper called for a Socio-Economic Unit to bridge the gap between technical components and disciplines represented in the Project. The unit was to provide information of a quantitative and qualitative nature describing and analyzing livestock and land use systems operating in The Gambia. It was also to: 1) evaluate through field tests the relevancy of technological packages developed by the project; 2) longitudinally monitor project interventions to determine if they were proceeding as anticipated; and 3) build up a core of Gambians with a micro socio-economic orientation in the Ministry of Agriculture.

Initially, the staff of the socio-economic unit was to carry out a nation-wide baseline study on at least 2 percent of Gambian rural compounds to obtain an understanding of characteristics of farming systems in which livestock are incorporated. The baseline study was to provide a data base covering characteristics of rural households and farming systems in The Gambia.

The sample for the baseline survey stratified compounds based on two criteria resulting in six strata. The criteria were ecological (bottomland or upland soils) and village size (small, medium or large). Survey questionnaires were developed and field tested. Twenty five enumerators were carefully selected, provided with in-depth training, issued motorcycles, and posted in villages.

In the final sample 582 compounds (about 2.3 percent of all rural compounds) were selected. The compound head and his first wife were interviewed. The questionnaire for the compound head covered nine general areas : characteristics of people in the compound; cropping patterns and land use; maize production and

use; livestock ownership and management; integration of crop/livestock practices; on-farm and off-farm labor; credit and capital; technology transfer; and income and level of aspirations. The questionnaire used for the first wife was similar except it collected additional information on actual participation of women in farming and gardening activities. It also collected information on the woman's role in health, food preparation, and household activities.

Initial results of the survey were reported in the Mixed Farming Preliminary Report No.1 "Farming Activities in The Gambia". More in depth analysis of the data can be found in MFP Technical Report No. 10, "Mixed Farming in The Gambia."

Upon completion of the baseline survey, the Socio-Economic Unit began an intensive study of the main farming systems in The Gambia which incorporate livestock. It was to be a small sample with frequent interviews, some two to three times a week, over an extended period. The purpose was to accurately measure data of a technical, economic and social nature. Data was to be collected on inputs and outputs, income and expenditures and resource utilization.

This study was conducted over a two year period using the same sample of farmers. In addition to the criteria used in the baseline survey, ethnicity, location and livestock ownership were added as selection criteria. Mandingo, Wollof, Serehule, Fula and Jola villages were selected. Villages were purposely selected in portions of the country where livestock were concentrated. A sample of 46 production consumption units were selected. Enumerators were posted in the villages, enumerator supervisors were selected and the survey was carried out.

The survey instrument used for data collection was the FAO Farm Management Data Collection and Analysis System (FMDCAS).

The instrument was designed to handle large detailed farm level data bases obtained through frequent interviews.

Due to the nature of the FMDCAS program, a large mainframe computer was deemed necessary to treat data. It was decided processing would be done at Colorado State University on the CYBER because no main frame computer was available in The Gambia.. All data was transferred from questionnaires to code sheets and forwarded to CSU for processing. This became a cumbersome process in terms of turn around time necessary to receive, transfer, process and return data back to The Gambia. As a result analysis was slowed down and problems in use of the FMDCAS for proper analyses were not recognized during the two year data collection period.

During the third year mini-computers were purchased by the project and brought to The Gambia to expedite the analysis. These computers were helpful in assuring immediate correction of errors in collected data. However, initial draft reports produced for the study were unacceptable and responsibility for writing and editing the final draft of the report was shifted to the Project Director at Colorado State University. To present data and results in a more reliable manner, major modifications in use of the FMDCAS had to be made. Although this resulted in considerable delay in publishing this project report, a better quality product resulted (see Mixed Farming Technical Report No. 10, "Farming Activities in The Gambia") This report will be of long lasting use to the Departments of the Ministry of Agriculture and the Gambian Government as a source of reliable data about farming systems in The Gambia. It should be especially useful in future planning and agricultural policy development for the country.

Component No. 6:
Agricultural Skills Training and Communications.

This was the final component in the Project Paper. It was included as a support activity for the other components to insure adequate training of DOA, DAHP and PPMU research and extension personnel. This was especially important for Gambians working with expatriate MFP team members who were expected to carry on national agricultural programs at completion of the Mixed Farming Project.

Initially it was proposed that MFP team members would spend considerable time in class room teaching at the Agricultural College at Yundum. However, shortly after arrival, the GOTG closed the school due to the problem of an excessive number of MOA employees. It was deemed impractical to train new agriculturalists when there would be no new jobs available. This condition existed for three years after which time training in agriculture was reestablished in January 1984 at the new Gambia College near Brikama. The new program at the College concentrated on in-service training of Agricultural Demonstrators rather than pre-service training.

A committee composed of DOA, DAHP and USAID personnel made the initial selection of eight participants for long-term degree training in the United States. This was done prior to arrival of MFP personnel in The Gambia. Selections included two in agronomy and one each in range science, rural sociology, technical journalism, extension education and animal nutrition. In addition three participants were selected for two year certificate level training in animal husbandry in Nigeria.

The MFP team had no opportunity to work with these participants prior to their departure even though they were expected to be eventual counterparts for the component programs. As a

result the expatriate team, with the exception of the agricultural economist worked with counterparts with less than degree training for the first two and a half years.

Since teaching assignments at the Yundum Agricultural College did not develop, the MFP team concentrated in the first two years on in-service training for agricultural assistants, agricultural demonstrators, pasture assistants, enumerators and counterparts.

EARLY MID-PROJECT EVALUATION AND REDESIGN

An early mid-project evaluation was judged advisable for two reasons. First, an evaluation was necessary as a prelude for bringing the authorized PACD and funding ceiling in line with contracted work loads. Second, there was a recognized need to fine tune the scope of work in order to integrate and streamline activities.

The mid-project review was conducted by an AID contract team. Since CID, as a matter of policy, had also planned its own mid-term evaluation and had selected a team, the two teams conducted their reviews at the same time. However, each team wrote its own separate report.

The AID evaluation team found that the project's design as reflected in the Project Paper was excessively complex and placed too large a burden on the technical assistance and counterpart personnel in terms of planned activities. It proposed a modification of the project's definition, concentrating on three production thrusts in maize, forage and range management, in an integrated manner through village trials. Training and socio-economic data collection was seen to directly support these technical thrusts.

In evaluating the socio-economic component the team found the field data collection on the baseline and intensive village studies proceeding in a timely manner but behind schedule in data processing. The delay in data processing was due to inadequate expertise in the field team and slow turn around of data processing at Colorado State University. Concern was also expressed that there had been no provision in the Project Paper for analysis of market conditions and potential for maize and

livestock. This was viewed as a serious oversight in the project design.

Specific Recommendations of the USAID Evaluation Team

The evaluation team recommended the project be continued through a full five years of field operations. The technical assistance team and the PACD were extended to March 31, 1986. Specific recommendations made by the USAID evaluation team included the following:

A. Production

- Continue the maize commercialization program for at least two seasons;
- Begin village trials of farming practices integrating maize with forage and range management;
- Increase cooperation on crop residues, grazing and feeding trials;
- Accelerate work with LOAs in range management;
- Add small components of : human nutrition with emphasis on maize; animal nutrition for cattle and small-ruminants; and agricultural implements research and development;
- Eliminate the farm carts sub-component;
- Eliminate working on program of legislated, controlled grazing areas with necessary stock access routes.

B. Training

- Complete planned ten long-term participant traineeships;
- Limit short-term training to that which can be effected in the course of project activities of technical assistance staff;
- Undertake no intensive training in the use of remote sensing imagery and maps.

C. Data Collection and Analysis

- Complete the national land-use map set;
- Add short-term specialized farm management agricultural economist to socio-economic unit;
- Provide two year long-term marketing specialist to project team to conduct maize and livestock marketing studies;
- Replace data processing at CSU with in-country processing on micro-computers.

D. Administration

- Continue six long-term TA positions through extended life of project;
- Eliminate GOTG handling of AID funds;
- Accelerate data processing in the field and U.S.;
- Improve project management by adding an administrative assistant to free Chief of Party for substantive work;
- Assure efficiency of operations by judicious replacement of equipment and addition of office space and up-country quarters;
- Prepare complete quarterly financial reports to assure judicious use of funds;
- Avoid discontinuity by timely replacement of departing TA staff and provision of new TA inputs.

YEAR THREE: A TRANSITION YEAR

In view of the recommendations of the mid-term evaluation team a number of adjustments were made in the Mixed Farming Project program.

A senior agricultural economist from Washington State University was hired for a short term consultancy to provide expertise in socio-economic data analysis. He was later selected in July of 1984 as the MFP team agricultural economist for the final two years of the project.

An agricultural marketing specialist from Colorado State University served two short term consultancies to conduct marketing surveys and prepare a preliminary report on maize marketing potentials in The Gambia (CR-3). He was later hired to fill the two year long-term position of MFP marketing economist.

A senior rural sociologist from CSU served a short term consultancy to assist in developing the sociology component of the final two year workplan for the Project.

A former Peace Corp Volunteer who had worked with MFP and Women's Societies in promotion of maize production and use of maize in the rural Gambian diet joined MFP on a one year contract through CSU as the human nutritionist and women's program coordinator.

A CSU computer specialist was brought to The Gambia on a three week assignment to design a micro-computer operation. A computer room was prepared, a Compaq and two IBM computers, plus Epson and Qume printers were installed. A Peace Corps Volunteer with an MS Degree in Agricultural Economics from CSU and consi-

derable experience in computer programming and operation was reassigned from the South Pacific to Banjul and joined MFP to run the computer center.

