Report #15

Report of GARD Consultancy

Animal Science Team

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SUMMARY

This report details the results of discussions between animal scientists from the Universities of Wisconsin and Virginia State and Gambian counterparts in the Departments of Animal Health and Production, Agriculture, Agricultural Engineering, Forestry and PPMU to define priority areas for livestock related research.

The overall emphasis proposed is for research on small ruminants, poultry and draft animals which were the groups perceived to have the highest potential for improvement of nutrition and diversification of agricultural practices for a broad range of Gambians. Lesser emphasis is placed on cattle because of research in this area by the International Trypanotolerance Center and because of concerns about social constraints to improvement of nutrition through cattle production (99). Proposals have been developed for research on village poultry production to improve breeding, feeding, housing and health care (22), for research in support of commercial poultry development to evaluate improved breeding stock, nutritional resources and health care (15), and for small-scale demonstrations of pigeon and duck production (28). In the area of small ruminants, the proposals are for an integrated program for on-station development of management techniques for Djallonke sheep, evaluation of dual purpose goats (32), and the development of forage resources to support production of both. Forage research will address both the resource management to develop a strategy for all-season feeding and evaluation of additional potential forages. A review will be made of the social and economic acceptability of deferred grazing before decisions are taken on extension of this practice (55). For animal traction, a two-step process is suggested to allow a survey to provide draft animal health and production information before the priority research focus for animal traction is determined (61). As a forerunner to extension of small ruminant technical packages, a sociologic study is proposed to analyze the incentives and constraints affecting small ruminant and poultry production and the acceptability of proposed interventions (66). Strengthening of the research infrastructure through station rehabilitation and support for laboratory operations is recommended (69). The potential for GARD to strengthen the livestock assistants training progam should be explored.

The needs for technical assistance in carrying out the proposed research are addressed (73). The principal recommendations are for a long-term animal scientist, a long-term forage agronomist and research associates in sociology and economics. A series of short-term visits are suggested to provide specific specialist inputs.

Training recommendations (83) call for long-term training of MS candidates (poultry science, ruminant management, sociology) and BS

candidates (extension methods, animal science, two in forage agronomy, economics) and for one additional candidate to upgrade a diploma to BS level. Short-term trainings are suggested to provide practical training in key areas related to the proposed research and in research administration (90). Proposals for networking include conference attendance but a delay of visits to other projects until livestock related research in The Gambia has developed further.

Overall, the work in small ruminants and forages builds on the work accomplished in The Gambia under the Mixed Farming Project and in Kenya in the Small Ruminant CRSP Project.

Introduction: The Workshop Approach

The objectives of the planning workshop were to determine what were the overall research priorities in livestock production in The Gambia, the most productive means of addressing these priorities and to develop detailed plans for carrying out the research identified. The format of the workshop was adopted to ensure active participation by Gambian scientists in understanding and determining the directions of livestock related research which they will be carrying out and to encourage a broad review of possible areas of research before concentrating on specific proposals. It was intended that this experience would also contribute to training in research planning. It was felt that the outcome should be a series of detailed proposals agreed upon by both Gambians with first hand experience of local needs and feasibility and expatriates with more experience in livestock research. Throughout the process it was emphasised that research priorities should be worked out without regard to the potential funding sources, but based on the need for work in a particular area.

The steps identified as necessary in achieving this progression were as follows:

1. Analysis of available information
2. Identification of livestock production objectives
3. Identification of major constraints in achieving these objectives
4. Identification of the main priority research domain
5. Listing of tentative component research
6. Development of detailed research recommendations
7. Identification of supporting information needs

Needs for training, consultancies, long-term technical assistance and networking were discussed as they arose in developing plans for research. Detailed analyses of training and technical assistance needs were made by the expatriate team whose recommendations will be reviewed by the appropriate departments in The Gambia.

The initial step of reviewing available information comprised both review of relevant literature from elsewhere in West Africa, including the presentation made by Jane Ellis on work in Senegal, and review of previous and ongoing activities in The Gambia. The initial day and a half of the workshop provided the Gambian counterparts with an opportunity to present their views on activities carried out under the Mixed Farming Project. A review was made of activities of groups peripheral to the DAHP as well as activities within the Farming Systems Research Focus villages. For the expatriate participants these reviews complemented the information already gathered during visits, informal conversations and report reading. For the Gambian

participants it provided an unprecedented opportunity to review and discuss each other's work. It was agreed that a presentation by ITC should have been included in these introductory reports. While the expatriate team was informed of ITC's activities, it emerged that the Gambian participants from DAHP were not clear on the objectives and scope of ITC's activities.