Courses in computer operations were conducted, Gambian staff members were trained, and the project soon became self sufficient in data input and analysis. Establishment of the computer operation proved to be an outstanding success and an important improvement in efficiency in terms of rapid data analysis and use of computers as word processors in report preparation (TR-15).

The CID Women in Development (CID/WID) Program provided MFP with a two month fellowship of the services of an animal scientist from California State Polytechnic University at Pomona who was a specialist in small ruminants. After a thorough evaluation of the Gambian situation, she provided a useful report explaining the difficulty in trying to modify the project to include a sheep and goat component with only two years remaining in the program (CR-4).

During the third year transition period, effort was concentrated on : finishing the in-depth farm management data collection (TR-10), completing reports on the initial forage agronomy (TR-2) and maize production programs (TR-3); commencing village livestock feeding trials; bringing in new staff members to replace the original team members in forage agronomy, maize agronomy, agricultural economics, and rural sociology; and commence planning and carrying out the integrated maize-forage-range management village programs recommended by the mid-term evaluation team.

LAST TWO YEARS: INTEGRATION AND COMPLETION

In developing an integrated work plan for the final two years of the project it was realized it was time to consolidate and stress those activities which would have the highest pay off. Tangential activities were phased out and few new thrusts were started.

It was recognized that the Ministry of Agriculture had constraints in its capacity to implement intensive programs in the field. Furthermore, these limits (inadequate budgets, lack of mobility, poor incentives in the civil service, shortage of trained staff) were likely to prevail, in view of the national economic outlook, for an extended period. Even though the project continued to strengthen the Ministry of Agriculture Departments through formal training, on-the-job collaboration, and providing assistance in data and policy analysis, it was not expected there would be any significant institutional reform during the life of the project. Therefore, technologies designed were those that could be extended easily through a combination of modest governmental support and strong farmer acceptance. The plan stressed appropriate technology farmers would continue to use and carry out regardless of government support.

As previously stated, the goal of the project was "to increase the economic well-being of the rural people through more intensified integration of crop and livestock production within existing Gambian farming systems". It was decided by the team to de-emphasize the word "economic" as the project entered its final two years since many project outputs impact rural people's lives in areas not now monetized and are thus hard to value economically. Greater dietary diversity, stability in livestock

husbandry systems and increased consumption of animal proteins are examples of benefits not best described in economic terms. The project continued to emphasize integration of crop and livestock systems. Attention was focused on appropriate incremental changes rather than wholesale replacement with modern technology.

With the project goal of increasing the well-being of Gambian rural people as the constant guide, three core activities were stressed: 1) Maize Production and Utilization; 2) Range Management and Forage Production; and 3) Agricultural Development Support Services (previously known as the Socio/Economic Unit). Plans were developed for each activity stressing purposes, strategies, outputs and implementation procedures.³

The three core plans were developed to illustrate vertical relationships within activity areas. All stated purposes related directly or indirectly to the common overall project goal. In combining the many activities of the project into aggregate activity areas, the plan emphasized interdisciplinary collaboration in contrast to the discipline - specific work plans set out in the original project paper. Many of the outputs required collaborative interaction of several individuals.

Social science activities were grouped under Agricultural Development Support Services (ADSS) to emphasize their primary role of collaboratively supporting the technology development, testing and extension role. All of these activities were done with biological and social scientists interacting closely together. In addition social science skills were involved in assuring that final technical packages were appropriate to small

3. "An Integrated Work Plan for the Final Two Years of the Mixed Farming Project" Special Administrative Report by the Project Team, April 1984.

farmers with respect to economic returns, risk minimization, low cash outlay, and cultural acceptance.

The villages of Boiram/Njoben and Piniai/Choya were selected and used as a test of the integrated package as an overall strategy during 1984 and 1985. Good cooperation was received by the villagers in helping to develop the integrated village trials and providing necessary information for evaluation.

Maize Production and Utilization Thrust

The maize production program proved to be highly successful. More farmers planted maize and the hectares planted increased from 2,600 in 1983 to 10,000 in 1984 and to 18,000 in 1985. Farmers were quick to realize maize was a fast maturing crop, required less labor to produce, stored well and was a good alternative cash crop. Yields of 2 to 2 1/2 tons were common and there was a ready free market with higher prices than those being offered by the Gambia Cooperative Union (GCU).

During the life of the project over 300 Agricultural Assistants (AAs) and Agricultural Demonstrators (ADs) were provided training on how to deliver the maize technology package to farmers. MFP cooperated with FAO to conduct numerous field days where farmers were brought to view maize trials both with and without recommended levels of fertilization. In the final two years of the project, training efforts were directed largely toward farmers.

In 1984 the project sponsored a field day at Yundum Experiment Station which brought research and extension personnel and farmers together to see the results of research (especially maize/legume intercropping trials) and to discuss, face to face, farmers' problems in crop production.

Maize/legume intercropping trials had been conducted on the experiment stations in 1984. As a result of the field day at Yundum, farmers wanted to test intercropping on their own fields in 1985. Fifteen intercropping trials were conducted throughout the country with varying success. In general, farmers were pleased with the maize yields but late maturity of cowpeas coupled with insect problems resulted in minimum yields for this intercrop. Further trials on station with short maturing varieties are planned for 1986.

With the rapid expansion in maize production, providing Gambian farmers with adequate quality seed has been a serious problem. Attempts were made by the MFP to help solve this situation. In 1983 two hectares of maize were raised at Sapu under flood irrigation during the dry season. A yield of five tons per hectare was obtained. In 1984 farmers were contracted to raise 33 hectares for certified seed in the Gambian Opportunities Industrial Center (GOIC) area on the north bank. Although fair yields were produced, the DOA could not agree on a premium price to farmers and the bulk of the maize was sold in the open market for food.

An attempt to raise maize for seed and carry out intercropping trials was made in 1985 in the Yundum area using sprinkler irrigation during the dry season. An agreement was reached with a group of farmers to provide water from their wells and water storage system. Although some seed was produced, this trial was a physical and economic failure due to fuel shortages, pump breakdowns, inadequate water supply and reluctance on the part of the farmers to live up to their commitments.

Pre-emergence herbicide Primagran 500 FW containing Atragen + metachlor applied at 2 1/2 litres per hectare was tested on a 1.75 hectare plot for NCB maize seed multiplication at Yundum in 1985. Weed control was excellent. No hand or mechanical

weeding was necessary and yield was 3 1/2 tons per hectare. Use of herbicides to reduce labor requirements for weed control could become important in The Gambia. Further testing and economic evaluations are needed. The test provided a six ton supply of quality seed for the 1986 season.

Quality seed production in adequate amounts for all varieties of crops continues to be a serious impediment to increasing agricultural production in The Gambia.

The initial maize technology package recommended maize be planted in rows 90cm X 30cm with two plants per space to obtain the best plant density and yield. Further testing on experiment stations showed that planting in rows 75cm X 30cm with one plant per space produced greater yields. Also, this spacing resulted in more efficient use of the Sine Hoe and MFP cultivator. The technology package was modified to include this recommendation in 1985.

Maize variety testing on the experiment stations was continued throughout the life of the project but with special emphasis in 1984 and 1985. Yellow varieties (NCB and Jeka) continued to produce the best yields. However, five white varieties provided by CIMMYT were tested and three proved promising. Continued testing of these varieties is recommended.

Weed control in production of maize is one of the most serious problems facing the farmer. In an effort to resolve this problem, MFP agronomists working with farmers, DOA agricultural engineers, and a farm machinery company in Senegal developed an oxen drawn, over-the-row cultivator. Nine prototypes were produced and tested in 1984 and '85. First year testing showed that some modifications were needed. These changes in design were made, improved training for farmers and ADs was carried out and farmer trials were carefully supervised through

the time of second weeding. Three farmers with well fed and trained oxen used the cultivator for field preparation, planting and cultivation. No hand weeding was done. The farmers stated that the cultivator was ideal for The Gambia and they were anxious to own one. Other farmers were less successful in its use due to poorly trained and/or smaller sized oxen. Their general complaint was that without large healthy oxen the cultivator was still too heavy. In spite of these perceived problems eight of the farmers wanted to use the cultivator again in 1986. Selected farmers should be allowed to continue to use the prototype MFP cultivators and further evaluation should be made.

To improve mobility of AAs, ADs and Pasture Assistants to better serve the farmers in carrying out extension work, 23 motorcycles and 135 bicycles were sold through MFP to the extension workers by deducting monthly payments from salaries. The remaining 46 motorcycles were allocated to SEU enumerators, Peace Corps Volunteers and/or used in motorcycle replacements.

The MFP maize agronomists were instrumental in getting farmers to form regional and national Maize Growers Associations. These associations have the potential of assisting farmers in obtaining fertilizer and seed and in working with the Government to set higher floor prices for maize. Over 4000 farmers have become members of the associations.

One important component of the MFP integrated program package was a fertilizer revolving fund scheme or Kafo credit scheme. This scheme was tested on a pilot basis in the 1984 season in the integrated program villages of Piniyai/Choya and Boiram/Njoben. Six Kafos of 10 members each were formed. Fertilizer was provided on a revolving fund credit basis and each Kafo grew 10 hectares of maize (1 ha per member). This program was lauded by the farmers. They were able to have a maize

program and they were generally satisfied with production from fertilizer inputs. However, credit repayment by the Kafos proved to be a problem. Repayment varied by Kafo, ranging from 0 to 74% with an average collection rate of 33%.