Defining the objectives of livestock production in The Gambia: This section formed the transition between review of earlier program work and definition of new directions for research and provided a baseline for determining high priority research areas. As a group we attempted to answer two basic questions: (1) Why do people in The Gambia raise livestock? and (2) What are the overall goals for livestock production? A combined listing was made by the participants and an attempt was made to assign a score for relative importance to each goal (Table 1). Referring to each of these goals, we then tried to evaluate the contribution of each of the classes of livestock towards fulfillment of these goals. This forced us to recognize the differing roles of each livestock group in the community and the potential beneficiaries of research in each area. While the importance of beef cattle production was noted, it was also recognized that the only area where there was currently a major input into research and development on livestock was beef production, through the livestock development program with the ITC.

We assessed the general mechanisms and tools available to bring about development of livestock production towards the objectives identified and reviewed which of these goals were encompassed by the mission statements of GARD and of DAHP, and which were beyond the control of either of these entities (Table 2). As we discussed these mechanisms it became apparent that we needed some kind of definition of what research was. It was concluded that, in the Gambian context, research could be:

- Problem analysis, description and diagnosis
- Design and testing of new technologies
- Adaptation and application of known technologies
- Researching information in published and unpublished literature and from resource people

Identification of major constraints: This was done by three subgroups addressing poultry, ruminants and draft animals. The first two areas of project focus were outlined in the GARD project paper; draft animals were subsequently identified by DAHP as being an additional area needing attention. These three categories with the addition of cattle were those identified by the workshop as being the most important categories of livestock produced. Until fundamental changes in the patterns of cattle ownership and exploitation take place, investment in developing cattle production will not necessarily translate into food self sufficiency for The Gambia. However, small ruminants and poultry have the ability to contribute to the economic and nutritional well being of essentially all Gambians. Within each

subgroup a list was developed of the major perceived constraints and was broken down into contributing problems. Some of the constraints were identified as being beyond human management. Those which were potentially controllable were categorized by whether they could be addressed by a livestock oriented team (recognizing that this would not be an exclusively DAHP team) through research and extension, or by another ministry or agency. It emerged that many problems fell into more than one category but that a list of problems could be developed which were researchable or which could be addressed by extension packages by a livestock team. The "researchable problems" were then ranked both by importance and feasibility of bringing about a desirable change (Tables 3 and 4). At the same time research and extension problems were reviewed to see which were associated so that one "program approach" might address more than one constraint. The subgroups were encouraged to select the three or four packages of research which best addressed several high priority and manageable constraints and then to check back on the validity of the basic assumptions made with the original list of objectives for livestock production. Lists of potentially highly rewarding areas for research and extension inputs were thus developed. For each of these the participants were asked to outline in writing the justification, specific objectives, and procedures necessary to attain the objectives. They were then asked to list the inputs in infrastructure, facilities, materials and manpower needed and to propose a line item budget. The accompanying proposals are the outcome of this exercise and the additional process of review, discussion and refinement. In developing research outlines, some components identified were suitable for direct application on-farm. Others would require evaluation in a controlled, on-station mode before adaptation to the varied farming systems incorporating small ruminants and poultry. Livestock research, with its longer turn-around time for results and potentially longer term impact of inappropriate technologies, differs in this from cropping components of farming systems which are more easily handled in an experimental or demonstration situation on-farm. The socioeconomic inputs recommended will be important in defining and sharpening the focus of recommendation domains for application of the packages developed on-station. In the case of draft animals it was clear that we were still at the problem description and diagnosis stage as far as the health, management and nutrition of the animal component was concerned. It would thus be inadvisable at this stage to direct all resources to the priorities already identified in the agricultural engineering and equipment design component of the system until a more balanced analysis could be made.

In the Friday afternoon session on research methodology requested by DAHP, Dr. Dentine reviewed the sequence of hypothesis formulation and experimental design in scientific research. Dr. Pope addressed differences between research and extension and Dr. Wentworth the role of applied and basic research. Despite these guidelines, difficulty was encountered by the subgroups in 2 areas: defining manageable lists of specific objectives which could be subdivided into sound

experiments, and in confining the inputs requested to those needed to address the objectives defined. The most difficult concept to grasp was that while we recognized a vast array of problems to be tackled, only some of these were amenable to research and extension solutions, and that within this subset priorities had to be set to reduce the list to a size compatible with the available material resources and manpower. Thus proposals developed had to address those areas most likely to be of benefit in terms of production for nutrition and self sufficiency.

The review sessions on Tuesday and Wednesday, with inputs from Drs. Posner, Gilbert, Gaye, Boughton, Bakary Touray, McIntyre, Clifford and Sompo-Ceesay, were useful in addressing two issues. Firstly, the need for coordinated station management to ensure the balance of activities carried on with limited space and resources available for on-station work. This has not yet become a problem but it was agreed that as research activity increased, particularly at Yundum, it would be necessary to develop an integrated management plan and also that a cohesive approach to research station management would better equip the Ministry of Agriculture to negotiate in the face of demands for land for extension of other government installations. Secondly the review stressed the importance of the need, already identified, for socioeconomic analysis of potential markets, incentives for production and acceptability of new products. A potential problem identified by Professor McIntyre as needing additional attention in developing a poultry program was that of vaccine delivery. Professor McIntyre stated IFC's willingness to collaborate and participate with DAHP and GARD especially in small ruminant studies.

Two types of recommendation have emerged from the workshop. On one hand there are research proposals addressing plans over a six to seven year time span with associated needs for technical assistance and training inputs. These proposals will be reviewed for inclusion in the next and subsequent annual work plans. Some of these long-range proposals, or subsets of them, may be suitable for consideration for other sources of funding. More information is needed on funding already tentatively committed to Gambian livestock development by the World Bank and UNDP to determine how efforts may best be coordinated. At the same time we also prepared short-range plans addressing activities requiring low budget inputs or continuation of activities already in progress. These contain guidelines for the period leading up to the next annual workplan and will be reviewed by the in-country Farming Systems steering committees for immediate implementation.

Table 1.

Objectives in Raising Livestock in The Gambia: Group consensus

Objective	Importance High = 5
Provide food for domestic consumption in rural areas	5
Provide food for urban consumption	5
Generate rural cash flow, including that of rural women	5
Provide security and risk avoidance	5
As a store of wealth	4
Provide inputs to other farm work: draft power	4
Meet traditional and cultural needs	3
Stabilize the environment	3
Provide self sufficiency and reliance (avoid imports)	3
Produce fibre, hides and skins	2
Generate urban income	2
Provide manure	2
For consumption by the tourists	1
For export to provide foreign exchange	1
Means of usage of agricultural and industrial by-products	0
Provide luxury items	0
Provide employment	0

Table 2.

Tools and mechanisms for bringing about livestock development

Tools and Mechanisms	Involvement of GARD	DAHP
Extension - education	+	+
Extension - farmer feedback	+	+
Research - basic	(+)	(+)
Research - applied	+	+
Infrastructure for research and extension	+	+
Disease control - veterinary services	0	+
Capital for research funding	+	+
Capital for credit	0	0
Training for technical personnel	+	+
Training in program design and seeking financial aid	+	0
Training in management and administration	+	0
Training of farmers	0	+
Promotion of good communication nationally	+	+
Making technical information accessible	+	+
Promoting integration with other agricultural activities	+	0
The national herd	0	0
Market development	(+)	0
Technology transfer	+	+
Availability of labor	+	+
By-product usage	+	+
Willingness of farmers to adapt	0	0
Farmers experience	0	0
The will to bring about change	+	+
Conducive prices	0	0
Cultural change	0	0
Changes in the land tenure system	0	0

(+): low level of involvement.

Table 3.

Small Ruminant and Forages Subgroup

	Feasibility Easy	Feasibility Moderate	Feasibility Difficult
Importance			
Low	Footrot Controlled breeding (R)	Controlled breeding (Ext.)	Info. on feed intake
Moderate	Parasites (LR)	Avail. feed resources Pasturella (SR) Heartwater (SR) Genetic improvement Convincing farmers - vet. programs (Ext)	Feed composition
High	Blackquarter (LR) Hem. Septicemia (LR) Parasites (SR) Info on diseases Feed handling (Res) Documentation	Seasonal var.-feed Forage studies Train.-vet personnel Info/repro performance Housing/enclosure LOA's Convincing farmers -forage planting	PPR Diagnosis/personnel Vacc/drug supply Manpower/vaccines Feed handlirg (Ext) Market finished product

Res: research
Ext: Extension
SR: Small ruminant
LR: Large ruminant.