Despite the problem of collecting the loan, the MFP decided to go ahead with the scheme in the second year. Five kafos were reorganized to totally eliminate the farmers who defaulted. Fertilizer was issued to members based on how much each had paid back in 1984. Thus some members received far less than the recommended fertilizer requirement for one hectare of maize. However, all who received fertilizer participated fully in the scheme. Loan collection for 1985 improved in the three kafos in the Boiram area who repaid 100%. However, the two kafos in Piniai and Choya failed to repay anything. The three kafos in the Boiram area are well established. Since credit for farmers to obtain seed and fertilizer inputs is so important, effort should be continued to develop reliable farmer managed credit/repayment schemes in The Gambia.

Nutrition and the Women's Program

A full time human nutritionist who also served as women's program coordinator was hired by MFP in 1984. She and her counterpart concentrated on bringing women, food production and consumption together into one program with the major goals of increased production and decreased malnutrition. Life expectancy in The Gambia is among the lowest in the world at 36 years and infant mortality is among the highest at 194 deaths per 1000 births. The years between birth and age five are the most critical in terms of nutrition risk. Proper nutrition for both mother and child are of utmost importance during this period.

In 1984 the nutritionist and her counterpart worked with 78 women's societies to grow maize. Each society grew 1-3 hectares of maize.

To reduce women's labor in maize preparation, 50 hand shellers, 39 small hand mills, and 11 large hand mills were distributed by MFP to villages throughout the country. Work was also done with FAO and the U.S. Embassy self-help program to distribute a limited number of diesel powered mills. (Although the power mills make the milling task much easier, problems arise such as: initial cost of mills, high cost and poor availability of fuel, expense and lack of spare parts, village management, etc.). Hand and power mills have helped. However, milling of grains into an edible form remains a significantly heavy work load in terms of necessary time and effort input for village women.

Working with the Training Unit of DOA five sessions were conducted to train a total of 35 female extension personnel in proper nutrition practices and principles. They were shown how to prepare eleven maize and maize/cowpea recipes and how to demonstrate their preparation to village women. Representatives of Save The Children and other private organizations also attended.

Fifty five village cooking demonstrations were held in 1984-85. (30 had been held in the three previous years). The cooking demonstrations involved some 8,500 women participants. A follow-up evaluation one year later found that an average of three of the 11 recipes were being commonly used by the village women. Of special interest in terms of child nutrition was the frequent preparation of weaning food. (TR-4)

Working with EAU, recordings were made on audio tapes of the eleven recipes in Mandinka, Wollof and Fulla for playing in village training sessions. In addition EAU published the recipes in Mandinka in an extension bulletin entitled "Tubaanou Tabiri Siifaalu" 1986. In July of 1985 the MFP nutritionist completed her assignment and returned to the States. Her well trained and competent Gambian Counterpart took over the leadership as the Women's Program Coordinator for the remainder of the project.

During the 1985 growing season 28 women's societies were actively involved in maize/cowpea intercropping trials. Serious problems arose with respect to seed supply. Cowpeas of unknown variety and maturity had to be used as a result. We also tried to reach too many societies to provide proper supervision. Results were disappointing. However, in the few societies where short maturity varieties were used, the women farmers were well pleased. Even in societies where cowpeas failed to mature, women wish to repeat the demonstrations in 1986 with proper maturing varieties. In general maize production from these intercropped fields was satisfactory.

In June 1985 the CID/WID fellowship program provided a two month short term agronomy consultant. The purpose of the CID/WID agronomy fellow was to conduct maize/cowpea intercropping trials at Yundum Experiment Station. However, inadequate seed of the early maturing varieties, excessive rains, and inadequate insect control resulted in disappointing production (CR-5).

The CID/WID fellow agreed at the end of her two month assignment to stay and work through the harvest season in assisting in the Women Societies intercropping trials. She was employed by the project, with the Ministry's approval for this additional assignment.

Range - Forage Thrust

The Forage Agronomy Unit concentrated its research and demonstrations in two main subject areas: forage introductions, including intercropping experiments, and animal nutrition. The plant experiments were directed toward finding forages and forage cereal combinations that could provide reliable animal feed. The animal experiments tested local crop residues and introduced legumes for their value as dry season feeds

Forage Introduction Trials

In the first two years of the project, the forage effort concentrated on introduction of legumes. Fifteen varieties were tested in plantings at Sapu, YBK and Yundum. Also, half-hectare plantings of various legumes were made at four Mixed Farming Centers, the Mansakonko Rural Development Center and the village of Boiram. Further tests were carried out in 1983 - 85 at Yundum. In total four dozen legume varieties were tested. Even though varieties selected were expected to be adaptable to Gambian conditions, after four years of testing, one half survived and only a few have potential under Gambian conditions.

Factors affecting successful establishment of legumes are: amount and distribution of rainfall; competitiveness with weeds; and resistance to insect and pest attack (including rodents). The forage agronomists concentrated on introduction of legumes rather than grasses because of need for protein in livestock diets and legumes are a crop that fit into local cropping systems whether as fallow or intercropping. Grasses on the other hand are better suited to extensive range pastures where permanent establishment is the goal.

Range scientists concentrated mostly on introduction and expansion of grasses with less emphasis on legumes in developing deferred pasture and range demonstration plots. Thus the forage and range units complemented each other in the integrated program. Forage agronomists confined their attention to cultivated and fallow lands for legume introduction and crop residue production while range ecologists concentrated on improving forage production on the bushlands. At the same time maize agronomists were promoting expansion of maize production to increase human food supply and also to increase maize stover as a dry season crop residue for livestock feed.

The forage agronomists realized that any forage improvement program on cultivated or fallow lands must be done without reducing cereal grain and cash crop production if it were to be acceptable to the farmers. Also the program must not seriously add to the farmers' labor requirements during the busy cropping season. With these constraints in mind various experiments were tested.

The testing of Stylosanthes humata and humilis proved they were well suited for The Gambia. Once established they produce lush stands that suppress weed growth. However, farmers will not grow legume crops for the sole purpose of livestock feed. Therefore, could Stylos be effectively introduced into the cropping system? Unfortunately there was limited seed supply for on farm trials. Seed ordered from Australia was lost in shipment. Most of the seed produced at Yundum, Sapu and YBK was used for seed multiplication expansion.

A technique that appears to work well and doesn't disrupt traditional practices is to undersow with or after the main food crop which is harvested first, leaving the legume more room to continue growing. This method was briefly tested in 1985 at Yundum with maize. (TR-11). Results were promising and further

research on rate of seeding, row widths and time of legume planting is needed.

Cowpea/maize intercropping was tested both on the stations and in cooperation with the human nutritionist in the women's societies programs. Even though results were discouraging due to inadequate supply of seed from known short maturity varieties and inadequate insect control, the technology appears to have potential as well as farmer acceptability. Further testing is warranted.

In 1984, in cooperation with the maize agronomist, maize was planted in bush fallow and in established Stylosanthes plots at Sapu with the intent of comparing production between legume and bush fallows. Small strips were cleared and maize planted. In both cases the strips proved to be too narrow. Rapid regrowth of both the bush fallow and stylos crowded out the maize. In addition it was a year of severe drought. Further testing is needed using wider strips and normal weeding practices to evaluate if there is a measurable nitrogen fixation effect from legume fallow versus bush fallow.

Alley cropping with the leguminous shrub Leucaena and cereal crops is another potential intercropping system that has been successfully tested in other African countries. Due to a single rainy season and prolonged dry season, the legume Leucaena does not grow as well in The Gambia as in areas of greater rainfall. Initial attempts to establish leucaena for alley cropping tests were made in 1984 and 1985 but in neither case was there an adequate establishment of leucaena. (TR-7) Further testing should be conducted on the experiment stations at Yundum and Sapu with well designed trials to assure proper leucaena establishment and row spacing.

Clipping trials were carried out on legumes to determine effects of grazing at different periods and different heights on total dry matter production. Results varied between species, height of clipping and period of time between clippings. However, clipping at six week intervals resulted in nearly double the dry matter produced. This indicates that some of these legumes could be used for grazing from August through December for short periods without reducing productivity for dry season grazing. If planted near a village, for example, the legumes could be used to feed draft animals during their major work season and then used for grazing late in the dry season for other livestock. Land tenure problems might create difficulty in establishing these kinds of arrangements.

Crop Residue Feeding Trials

Inadequate nutrition is perhaps the single most important constraint to livestock productivity in the tropics. In The Gambia the problem of inadequate feed supplies is even more severe due to the eight month dry season, decreasing area of swamp and bush lands available for grazing, increasing human and livestock populations, and a lack of research on animal nutrition. The traditional land tenure system with land use assigned by the village chief coupled with communal grazing lands, provides little incentive for farmers to grow forage for their livestock.

From Base Line Survey data reported in MFP Technical Report No 1., an understanding of Gambian farming systems evolved in which livestock production is only one aspect. The small farmer's livestock production goals are usually survival of the animals during the dry season rather than a highly productive performance. Generally little cash expenditure is made on the animal production enterprise.

For these reasons, forage agronomists concentrated their efforts on the harvest, storage and use of crop residues for dry season feed. Feeding trials were conducted from 1982-85 to evaluate readily available crop residues.

Results of the initial trials in 1982-83 conducted at the DAHP Yundum farmyard showed animals gained weight over the four week trial when fed groundnut hay, retained their weight on rice straw, and lost some weight on maize and sorghum stovers and Gamba grass. However, in all cases, the animals retained a healthy and vigorous condition.

The initial tests led to feeding trials mixing groundnut hay with each of the other farm crop residues. In the 1984 trials 16 of the 20 animals registered small weight gains. These trials were repeated in 1985. The average daily intake was equal for the feed combinations. The heifers essentially maintained their weight with minimal gains or losses. The tests showed that any of the crop residue combinations would maintain the animals during the critical dry season without serious weight loss. Actual weight gains could occur with increased amounts of groundnut hay in the ration.