Table 4.

Poultry Subgroup

A. EXTENSION

	Feasibility Easy	Feasibility Moderate	Feasibility Difficult
Importance			
Low			Poultry Association Drugs/acute disease Artificial nest eggs
Moderate	Sanitation	Parasite control Vaccinator training Vaccine transport Brooder lamps	Egg storage Chick transport
High		Vaccine availability Technical training Water supply	Chick supply Vaccine storage

B. RESEARCH

	Easy	Feasibility Moderate	Difficult
Importance			
Low		Calcium for layers Coop sanitation Removable roof on coop	Brooder lamps
Moderate	Parasite control	Local feed for dayolds Hatchery source Coop incubation	Medication
High	Extension programming Vaccine source Sanitation Coop design	Improved genetic stock	

LIVESTOCK TEAM ASSESSMENT OF THE CURRENT POULTRY PRODUCTION AND RESEARCH NEEDS IN THE GAMBIA

Justification

The team did not attempt to do a complete survey of the poultry production in The Gambia, but they were able to verify reports that the majority of the poultry population is found roaming free in the villages (estimated to be about 280,000 birds). Near urban areas there is more intensive production on approximately 20 farms with up to 1,000 birds per farm. Interviews in several villages (Homan and Yuill in September and Livestock Team in late November) provided assurance that the village people would like to produce more poultry and that they eat eggs and poultry meat when it was available. There were a few comments that eggs should not be eaten by children and pregnant women, but we could not confirm a foundation for this belief.

The Livestock Team was unanimous in its conclusion that increasing poultry production in The Gambia would be beneficial, for human nutritional health (current protein intake is less than 40 gm/person/day), cash flow and diversification; especially as poultry production relates to division of labor, with the greatest inputs from the women and children.

The Workshop participants were assembled knowing this background information and were briefed on current poultry production in Senegal by Jane Ellis (Appendix 3) and by a summary of a report given to Jane Homan by Dr. Laurent on poultry development in Burkina Faso.

The initial charge of the Workshop participants was to identify and prioritize the problems and constraints related to poultry production in The Gambia. These problems and potential solutions from research and extension (demonstrations and transfer of technology) were discussed in terms of feasibility and benefit, measured mainly by improved quality of life for the Gambian people. The major problems and constraints are summarized in Table 4.

The workshop participants identified several projects where research or demonstrations should be initiated immediately to increase poultry production in The Gambia.

A detailed description of the projects follows: 1) Commercial Poultry Production; 2) Village Poultry Production; 3) Duck Project (Demonstration); 4) Pigeon Project (Demonstration). These project documents are in the form of workplans for the participant DAHP researchers.

COMMERCIAL POULTRY PRODUCTION RESEARCH

Improved commercial poultry production will help to provide a greater quantity of high quality protein and energy for human consumption, especially in the urban Gambia. It will provide added employment, added income, and a foreign exchange savings. Besides being a source of agricultural diversification, commercial production of eggs provides a commodity that has a good shelf-life without refrigeration. The by-product manure will be valuable for fertilizer and a market for feathers could be developed. The aim is to achieve self-sufficiency in poultry production in The Gambia.

The hypothesis is that improved breeding stock, nutrition and health care will facilitate commercial poultry production in The Gambia.

The primary reason for conducting research is to provide commercial poultry producers with guidelines on the most cost effective methods of management. For maximum productivity, the experiments detailed below address key questions which need to be resolved before proceeding with development of private commercial enterprises: what strains of birds are best adapted to provide good egg yields in Gambian conditions? How can an economic feed supply be developed from local ingredients? What is the best way to effectively control diseases which result in high mortality? The outcome will be information used in extension to potential commercial producers.

Objectives

1. Determine the performance of two egg laying strains under commercial conditions.
2. Determine egg laying performance of hens fed rations formulated with locally available ingredients.
3. Determine the effectiveness of live virus vs. killed virus vaccine during brooding and rearing periods.

Material and Methods

At DAHP, using a house with eight pens, each pen containing 250 day-old female chicks, we will compare two lines, two rations formulations and two vaccine procedures. The initial test will be with ISA stock compared to White Leghorns fed two rations with two types of vaccines. Ration A will be a reference control maize and soybean, while initial trial for ration B will be maize, rice bran, pigeon peas, sesame seed cake and shrimp by-product. Other feed formulations will be considered to reduce the amount of maize before the research starts. The chicks will be started in 8 pens with a replication of each treatment. Following is the design that illustrates the 2 x 2 x 2 factorial design of the brooding

experiment. All birds will be given coccidiostat during brooding as well as pre-vaccination antibiotic treatment.

All data will be subjected to analysis of variance and the major components
as well as interactions evaluated. The following treatment by pen is planned.

Pen 1 Leghorns, live virus vaccine and feed A.
Pen 2 Leghorns, killed virus vaccine and feed A.
Pen 3 ISA, killed virus vaccine and feed B.
Pen 4 ISA, live virus vaccine and feed B.
Pen 5 ISA, live virus vaccine and feed A.
Pen 6 ISA, killed virus vaccine and feed A.
Pen 7 Leghorns, live virus vaccine and feed B.
Pen 8 Leghorns, killed virus vaccine and feed B.

Following is the design for the egg laying experiment:

Pen 1 Leghorn, live virus vaccine and ration A.
Pen 2 ISA, killed virus vaccine and ration B.
Pen 3 ISA, live virus vaccine and ration A.
Pen 4 Leghorn, killed virus vaccine and ration B.

This experiment will have a confounding effect of vaccine and ration, and since these birds are mature, the effect of vaccination would be associated with mortality. Therefore, if mortality in all groups is statistically the same, the major effects of breed and ration can be statistically evaluated.

Year 2 Broiler Breeders (same design as laying hen study)
Year 3 Comparison of F-2 progeny from broiler breeders in year 2 vs. F-1 imported broilers.

Major emphasis on data collection will focus on mortality (all birds dying being autopsied), body weight, feed consumption, age at first egg, total egg production, egg weight, shell quality, Haugh units, fertility and hatchability. Surplus eggs will be candled for interior quality and sold. The surplus chicks will also be sold.

There is justification for upgrading the hatchery for the outlined research requirements as it will also be used to promote local commercial poultry production.

Presently the Department's hatchery is unable to function effectively. Major breakdowns have been encountered during the hatching process and incubators are subject to wide fluctuations in temperature during the hot season. Installation of evaporative cooling in the hatchery would play an important role in stabilizing temperature. Also during the hot season there is considerable embryonic mortality as the embryos start developing during the hot part of the day and die at night due to inadequate egg storage

temperature control, resulting in a general reduction in hatchability. An evaporative cooler or air-conditioner would eliminate this major problem. The wiring that supplies power to the incubators and brooder house must be replaced to insure dependable operation. A separate hatchery and hatch handling room is desirable for vaccination, medication, banding and debeaking of day-old chicks.

Services and Programming Required for Commercial Poultry Extension

The section of the report on training needs details the training we feel is essential to develop an effective poultry extension team.

The extension workers will give advice to poultry farmers on general poultry husbandry such as types of birds they should keep, type of equipment needed for efficient production, and suitable sites for poultry houses. House plans with correct stocking densities, ventilation, feed and water containers, and nest boxes will be designed by extension workers. There will also be a two-week training course offered to farm workers at DAHP on basic poultry management. Programs on vaccination for prevailing diseases, debeaking, medication and feeding systems will be prepared by the extension workers. Frequent visits between researchers and their former clients will help to promote communication.

Time Table of Commercial Activities

Month	Activity
June 1987	Purchase of housing materials required for construction of pens.
July 1987	Construction of pens, rewiring of brooder houses and incubator room.
July 1987	Ordering of parts for current incubator and central lab equipment.
August 1987	Ordering of stock, feed ingredients, drugs, and vaccines.
	Expect material for hatchery repair Start repair work on hatchery Arrival of hatching eggs Purchase of feed material Arrival of feed materials (standard reference) Arrival of vaccine and drugs Purchase of vehicle and fuel Set eggs in hatcher Personnel Training Hatching out of day old chicks Day olds transferred to pens after they are vaccinated.

Future of Commercial Poultry Production in The Gambia

The workshop participants concluded that for sustained growth in poultry production, donor support must be aggressively sought to obtain equipment and technology transfer to provide a hatchery, a feed mill and a processing plant. Although the rural poultry research scheme and proposed commercial research may provide guidelines for Gambian poultry production, the current practice of importing chicks and feed ingredients will not allow continuous growth of The Gambia's poultry production.