The Project Paper required testing maize grain as a livestock feed. A trial was conducted using eight four-year-old bulls in which four were fed groundnut hay and maize grain in a fattening ration and four were fed only groundnut hay over a nine week feeding period. Animals receiving the maize grain-groundnut hay mixture gained an average of .8 kg per day and those on groundnut hay alone gained .3 kg. per day. Gains of the grain fed bulls were impressive and the carcasses were of superior quality to animals fed only on groundnut hay. However, without a premium price for the grain fed bulls and with maize priced at human food levels, the feeding of maize grain to cattle would

result in serious economic loss to the farmer. (TR-3, Appendix E)

Other agricultural by-products such as groundnut cake, groundnut dust, citrus pulp and peels, rice bran and cotton seeds and pods were tested (TR-11). Results in terms of animal gain were encouraging. The small quantities of these by-products available in The Gambia make their use for cattle feed rather insignificant.

The MFP crop residue feeding trials have shown that animal weights can be maintained over the dry season particularly if groundnut hay is included as part of the ration. A major extension effort is needed to help farmers understand the value of crop residues with special emphasis on the value of groundnut hay.

Forage Analysis Laboratory

A start was made toward establishing an animal nutrition laboratory. A Wiley Mill (for grinding samples), a drying oven, a blower for the hood so the Kjeldahl unit could be used, an atomic absorption spectrophotometer and various chemicals were purchased. This equipment was installed in the Yundum soils laboratory. A Gambian sent to the U.S. for training in plant analysis and animal nutrition returned for the final two years of the project. Although only a limited supply of chemicals were available, over 400 samples were analyzed for dry matter and crude protein. For an adequate forage agronomy program, The Gambia definitely needs a well supported forage testing laboratory.

Crop Residue and Deferred Pasture Feeding Program

In the final three years of the project the three components (Maize, Forage and Range) unified their efforts to assure a year round adequate supply of forage for the livestock, a major purpose of the MFP. The scheme, with flexibility depending upon quantities of farm crop residues harvested and stored and deferred pasture is to: graze bushlands from late June through October; graze both bushlands and harvested croplands from November through February; feed stored lower quality farm crop residues (maize and sorghum stovers and rice straw) from March through mid April; graze deferred pastures until rains start in late June and by early July start the cycle over returning to graze the bushlands. If available, stored groundnut hay should be fed from the last week of May through late June.

The range ecologists, in the last two years of the project, concentrated on implementing the farm crop residue/deferred pasture feeding programs in the villages of Boiram/Njoben, Sukuta/Tuba Kuta, Piniai/Choya and Makama Sireh. In all these villages, deferred pastures of 10 to 15 hectares were fenced as well as crop residue storage areas.

In the 1984 feeding trials at Boiram/Njoben, the 20 selected heifers were started on farm crop residue feeding in January. However, periodic weighing of the animals showed that the control group grazing on bushlands and harvested crop lands did not start to lose weight until March. Therefore, feeding farm crop residues starting in January was not necessary and resulted in requiring much larger volumes of harvested residues.

In 1985, the start of residue feeding was delayed until March 8th. The plan was to feed maize and/sorghum stover for the first month until stored supplies were exhausted. The

animals were then to go on deferred pasture in mid-April, remain on deferred pasture until the first of June and then be fed groundnut hay, if available, until rains rejuvenated the bushlands in late June or early July. However, in most of the trials groundnut hay was not available. Farmers were reluctant to provide groundnut hay for the feeding of community animals. Also when groundnut hay was stored it often disappeared (stolen at night) and was used for feeding of draft animals. As a result the fed heifers remained on the deferred pastures until late June when they were turned back with the herd.

The Boiram/Njoben feeding trial started in 1984 with 20 fed heifers and 20 heifers (control group) traditionally run on open rangelands and harvested croplands. In 1985 only 13 of the fed animals and 15 of the control animals were available for the second year. Difficulties were encountered in monitoring the control group. Cattle herds left the Boiram area in March in search of food and of the 15 weighed on March 8th only 3 were available to weigh on June 28th, the last day of the trial.

For the 1986 feeding trial 13 of the original fed animals, seven new heifers and none of the control animals were available. Final results were not available by the end of the project but in general the farmers were well pleased with the condition of the fed animals in comparison to the control group.

In the 1985 feeding trials at Boiram/Njoben, Sukuta/Tuba Kuta and Makama Sireh, ninety heifers were fed a total of 99 days. In Makama Sireh the heifers went directly on to deferred pasture for the total time but there were no scales to weigh the animals. The 39 head at Sukuta/Tuba Kuta and Boiram/Njoben were weighed every four weeks and they gained an average of five kilograms for the period. The limited number of control animals available for weighing prevented reliable comparisons. The physical appearance of the fed animals was far superior to the

control group. Forty-eight stockmen participated in the program and provided the 90 heifers.

Unfortunately at Piniyai/Choya the stored crop residues and deferred pasture were totally destroyed by fire on March 10th, 1985 just 3 days after starting feeding of 23 heifers. All stored maize, groundnut hay and deferred pasture was destroyed. However, the livestock owners were anxious to repair fences and make sure the program was continued in 1986. Farm crop residues were stored, a large fire break was made by the farmers around the deferred pasture and 33 heifers were started on the program on March 8th, 1986.

Supplemental Crop Residue Feeding Programs

In 1985, in addition to the deferred range/crop residue feeding programs which were implemented by groups of farmers from several villages. Supplemental crop residue feeding programs were started in villages where no deferred pastures were available. Nine villages participated. Village storage units were constructed using fencing materials provided by MFP. Maize stover and rice straw were stored and not fed until the last six to eight weeks of the dry season. One hundred and thirty nine heifers were fed for 5 1/2 weeks in May and June.

In 1985 a one month delay in rains (until the last few days in June) resulted in a very dry and stressful period for range livestock. More dead animals from starvation were observed in June 1985 than had been seen in the previous four years. This resulted in farmers becoming much more aware of the need for harvesting and storing farm crop residues. Farmers who observed the condition of animals on the feeding trials were impressed. As a result 19 additional villages requested inclusion in the crop residue storage program for 1986. Also, it was very encouraging in URD and MID to observe the number of farmers who

stored maize stover in their own compounds. Ultimately this was a major goal of MFP to get farmers to individually store crop residues for their livestock. In this way they have the opportunity to balance the feed ration between stovers, rice straw and groundnut hay. In the village of Mamu Fana, one farmer reported he had saved so much maize stover for his livestock that he was selling part of his groundnut hay as a cash crop to traders from Dakar, Senegal.

With the Mixed Farming Project entering its final year, the 1986 supplemental crop residue storage program was left exclusively with individual Pasture Assistants to organize and assist stockmen with implementation. Individual initiatives taken by Pasture Assistants are an important key on how farmers perceive harvesting, storing and later feeding residues to their livestock. Expansion in the number of participating villages is a tribute to the motivation of these extension workers and their dedication. Their continued support by the DAHP is important to the continued success of the crop residue feeding and range improvement program.

Range Inventory

In 1985, for the first time in four seasons, two mobile range inventory teams were possible with the assistance of a short term range technician. The range inventory was expedited and all field work was completed on January 17, 1986. Over the four years, fourteen districts including 18 administrative units were inventoried in MID and URD. This covered 485,845 hectares and required 1,322 samples (writeups) to be collected. Information from the writeups was entered into a computer program and results were tabulated, land use maps prepared and a final report completed. (TR-17). This has been a time consuming and arduous task. It provides a range resource base of value to present and future planners and resource managers in The Gambia.

Seed Multiplication and Root Transplanting

As the range ecologists entered into the fifth year of working with seed multiplication at YBK and Giroba Kunda they became more and more convinced the best range forages for The Gambia are the native grass Andropogon gayanus (commonly known as "Gamba" or "Waa" grass) and Cenchrus ciliaris (common name buffel grass). Major emphasis has been placed on these two species.

Root transplanting of gamba grass has been done over the past four years during the month of August, the peak rainfall month. In 1985, nineteen truck loads of plants were transplanted by farmers in the range plots at Boiram/Njoben, Piniai/-Choya, Sukuta and the ITC Solo site. Reseeding of gamba grass was carried out in five demonstration plots and three of the deferred pastures. Difficulties were encountered in getting the busy farmers to weed the seeded gamba grass. Young seedlings must be weeded within the first four weeks following emergence in order to successfully compete with annual grasses and forbes. Heavy rainfall in 1985 increased on-farm labor requirements at the critical time for weeding the gamba grass. Constraints on farmer labor available in August for the range seeding program will continue to be a problem.

Livestock Accessways

Three livestock accessways to The Gambia River were completed. The project furnished shovels, pickaxes, wheel barrows, cement and construction rods and hauled sand and rocks to the site. The stockmen furnished all the labor and the accessways were constructed under the supervision of the MFP maintenance foreman. It was hard work and took a great deal of cooperation but farmers commented they had never seen such a good job of con-

struction. The accessways will provide a maintenance free source of livestock water for years to come.

In addition to the accessways, MFP provided assistance and funds to renovate an old village well at the Piniai/Choya deferred pasture. The well now provides water for cattle both inside and outside the deferred pasture area. Also, concrete watering troughs were constructed by MFP in all the deferred pastures.

Range Plants Herbarium

A quality herbarium has been established with 348 plants collected, dried and mounted of which 316 have been identified to specie. The herbarium will be a valuable source for teaching plant identification in The Gambia.