The Gambia must become self-sufficient in production of replacement chicks. Currently there is no commercially operated hatchery. Local by-products must be mixed for the commercial production of poultry feed. The milling facilities should include driers for processing fish, plant waste and brewery by-products for use in poultry feed.

In order to maintain a dependable market for broilers and spent fowl, a simple, efficient poultry processing plant must be constructed. The hotel and restaurant trade and other markets should be provided with an inspected product, processed in a sanitary plant.

The workshop participants favor a privatized hatchery, feed mill and processing plant, with DAHP providing guidance in technical issues as well as providing input to the Poultry Farmers' Association to form a cooperative to ultimately own and operate the hatchery, feed mill, and processing plant. The cooperative should be producer-owned and share in the profit. All villages must be given assurance that a source of dual-purpose chicks will be available at least twice a year.

During the period of cooperative development the Gambian government should consider deferral of taxation to allow expansion.

Another point which workshop participants agreed upon was the importance of market analysis before investment in commercial poultry development. We have expressed the need for technical assistance in economics. This should provide a general assessment of the strong and weak points in developing a local poultry industry which can compete for cost and reliability with imports. Investment in individual commercial producers must be predicated on their having adequately researched the market they will serve. The report by Jane Ellis on commercial poultry endeavors in Senegal provides several telling instances of the consequences of failing to do adequate market analysis.

Village Poultry Production

Justification

Over 90 percent of Gambian poultry is scattered throughout rural areas in "back-yard" traditional forms of poultry keeping. A high occurrence of malnutrition and marasmus amongst rural children (from birth to 8 years), has caused the government to explore possible areas of research to help alleviate this problem. The government in its second five-year development plan, has emphasized the importance of increasing production in the livestock sector as a means of creating food products and cash flow systems for the rural community. Both poultry meat and eggs are high quality protein sources for humans. In the tropics where refrigeration is scarce the egg is the most durable of all animal food products. Thus increasing poultry production in The Gambia would augment the government's current five-year development plan. Almost every rural family is engaged in the traditional production of chickens.

Poultry adds diversity to Gambian agriculture. It can make use of recyclable resources in the village, such as, household waste, by-products from rice and groundnuts as well as vegetation, insects and weed seeds without taking labor away from other activities. The manure can be used on gardens or fed to ruminants. Constraints such as disease, feed, predation and housing have been identified as limiting poultry production in the rural areas.

The aim of this project is to secure maximum availability of poultry with potential for high productivity in both quantity and quality. Ultimately, this can help to raise the quality of life in rural Gambia, especially for women and children.

The hypothesis is that improved housing, breeding, feeding and health care will double poultry production in the rural areas of The Gambia in five years.

Objectives

1. Determine if improved housing and management at village level will improve poultry production in The Gambia
2. Determine the effect of improved genetic stock and supplementary feed on poultry production in The Gambia.
3. Determine if improved health care package (vaccination, parasite control, medication, and sanitation) will improve production of poultry.

Materials and Methods

The poultry houses, 3 square meters in size, will be constructed in four compounds in each of the following three villages: Kunkujang

(western region), Kerewan (north bank) and Giroba (eastern region). Four poultry houses in each village will be constructed of bamboo poles to raise the house about 1 meter above the ground level (see Annex A). Woven bamboo will be used for the body of the house. The roof will be made from thatching of elephant grasses, and the floor constructed from bamboo slats. Woven bamboo will be tied around the raised poles to prevent the chickens from going under the house. This house construction allows for frequent cleaning underneath especially when flies invade the environment. All manure will be used for gardening.

Day-old chicks will be brooded with rice hull brooders, with a prototype constructed at the nearest field station (See Annex B).

The four Compounds in each village will be identified as red, blue, green and yellow. The chickens used for this research will be New Hampshire breed from a European source. These chickens are dual purpose and will be exchanged for the local birds. If the quantity to be exchanged is insufficient then villagers will be encouraged to buy experimental stock at production cost. The local birds to be used in this research program will come from the Compounds involved. The distribution of wing-banded birds in these Compounds will be as follows.

Compound Red - 24 local birds (20 hens and 4 cocks) allowed to range free from 11 AM until dark.

Compound Blue - 24 local birds (20 hens and 4 cocks) on supplementary feed (semi-confinement).