Socio-Economic Thrust

In the first three years of the project the agricultural economists and sociologists concentrated on meeting the Project Paper's requirement of a national baseline survey of Gambian farming activities and an intensive two year farm management study of nine villages and forty six compounds. These activities were completed in 1984 and the replacement agricultural economist, rural sociologist and new marketing specialist then shifted program direction. The emphasis then focused upon resolving difficulties in data processing, carrying out recommendations of the mid-term evaluation and concentrating on activities outlined in the MFP integrated workplan for the final two years.

A major effort was to integrate the rural sociologists and agricultural economists into the Program Planning Monitoring Unit (PPMU). This was accomplished and the work plans in 1985-86

were functionally identical for rural sociology, agricultural economics and agricultural marketing for both MFP and PPMU.

The component had a productive final two years in meeting the purposes and outputs in the integrated work plan. The report on "The Gambia Mixed Farming Systems" was finalized by the Project Director (TR-10). The report included analysis of data from the baseline survey (582 compounds in 89 villages) and the intensive village farm management study (46 compounds in 9 villages over 2 years).

Evaluation of the integrated program in Boiram/Njoben and Piniyai/Choya villages was completed in 1986. Data for this study were obtained using The Gambia Agricultural Data System (GADS) which was developed by the senior agricultural economist and the PCV computer specialist in conjunction with PPMU personnel. It has been recommended by a statistical consultant team for The Gambia Agricultural Research and Diversification Project (GARD) that this system be adopted for The Gambia for reliable farm management data gathering. Special training was provided to eleven enumerators and PPMU staff in the use of GADS. A users manual has also been produced (TR-20).

A two week marketing short course was conducted by the MFP marketing specialist and his colleague from CSU. Eighteen participants including personnel from government agencies, parastatals and private enterprises attended. The course was well received and requests were made for follow-up courses.

The rural sociologists completed their study of livestock owners associations (TR-5). The findings indicated livestock owners were enthusiastic and willing to use certain drugs for their livestock, develop water sources and work on forage improvement. LOAs have languished, not from lack of interest or

capacity, but due to lack of effective technical assistance and materials from appropriate government agencies.

Agricultural marketing news was commenced on March 25, 1985 through cooperation of MFP, PPMU, EAU and Radio Gambia. The broadcast, in five local languages, covers prices of grains, fish and seasonal products from six key markets of Banjul, Serrakunda, Brikama, Farafenni, Bansang and Basse. This program received widespread interest from both farmers and urban dwellers.

Inadequate price information was identified as a severe constraint in conducting agricultural marketing research and analysis. The MFP and PPMU set a priority of gathering, analyzing and disseminating market price information. This culminated in the marketing specialist preparing a handbook of graphs and tables of market prices from 16 rural and urban markets for selected agricultural products (TR-6). Data for the handbook was collected by MFP enumerators from May 1984 through April 1985 on grains and livestock. It has been a useful first step in providing much needed price information on a national level.

There are two main competing marketing channels for cattle in The Gambia, the Livestock Marketing Board (LMB), which is a parastatal organization, and the private trade. A survey of livestock dealers was made by members of the MFP staff in 1985. A comparison between the two sources of marketing for farmers was carried out. In general it was determined that the livestock merchandising process is competitive and economically efficient. In the baseline survey, 81 percent of farmers who had recently sold cattle expressed a strong preference to sell to private dealers, while 12 percent preferred to sell to LMB (TR-1).

A herding study was conducted in four widely separated villages from June 1984 to May 1985. The villages were Jakoi

(WD), Piniai (MID), Sukuta (MID) and Lamoi (URD). The purpose was to determine patterns of herd management and production over time for four locations (TR-16). Herding mechanics, watering, grazing patterns and inventory changes were studied. In addition, use and distribution of herd products including milk, manure, draft power and meat were evaluated. This evaluation also looked into use of livestock as a source of cash for emergencies and as a store of wealth like a savings account. All of these functions influence livestock owners' response to development initiatives.

A land tenure study was completed (TR-19) which examined men's and women's rights to land and tenure on grazing land as well as cropland. It was found even though grazing land is an open common to which all Gambians have free access there is little conflict over grazing areas. Also traditional tenure customs regulating use of crop land have been flexible enough to permit reasonably efficient reallocation among producers.

An evaluation of the acceptance and benefits of the farm crop residue/deferred grazing program and livestock accessway developments was carried out and results are included in the comprehensive livestock report (TR-16).

In view of less emphasis on economic versus social well-being as stressed in the integrated work plan for the final two years, adoption/diffusion criteria were used. Although partial economic evaluations are included, social acceptability and amount of effort required for new technological interventions were also key factors in the evaluation. Results indicate: farm crop residue storage and feeding will probably expand rapidly where maize is being extensively grown; pasture improvements in the form of range reseeding and/or seeding on fallow cropland will probably be most feasible in those villages without intrusion of outside cattle; water accessways, needed in

the eastern third of the country where banks of the river are steep are highly desired but beyond the resources of most villages without outside assistance; and, deferred grazing on anything like a large scale will be difficult under the present land tenure and grazing of the commons situation in The Gambia.

If livestock development interventions are going to depend upon voluntary participation of livestock owners, these owners must be able to see, from their perspective, benefits over the existing system. The values of the traditional owners (milk, healthier animals, increased fertility, herd expansion, stronger oxen, store of wealth) become part of the decision process. This frame of reference on part of livestock owners is in contrast to the goals of commercial producers whose major concern centers on the profit motive.

Nine prototype grain storage structures were constructed to demonstrate storage techniques for maize and other crops for protection against insects and rodent losses. This was a joint effort between the MFP marketing specialist, Crop Protection Service, EAU and Peace Corps Volunteers working with MFP. Traditional materials were used as much as possible and their cost was less than D220 (at the time when the dalasi exchange rate was D5 to the British Pound). The storage structures were not always used as planned but they were generally well accepted by the farmers. Save The Children/USA was pleased with the structures and their potential to reduce storage loss and improve marketing alternatives by storing of grain until prices increased. Their organization is supporting continuation of the program with the assistance of Peace Corps Volunteers.

The senior MFP agricultural economist working with PPMU personnel redesigned the National Agricultural Sample Survey (NASS) for 1985 - 86 and developed the questionnaire and enumerators manual for conducting the survey. He also assisted as an

instructor in the two week course to train PPMU enumerators in the use of the questionnaire. The improved survey is designed to greatly increase reliability of agricultural statistics in The Gambia. A computer analysis program for the NASS is being developed.

A study of live-weight, carcass weights and heart girth measurements was carried out on 3000 N'Dama cattle slaughtered in the Abuko abattoir. Live-weights were obtained using an Avery beam balance scale and carcass weights were obtained using an Avery spring balance scale. The data were disaggregated by sex and age class and detailed statistical analysis carried out. Results were compared to those obtained using a Dalton Weighband, a common tool used in field estimations of live-weight for cattle. (The weighband is a non stretch tape calibrated in centimeters with associated weights in pounds). It was found that even though the Dalton Weighband was developed for European breeds of cattle it is relatively accurate for estimating weights of N'Dama cattle except for old males and young cows. It was concluded in the absence of weighing scales the Dalton Weighband is usable as a reliable method of estimating cattle weights in The Gambia. However, simple linear equation developed in this study provide an even more accurate means of estimating live-weight and carcass weight in the field using only a centimeter tape measure.

A major responsibility of the social scientists on the project was to establish and operate computers for data analysis for all components of the project. A Peace Corps Volunteer knowledgeable in computer programming and microcomputer operation joined the staff. He conducted three computer training courses for MFP and PPMU Gambian staff members in BASIC language, LOTUS data systems and Peach Text word processing. The Gambian computer facility manager was sent to the States for a two month intensive course in computer operations. As a result of these

activities a highly functional computer operation was developed which in time provided an invaluable service to all components of the project in data analysis and report preparation. In addition a cadre of personnel for data entry and analysis has been trained for the Ministry of Agriculture as well as a secretarial staff highly proficient in the use of computers as word processors. With termination of MFP there is concern as to continued support for the computer program.

One of the responsibilities of the social sciences staff in integrating with PPMU was to improve that organization's monitoring capabilities. As a major exercise in carrying out their responsibility the MFP Rural Sociologist worked closely with his Gambian counterpart in PPMU to complete a series of social monitoring studies of the effects of the Jahaly/Pacharr Irrigated Rice Project on the smallholders in the scheme. Enumerators were trained and studies conducted to evaluate : sexual distribution of labor inputs and benefits (SMR-1); impacts of the project on upland crop production (SMR-2); participation and satisfaction with the cooperative societies (SMR-3); and, assessing level of living impacts (SMR-4). The studies served to increase the capability of PPMU as a monitoring unit and also to provide valuable information on the social effects of projects of the magnitude of Jahaly/Pacharr.

Integrated Village Program

In the final two years, efforts were made to integrate MFP field activities through a common objective. The objective was to improve the economic and social well-being of agricultural households in The Gambia through improvements in maize production and improved management of range and forage resources. This was accomplished by combining the many activities of the project into aggregate activity areas and an interdisciplinary approach.

The social scientists shifted their primary role to collaboratively supporting the technology development, testing and extension role. Working with biological scientists they concentrated on: evaluating MFP technology packages and marketing opportunities for outputs of the technical thrusts; collaborating in the design of on-farm trials; and analyzing the various mixed farming systems in The Gambia.

Work of the biological scientists also fit well together. While the primary support for the maize program was derived from the need for cereals for human consumption, the program produced a valuable by-product of stover. The maize and forage agronomists worked together to develop crop residue management practices to enhance dry season feed supplies including maize stover and intercropped legumes. The range ecologists worked hand in hand with the program to promote harvest and storage of farm crop residues to fit in with the practice of deferred range use to provide a year long adequate food supply for improved animal nutrition.

The human nutritionist entered into the integrated activities with a dual role; working with Women's societies to promote maize production and organizing village cooking demonstrations to improve the nutrition level of rural Gambians diet with special emphasis on the use of maize in a variety of recipes. Maize/cowpea trials were also tested with the women's societies to determine the possibilities of producing a dual cereal crop.

Agricultural engineering skills were used to improve the maize production thrust through development of the MFP cultivator as well as testing village and household maize grinders.

In the culmination of the project, a video specialist was brought to The Gambia to produce a video tape that both visualized and explained the Gambia Mixed Farming and Resource

Management Project as to its complexity, its acceptance by rural people of The Gambia and the effectiveness of the technological interventions in the integrated village programs. The EAU developed a 16 mm movie on the project which, in addition to English, is being reproduced in Fula, Wolof, and Mandinka for widespread showing in the villages. These two visual aids will be valuable for training of agricultural extension personnel and farmers in continuing to carry out the programs for the Departments that were developed with the assistance of the Mixed Farming Project.

Recommendations and Their Rationale

The following recommendations represent the considered view of the Mixed Farming Team as to activities that should logically be next steps beyond MFP. There are many activities that should follow to reinforce, extend or build upon MFP results. The brief list here are items which need emphasis either because of their importance or because they have yet to be fully absorbed as an official responsibility by any agency. Each recommendation is followed by a brief statement of its rationale.

1. Recommendation: Training of Gambian personnel should continue to receive the highest priority in foreign assistance programming. Technical areas requiring priority emphasis include animal husbandry, marketing, rural sociology, agricultural policy analysis and project/program evaluation and monitoring. Perhaps more important than these, however, the Ministry of Agriculture needs staff at several levels who are trained in management and administration. This skill area deserves the highest priority in the near future.

Rationale: Advanced training of Ministry personnel is a lasting contribution to the development of any African

nation and it is critically important at this juncture in The Gambia. Not only are government programs made more effective, but a significant measure of national pride and self determination is achieved as well. Training levels in The Gambia are a long way from meeting the growing needs of the country. Institutional maturation ultimately depends on technical skills as well as the management and administrative capacity that will permit technical skills to flourish and be well applied.

2. Recommendation: Continued donor assistance is warranted to PPMU. In particular, the Agricultural Market News, the National Sample Survey, project monitoring and evaluation and preparation of policy analyses are important areas needing strengthening.

Rationale: During the recent past USAID, FAO, World Bank and other organizations have assisted in strengthening and supporting PPMU. As a result of this assistance, PPMU has an increased number of trained personnel and in-place computer equipment which will continue to upgrade and improve the data analysis capacity of that unit. Yet several of their programs, which are important to policy formation, are in their early, trial stages and would profit from further nurturing and logistic support. To meet this goal, provision must be made for adequate salaries, computer supplies, computer maintenance and continued personnel training.

3. Recommendation: Effort should be made to determine methods of economically increasing maize yield per hectare. Research is needed in the following areas:

- (a) Fertilization rates based on specific regional or local conditions versus single country-wide recommendations;
- (b) Fertilization rates based on economic returns;
- (c) More effective use of manure;

- (d) Continued testing and release of higher yielding maize varieties;
- (e) Evaluation of the effectiveness and cost of herbicides relative to increasing yield and reducing labor requirements;
- (f) Continued testing, followed by extension, of an appropriate technology for maize grinding and shelling;
- (g) Methods of expanding seed production through premium price strategies to assure an adequate supply of quality certified seed;
- (h) Potential use of maize/legume intercropping and the subsequent development of a technological package based on these findings.

Rationale: Maize production has greatly increased under the MFP/DOA program in the past four years. In order to assure that maize production will continue to progress toward its potential, continued research and extension efforts are necessary. The potential of maize in The Gambia is sufficiently great that donors should provide whatever support the GOTG needs in their efforts to expand hectarage and production nationwide.

4. Recommendation: Continued support is needed for the crop residue utilization effort, in conjunction with programs for pasture and bush management. Effectively functioning bridges are needed between DAHP and DOA, both at the level of senior technicians and with extensionists.

Rationale: In 1985, farmers in MID and URD saved more crop residues than in previous years. Due to recent programs, the importance of saving residues appears to be better understood by the farmers. It appears that the greatest potential for increased forage for dry season grazing rests with increased harvest and storage of farm crop residues of maize and sorghum stovers, rice straw and groundnut hay.

5. Recommendation: Research should be continued on methods of introducing legumes as a livestock forage with minimum labor input. Additional testing of improved cereal legume varieties is critical to finding a variety that will yield well in The Gambia. Further evaluation of Leucaena both as a livestock forage and for use in alley cropping should be continued.

Rationale: The MFP work in undersowing legumes with or after the main crop as well as broadcasting seed followed by trampling with livestock on areas reverting to fallow land shows promise. The resulting practices would be of positive benefit to the farmers. The Leucaena work has shown promise. The considerable time that is necessary to sufficiently establish the Leucaena for adequate testing demands a long-term plan.

6. Recommendation: Additional support is needed to establish a fully functional nutritional analysis capability. Basic beginnings have been made but they need strengthening and expansion. Both DAHP and DOA should have access to this analysis capability.

Rationale: Animal nutrition is the principal problem constraining livestock productivity in The Gambia. Technologies to improve this situation must be grounded in nutritional research. Gambia needs the capacity to perform nutritional analyses on a routine basis on 1) forage plants, 2) native and introduced range plants and 3) farm crop residues. Balanced nutritional programs for year-long maintenance and productivity can then be developed for each major class of livestock.

7. Recommendation: Every effort should be made to fully establish a Range/Pasture Division within DAHP and to obtain adequate financial support for this Division to continue to carry out and expand the deferred pasture/crop residue livestock feeding program.

Rationale: Most of the essential components for an effective pasture and range management program have been initiated during the last five years. These include a good herbarium, range resource inventories, range resource maps for a major portion of the country, professionally trained technical specialists and practically trained pasture assistants. In order to coalesce and focus these resources, a formally organized unit within D.A.H.P. seems essential to provide an institutional home. This type of institutionally backed program focus is essential to ensuring an extendable year-round livestock nutrition program.

8. Recommendation: Continued evaluation is needed on the prototype cultivator developed by MFP. Further research is needed on lighter cultivation equipment suitable to single donkey, horse or oxen draft.

Rationale: Weed control remains a serious constraint in maize and other crop production. The MFP prototype over-the-row cultivator is a first step in developing cultivators which can be used under differing conditions and this research should be brought to a meaningful conclusion.

9. Recommendation: Efforts should be made to carry out the deferred pasture and range reseeding program through herder control and livestock owner management without the use of fences.

Rationale: MFP has demonstrated the productive potential of grasses and legumes if grazing can be controlled in The Gambia. Further demonstrations established the efficacy of both root transplanting and reseeding as range improvement methods. However, these trials were performed in fenced enclosures. The question remains as to whether farmers, acting in concert and without fences, can control grazing periodically to achieve the same results. The answer is yes

elsewhere in Africa. Finding the answer in The Gambia is an important research need.

10. Recommendation: Continued support should be given to maintain and expand the forage seed multiplication sites at YBK and Geroba Kimda.

Rationale: Purchase of seed from Australia and other countries is both expensive and unreliable. Seed produced within the country from varieties with known production records provides higher probability of successful reseeding.

Appendix A
Written Outputs and Conference Presentations

Technical Reports

- TR-1. Alers-Montalvo, Manuel, Fasainy Dumbuya, Glen Fulcher, Baboucar Gai, John Haydu, 1983. Farming Activities in The Gambia, A Survey (Preliminary Report).
- TR-2. Hedrick, Don and Musa Bojang, 1983. Final Report of the Forage Agronomist.
- TR-3. Kidman, Don and Solomon Owens, 1985. The Commercialization of Maize in The Gambia.
- TR-4. Marlett, Melanie and Marie Sambou, 1985. Food Production/Consumption Linkage.
- TR-5. Eastman, Clyde and Momodou O.S. Jammeh, 1985. Gambian Livestock Owners Associations: A Brief Evaluation.
- TR-6. Spencer, William P., 1985. A Handbook of Graphs and Tables of Market Prices of Selected Agricultural Products in The Gambia, 1984-85.
- TR-7. Russo, S., 1986. Leucaena: A Potential Forage Crop for The Gambia.
- TR-8. Spencer, William, J.B. Eckert, P. Jakus, 1986. Estimating Liveweight and Carcass Weight in Gambian N'Dama Cattle.
- TR-9. Eastman, Clyde, 1986. The Cold Hard Realities of Agricultural Development.
- TR-10. Haydu, J., M. Alers-Montalvo, J.B. Eckert, Fasainy Dumbuya, Baboucar Gai, Lamin Jabang, 1986. Mixed Farming in The Gambia.
- TR-11. Russo, Sandra L., 1986. The Use of Crop Residues for Animal Feed in The Gambia.
- TR-12. Russo, Sandra L. and Bambo Ceesay, 1986. Research in Forage Agronomy by the Mixed Farming Project, 1983-1986.
- TR-13. Vesseur, Peter, E.J. Hurkens, Jerry Eckert, Jeanne C. Crouch, and Laurens Mol, 1986. The Gambia Cattle Herd: A Survey Report.