Compound Green - 24 New Hampshire (20 hens and 4 cocks) allowed to range free from 11 AM until dark.

Compound Yellow - 24 New Hampshire (20 hens and 4 cocks) on supplementary feed (semi-confinement).

The house will be closed at night to prevent predation and theft. The birds on supplementary feeding will receive a late afternoon ration each day. The ration formulated at the Station will consist of inexpensive local ingredients such as Leucaena, pigeon peas, sesame seed cake, cotton seed, mango seed kernel meal, gmelina seeds, brewer's grains and rice bran. Protected feeders and oyster shell grit containers will be constructed from one-liter clay pots. Plenty of clean water will be provided in three-liter clay pots. Nest baskets in each house will be made out of rhun palm leaves. Rice straw will be put in these baskets to prevent breakage. A scheduled visit from extension staff to supervise management practices is planned.

A vaccination program will be carried out at Kerewan village. We will have two groups of birds, with one group comprised of half local and half New Hampshire stock. These will be vaccinated against

Newcastle virus, Fowl Pox, and Gumboro disease at the recommended time. The other half of the local and New Hampshire stock will not be vaccinated.

A second health improvement program will be carried out at Kunkujang. There will be two groups comprising half local and half improved stock. All birds will be vaccinated using the same protocols for vaccanation as in Kerewan, but only half will receive coccidiostat and ectoparasite and endoparasite control.

The following data will be collected:

1. Growth rate (weight obtained every four weeks).
2. Morbidity (presence of ectoparasite and endoparasites).
3. Mortality (cause of death if known or determined by autopsy whenever possible).
4. Age at first egg and body weight at the beginning of lay.
5. Size of eggs (supply livestock agent with ruler of graduated cylinder to measure egg volume).
6. Number of eggs laid in each category (tell villagers to drop a pebble in miniature ballot container for each egg laid).
7. Egg shell quality (micrometer caliper, extension worker using a sample only).
8. Length of laying period during the year.
9. Hatchability by hens incubating egg in nest boxes provided.

During the second year disease control experimentation will concentrate on sanitation and medication, as well as the vaccination programs used previously. The same housing will be used and totally local ingredients for feed formulation.

The third year will include local feed ingredients, complete vaccination and medication program, but with emphasis on sanitation.

Village research services requirement for the Poultry Extension Officer and Area Livestock agents.

The rural poultry development research work will be carried out in selected villages within the country. Our first meeting will be with the village head (Alkalo) to tell him about our intended plans for rural poultry development and he will pass this message to the women

so that they can choose a suitable date for another general meeting. At the second village meeting the women will be advised to select a lady president and also identify compounds where the project work will be carried out. When this is done, a general survey of the number of birds in the village will take place. Site selection for improved housing will be made. Then all local birds in the villages will be vaccinated against Newcastle. The extension worker will help to supervise work on building poultry houses with locally available materials and the making of baked clay pot drinkers and feeders, rice hull brooders and egg baskets. Selection and exchange of some local birds or eggs for improved stock will take place three days after the vaccination of local birds. All new birds will be banded. The village women will be told the importance of giving birds clean, fresh water at all times, supplementary feeding (locally available), oyster shell grit and sanitation, which will result in less mortality, higher egg production, better egg quality, bigger birds (meat) and good hatchability. Pebbles can be used for recording mortality and daily egg collection in different containers. Monthly sample weighing of the birds and demonstration of different methods of cooking poultry meat and eggs will be done by the extension workers. Emphasis will be placed on the importance of these commodities especially for children and expectant and nursing mothers. The extension workers will also assist in forming Poultry Associations.

Sequence of Activities: Initial 4 Months of Program

- Selection of villages and meeting with village heads. The women will be advised to select a president, then identify compounds where project work will be carried out.

  General survey of the number of birds in the village and site selection for improved housing.

- Vaccination of all local birds.

- Supervision of the building of the poultry houses with locally available material.

- Help in making baked clay pots for drinkers and feeders as well as egg baskets and rice hull brooders.

- Brooding house preparation and then the chicks will be brought in. Weekly visits for the first three weeks of the chick's life. The monthly protocol outlined in the methods for data collection will be followed for the remainder of the year.

Duck Project (Demonstration)

Introduction of ducks will add agricultural diversification to The Gambia. Currently we know of only a very few small flock of muscovy ducks in a few villages in The Gambia. These ducks appeared healthy and were reproducing adequately.