- TR-14. Deffendol, Scotty, 1986. Final Report: Range Ecology Component.
- TR-15. Jakus, Paul and Jerry Eckert, 1986. Microcomputers in the Gambian Mixed Farming Project.
- TR-16. Patrick, Neil, C. Eastman, J. Eckert, P. Jakus, M.O.S. Jammeh, W. Spencer, 1986. The Gambian Livestock System: A Socio-Economic Perspective.
- TR-17. Deffendol, Scotty, Ed Riegelmann, Lauren LeCroy, Alieu Joof, Omar Njie, 1986. Range Resource Inventory of Maps.
- TR-18. Spencer, William P., 1986. Maize Crib Village Demonstration Program in The Gambia.
- TR-19. Eastman, Clyde, 1986. Traditional Gambian Land Tenure and the Requirements of Agricultural Development.
- TR-20. Patrick, Neil, P. Jakus, L. Jabang, 1986. Gambian Agriculture Data System: Users' Manual.
- TR-21. Jakus, Paul, N. Patrick, 1986. A Detailed Analysis of Labor Utilization in Gambian Agriculture: Two Case Studies.

Consulting Reports

- CR-1. Cuany, Robin "Reports on The Gambia Mixed Farming Project" Nov. 9 - Dec 3, 1981 and Oct. 28 - Nov 25, 1983
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Appendix B Training

One of the major MFP goals was to develop and/or train qualified Gambian scientists and technicians to up-grade the educational level of departmental personnel within the Ministry of Agriculture and to prepare Gambian counterparts to carry out project activities. To meet this commitment, the project provided both overseas and in-country training. Eleven Gambian professionals received two and three year university programs in the United States to the BS and MS level. Degrees were awarded in forage agronomy, range science, rural sociology, technical journalism, cereals agronomy, agricultural economics, extension education and animal nutrition. In addition three livestock specialist were provided two year certificate courses in animal husbandry in Nigeria.

Initially it was planned for the MFP team to provide considerable instruction and curriculum revision in the Gambia Agricultural College. The college was closed shortly after the commencement of the project for a period of three years. The team then shifted its emphasis to in-service training of personnel from DOA, DAHP and PPMU. Agricultural officers at all levels in the DOA and DAHP were trained in forage production. Working with the Extension Aids Training Unit 300 agricultural demonstrators and agricultural assistants of the DOA were trained in maize production. Manual laborers were trained at Yundum, YBK and Sapu in seed production, crop production and livestock feeding trials. Twenty five enumerators were trained to carry out the socio/economic and other surveys. Twenty of these enumerators were hired by PPMU in 1985 as the core team for its enumerator staff. Thirty five home extension personnel were trained to conduct village cooking demonstrations with special emphasis on the use of maize in The Gambian diet. Seven pasture

assistants were extensively trained to conduct the deferred pasture/crop residue feeding programs.

Courses to train counterparts and other personnel were conducted in : 1) marketing agricultural commodities, 18 participants, conducted by MFP and CSU marketing specialists; 2) farming systems research and extension, 30 participants, presented by FSSP with MFP support and participation; 3) on-farm experimentation, 30 participants, presented by FSSP and partially supported by MFP; and, 4) specialized courses in computer operation, 27 participants in four courses conducted by MFP.

Task and skill specific training was a routine part of MFP activities involving project personnel. Plant identification, sampling techniques, enumerator training, use of the Gambian Agriculture Data System, social monitoring procedures, marketing processes, village seed store construction and pasture assistant workshops were but a few of these recurrent activities.

In the fourth year of the project considerable training concentrated on bringing farmers and extension personnel together at demonstration plots. These activities were especially productive in training both extensionists and farmers.

Short term non-degree training outside of The Gambia was provided for Gambian project staff. Training visits were made to: 1) CIMMYT for maize production and research training, Mexico (3 weeks); 2) the West African Animal Traction Networkshop in Togo (2 weeks); 3) Seed technology related to tropical forages, Texas and Florida, (3 weeks); 4) Data processing and analysis, CSU (15 weeks); 5) Intensive short-course in computers, Michigan (9 weeks); 6) Animal nutrition and forage analyses, two people (3 months) ILCA, Ethiopia.

Specific training accomplishments are detailed below, organized by type of training.

Formal Degree Training Abroad

<u>Name</u>	<u>Organization</u>	<u>Field of Study</u>	<u>Duration</u>	<u>Location</u>	<u>Degree</u>
1. Solomon Owens	DOA	Crops Science Agronomy	1/81 to 8/83	Texas Tech. Texas Tech.	B.S. M.S.
2. Alieu Joof	DAHP	Range Science	8/81-8/83	C.S.U.	B.S.
3. M.O.S. Jammeh	DOA	Rural Sociology	9/81-6/84	U.of Mo.	B.S.
4. Amadou Jallow	DAHP	Forage Agronomy	1/80-9/83	CalPoly Pomona	B.S.
5. Hassan Sallah	EAU	Tech.Journalism	1/82-6/84	C.S.U.	B.S.
6. Musa M'Benga	DOA	Cereals Agronomy	1/81-12/83	Texas Tech.	B.S.
7. Sana M.Jabang	DOA	Extension Educ.	8/81-8/83	Washington State	B.S.
8. Momodou M'Boob	DAHP	Animal Nutrition	9/81-8/84	West Texas Univ.	M.S.
9. Fasainy Dumbuya	DAHP	Agric. Economics	1/84-12/85	C.S.U.	B.S.
10. Musa Bojang	DAHP	Agronomy	1/84-12/85	C.S.U.	B.S.
11. Omar N'Jie	DAHP	Range Science	1/84-6/86	C.S.U.	B.S.
12. Lamin Bojang	DAHP	Animal Husbandry	4/81-4/83	Nigeria	Certificate
13. Fatmatta Cole	DAHP	Animal Husbandry	4/81-4/83	Nigeria	Certificate
14. Assan Jaye	DAHP	Animal Husbandry	4/81-4/83	Nigeria	Certificate

Informal Training Visits Abroad

This type of activity was not specified in the Project Paper. However, MFP recognized the potential contribution of professional exchanges and short-term training visits for key personnel. The following such programs were completed involving travel outside The Gambia.

1. Solomon Owens
(Maize Program
Leader, MFP)
 - Professional visit to CIMMYT in maize production and research 3 weeks, 9/85.
 - "West African Animal Traction Networkshop," Togo, 2 weeks, 4/84.
2. Bambo Ceesay
(Forage Agronomist
MFP)
 - Study tour to Texas A&M Exp. Station at Beeville and various locations in Florida on seed technology related to tropical forages. 3 weeks, 5/85-6/85.
3. Baboucar Gai
 - Data processing and analysis, main frame and micro computers at CSU. Also presented paper at Kansas State FSR conference. 15 weeks, 1984.
4. Lamin Jabang
(Computer room
manager, MFP)
 - Intensive short courses in micro-computers, including software application and programming languages, 9 weeks, 1985.
5. Lamin Jobe and
Kutubo Sanyang
 - Three months training in animal nutrition and forage analysis at ILCA in Addis.

Formal In-Country Short Courses

The training programs described in this section were either wholly or partly supported by MFP and were delivered in The Gambia.

1. Marketing Agricultural Commodities for Developing Countries. This course has been taught by CSU for 12 years under contract to USDA/OICD as course number TC-140. Bill Spencer and Forrest Walters served as co-directors of this course at CSU. In January 1985, a condensed version (2 weeks) was presented in The Gambia with Spencer and Walters as instructors. Spencer's presence in The Gambia as MFP Marketing Economist permitted incorporating mostly Gambian marketing issues as core materials in the course. Twenty two people attended representing DOA, CSU, GPMB, GCU, PPMU, National Partnership Enterprises, Ministry of Fisheries, Radio Gambia, Crop Protection Services and a few private entrepreneurs involved in export of agricultural produce.
2. The Gambia/West Africa Systems Workshop. This course was presented by the Farming Systems Support Project (FSSP) at MFP's initiation and with MFP support and participation. The course was given March 12-20, 1984, with most of it up-country at Jenoi to get participants away from their desks. Some 30 people attended, mostly from Gambia, but attendees were invited from Senegal, Sierra Leone, Ghana, Ivory Coast and Cameroon.
3. On-Farm Experimentation Workshop. Presented by FSSP, supported partially by MFP, this program was attended by 25 people in May 1985. The course covered methodologies for conducting on-farm experimentation and familiarity with appropriate statistical design for this purpose. The

workshop provided an extended forum for interchange between research and extension personnel as well as for discussion between senior officers and agricultural assistants.

4. Specialized Courses In Computer Skills. As MFP developed a functional computer center, it became necessary to provide specialized training in programming skills and on selected software. Paul Jakus, a Peace Corps Volunteer assigned to the project's computer operation conducted the following specific courses.

<u>Course</u>	<u>Duration</u>	<u>Number in Attendance</u>
Basic language	28 days	7 people
Lotus 1-2-3	20 days	11 people
Word processing	12 days	6 people
STATPAC	10 days	3 people

Job Related Training

Many of the tasks undertaken by the project were new activities in The Gambia. Consequently, periods of training of varying length were included as part of initiating new tasks. Nearly all project staff were involved at one time or another.

<u>Trainers</u>	<u>Subject and Trainees</u>
Bambo Ceesay Sandra Russo Scotty Deffendol Alieu Joof	Plant identification and sampling methods for herding study enumerators.
John Haydu Manuel Alers-Montalvo Fasainy Dumbuya Baboucar Gai	Extensive recurring training in all phases of field data collection using sample survey techniques. Given to 25 enumerators used in Baseline and Intensive Village Studies.
Neil Patrick Clyde Eastman M.O.S. Jammeh Paul Jakus	Training in field data collection requirements and procedures of National Sample Survey and the Gambian Agricultural Data System. Given to PPMU enumerators.
M.O.S. Jammeh Clyde Eastman	Monitoring procedures and survey methods for enumerators at the Jahally-Pacharr project.

Bill Spencer Derek Clifford Kal Juwara	Marketing processes, commodity identification, cattle aging by dentition. Given to market news reporters attached to PPMU.
Bill Spencer	Training in construction of village level seed stores. Given selected MFP Gambian staff and PCVs attached to project.
Scotty Deffendol plus personnel from MFP, EAU, DAHP and ITC	Annual, one week workshop for Pasture Assistants.
Scotty Deffendol Omar N'Jie Alieu Joof	Annual one week workshop for field staff conducting the Range Resources Inventory

Many people improved their skills by participating in the various training activities. The Mixed Farming Project team hopes these individuals will effectively utilize their skills to benefit The Gambia in terms of improved economic and social well being of the rural population.

Appendix C
Construction

During the life of the project there were five houses constructed at New Mile 7 under a contract between USAID, the Ministry of Agriculture and the Public Works Department. These houses were completed by private contractors eighteen months after the arrival of the team and proved to be very satisfactory accommodations.

The Mixed Farming Project, under the management of its maintenance foreman, rehabilitated five offices at Abuko. In addition eight new offices and two rest rooms were constructed. This was accomplished at minimum cost as no contractors were involved.

At the Sapu experiment station the project constructed a rest house to accommodate eight persons. This double round house, constructed at low cost, proved to be invaluable to the team in carrying out up country activities. It also provided much needed accommodation for personnel of the many organizations working in agriculture.

With the completion of the Mixed Farming Project, the houses, offices and rest house constructed under the contract leave a valuable infrastructure for more effective and rapid implementation of new projects in agricultural development in The Gambia.

Appendix D

MFP Personnel

Consortium for International Development, Tucson, Arizona

Johr Fischer	Executive Director (until 1985)
Don Dwyer	Executive Director (since 1985)
Bernie Henrie	Associate Executive Director (until 1985)
Jean R. Kearns	Deputy Executive Director (since 1985)
Jim Hedrick	Comptroller (until 1985)
Eric Vimmerstedt	Comptroller (since 1985)

Colorado State University/On-Campus, Fort Collins, Colorado

Jerry Eckert	Project Director and Agricultural Economist
Betty Eckert	Administrative Assistant
Carol Bermond	Secretary
Robin Cuany	Agronomist, Advisory Team
Donald Jameson	Range Ecologist, " "
Frank Santopolo	Rural Sociologist, " "
Jeanne Crouch	Computer data analyst
Bruce Pflug	Computer data analyst
Lynn Gibson	Computer data analyst
David Harpman	Computer data analyst

In The Gambia

Glen Fulcher	Chief of Party
Jabel Pa Ceesay	COP Counterpart (1981-1984) former Acting Director DAHP (deceased)
Sidney Quartey	COP Counterpart (1985-86), Director DAHP
Manuel Alers-Montalvo	Rural Sociologist (1981-84)
Fasainy Dumbuya	Initial Counterpart Rural Sociologist, (1981-83)
Clyde Eastman	Rural Sociologist, (1985-86)
M.O.S. Jammeh	Rural Sociologist Counterpart. (1984-1986)
Musa Saine	Rural Soc. Ass. (1984-1986)
John Haydu	Agricultural Economist (1981-84)
Neil Patrick	Agricultural Economist (1984-1986)
Mustapha Darboe	Counterpart Agric. Economist (1981-1982)

Baboucar Gai	Counterpart Agric. Economist (1983-1986)
Don Hedrick	Forage Agronomist (1981 - 83)
Musa Bojang	Counterpart Forage Agronomist (1982-1983 and 1986)
Sandra Russo	Forage Agronomist (1983 - 86)
Bambo Ceesay	Counterpart Forage Agronomist (1983 - 86)
Don Kidman	Maize Agronomist (1981 - 84)
Solomon Owens	Counterpart Maize Agronomist (1984)
Amadou Mballo	Project Maize Agronomist (1985-86)
Bill Spencer	Counterpart Maize Agronomist (July 85-86)
Scotty Deffendol	Agricultural Marketing Economist (1984-86).
Omar Njai	Range Ecologist (1981 - 86)
Alieu Joof	Counterpart Range Ecologist (1981 -83)
Melanie Marlett	Counterpart Range Ecologist (1984 -86)
Marie Sambou	Human Nutritionist & Womens Program Coordinator (1984-1985)
Momodou Mboob	Counterpart W.P. Full time Coordinator, (1984-1986)
Lamin Jobe	Animal Nutrition, (1984-1986)
Kutubo Sanyang	Agricultural Assistant Forage Agronomist
	Agricultural Assistant Forage Agronomist

Short-Term Professionals

Lauren LeCroy	Range Technician (July 85 - Apr. 86)
Margaret Norem	Intercropping Agronomist (June- Oct. 1985)
Edward Riegelmann	Cartographer (Feb - May 1986)

Administrative Personnel

Lawrence Bruce	Administrative Assistant
Bintu Janneh-Nying	Head Secretary
Deborah Touray	Secretary
Mam-Marie Sallah	Secretary
Cecilia Senghore	Secretary
Abdou Marenah	Accountant
Matarr Touray	Warehouseman
Tims Thomas	Motorcycle Mechanic
Leon Prom	Maintenance Foreman
Lamin Jabang	Computer Room Manager

Mariama Ceesay

Janitress

Consultants

Kenneth Nobe	Chairman Dept of ANRE, CSU
James Meiman	Director of Intl. Programs CSU
John Fischer	Executive Director CID
Bernie Henrie	Associate Executive Director, CID
Jean Kearns	Deputy Executive Director, CID
Bobby Rankin	Range Science, Texas Tech.
Robin Cuany	Agronomist, CSU
Donold Jameson	Range Ecologist, CSU
Dan Hilleman	Communications Specialist, CSU
Jim Layton	Rural Sociologist, CSU
Roger Fox	Economist, Univ. of Arizona
Wes Gestring	Soils Lab Technician, CSU
Harold Cochrane	Computer Specialist, CSU
William Spencer	Agr. Marketing Specialist, CSU
Margaret Norem	Agronomist CID/WID Fellow, University of Arizona
Melinda Burrill	Small Ruminant specialist, CID/WID Fellow, Cal Poly
Alan Harney	Computer Specialist, CSU
Neil Patrick	Agricultural Economist, Washington State University
David Spiro	Maize Agronomist, CSU
Don Kidman	Maize Agronomist, CSU
Forrest Walters	Agricultural Economist, CSU

Enumerators

	Field Supervisor
Yero Bah	Enumerator
Sarjo Sanneh	"
Sherrifo Jobarteh	"
Malick Jallow	"
Landing Conteh	"
Famara Badgie	"
Jarika Sillah	"
Lamin Korta	"
Malamin Bojang	"
Charles Congira	"
Kebba Barrow	"
Lamin Juwara	"
Baba Jobarteh	"
Mohammed Drammeh	"
Kaaba Touray	"
Ebrima Bojang	"
Momodou Conteh	"
Dembo Touray	"
Omar Njai	"

Landing Bojang	"
Salifu Sambou	"
Lamin Kurang	"
Yaya Manneh	"
Kanteh Manjang	"

Peace Corps Volunteers

Melanie Marlett	Maize Program
Kerry Washinko	" "
Mike Moran	Forage Agronomy & veterinary
Chip Kolb	Maize Program
Ray Gaunt	" "
Dick Schuman	" "
Paul Jakus	Analyst Socio-Economic Unit

Acknowledgements of Other Persons Involved
with the Mixed Farming Project, 1981 - 1986.

Saihou Sabally	Minister of Agriculture
Alieu Jagne	Former Perm. Sec. of Agriculture
Sulayman Ceesay	" Under Secretary of Agric.
Ruben Thomas	" Director of Agriculture
Tom Moser	" USAID Representative
Merrill Asay	" USAID Agric. Officer
Quincy Bembow	" " " "
Mark Madland	" Asst. USAID Agric Officer
Horst Geuting	Former Director PPMU
Amadou Taal	Permanent Secretary of Agric
Galandou Gorre-Ndiaye	Under Secretary of Agriculture
Byron Bahl	USAID Representative
Ralph Conley	USAID Agricultural Officer
Tom Hobgood	Assist. US AID Agric. Officer
Sankung Janneh	Director of Agriculture
Sompo Ceesay	Asst. Dir. of Agr for Research
Kejaw Banja	Asst. Dir. of Agr for Extension
Sambou Kinteh	Director PPMU
Mohamed Ousman	PPMU/World Bank
Ian McIntyre	Director, ITC
Bakary Touray	Asst. Director, ITC
Baboucar Manneh	Director, EAU
Hassan Sallah	Assistant Director EAU
Musa Dampha	Cameraman, EAU
Karim Sonko	" "
Demba Manneh	Pasture Assistant, DAHP

Momodou Jobe	"	"	"
Omar Janneh	"	"	"
Seedy Phatty	"	"	"
Momodou Fofana	"	"	"
Lamin Jallow	"	"	"
Malang Sanneh	"	"	"
Abdoulie N'Gum			
Lamin Darbo	Stockman	DAHP	
L.K. Janneh	"	"	
Albert Cox	Former Supervisor	Sapu Station	
Tom Senghore	Senior Agr. Officer,	Sapu	
Sherrif Sima	"	"	"
Amie Jallow	"	"	"
Musa Tunkura	Agr. Supervisor	(Women Program)	
Tamsier Jagne	Agr. Demo. Basse	(Womens Prog.)	
Mamadi Jawo	Agricultural Officer,	Basse	
Ousman Marong	Officer in Charge	DAHP Livestock	
Malick Sabally	Former Administrative	Asst. MFP	
	"	Accountant	MFP