Ducks are more resistant to some of the limiting poultry diseases prevalent in The Gambia (i.e. Newcastle and coccidiosis). Ducks are known to consume more forage then chickens which is abundant during some seasons. Some breeds of ducks produce as many or more large eggs than chickens and would add a substantial source of high quality protein and energy for use as a food for the village. The carcass will provide additional sources of energy and protein. In addition, the eggs and the duck will provide a quick and useful source of cash flow. Establishment of ducks, if successful, would likely spread quickly to other villages adding to the diversification of Gambian agriculture.

The objective is to demonstrate by introduction of three breeds of ducks that at least one, if not all, may become established in The Gambia.

Materials and Methods

Nine males and twenty-seven females of Pekin, Karki-Campbell and local breed of muscovy will be obtained from breeders in The Gambia or Europe. Twelve ducks of one of the breeds will be placed in a compound in each of nine villages. The ducks will be wing banded, weighed and released in September with enough feed to provide a transition to scavenging for their diets. They will be weighed every two months. A shelter similar to those used currently for chickens will be provided. Clean, cool water for drinking will be provided ad libitum. Egg production will be recorded until March 30 by placing pebbles in a miniature ballot container for every egg collected. On April 1st, 6 nest eggs will be placed in a nest for all females remaining and when they start to incubate, twelve fresh eggs will replace the nest eggs. This is to encourage dry season nesting.

Information collected every 2 months will be body weight, general health (cause of mortality, if known at time of weighing), total egg production, incubating success, brood size and livability of ducklings until August 1st). We will recommend the population be reduced to 12 young ducks (3 males and 9 females). Extra ducks may be purchased by the project and placed in other villages.

The program will be modified as necessary before the next yearly cycle.

Pigeon Project (Demonstration)

Introduction of pigeons to villages will add agriculture diversification in The Gambia. Gambians eat pigeon meat. This has only been observed in rural areas. Observations suggest that they are currently found only in the urban areas. The pigeon is very mobile and can scavenge for food over several kilometers. Pigeons are very prolific, reaching sexual maturity in less than 90 days and will often start a second brood before the first brood leaves the nest. The ideal time to use squab for food is when they reach maximum weight, just before fledging. The pigeon is an excellent source of protein and their eggs, although small, can be used for food. Pigeons are very resistant to diseases and rarely have coccidiosis if the loft is kept clean. They will return to their home loft with certainty providing they have water, occasional food, calcium grit and adequate space to nest.

Pigeons are an excellent initial experience in avian husbandry and a good training experience for youth in the area of avian culture. In addition, the homing pigeon can be used for sending messages up to 500 kilometers. Short messages can be placed in a leg capsule or combined with modern technology (computer chip) to transmit many pages of information.

The objective is to demonstrate by the introduction of three breeds of pigeons, that at least one may become established as a food source in The Gambia, thus adding diversity.

Material and Methods

The demonstration program will be coordinated by the Boy Scouts of The Gambia. (Mr. Joof, point of contact), who will provide loft construction and management following their introduction. The lofts will be constructed for ease of cleaning and collection of droppings for gardens.

Six pair of local feral pigeons, Homing pigeons, or King pigeons will be leg banded and placed in three villages in each of three representative districts of The Gambia. All pigeons used for placement will be young (before they have flown from their home nest or loft). The pigeons will be weighed at the start and every two months to assess status. They will be confined to the loft for at least two weeks and fed ad libitum, then they will be released. Clean water and occasional grit and feed will be provided by the caretaker to reinforce the home loft. (Every two months they will be weighed.) A record will be kept of the number of eggs laid, number of squab that hatch and the number that fledge. Bands will be provided by DAHP for squab that hatch. Also, any mortality and use for food or sale will be recorded.

After one year the program will be modified as required and some pigeons may be purchased for distribution to other villages.

Personnel

One DAHP extension staff member will coordinate this project with leadership of the Boy Scouts of The Gambia. Coordination must also be arranged with a Livestock Agent to collect data and evaluate demonstration. Plans will be provided by extension staff for loft construction.

INTRODUCTION: SMALL RUMINANTS AND FORAGES.

Subsistence level farmers in the tropics often do not produce adequate and consistent amounts of high quality protein foodstuffs needed for the good health of their families, children and pregnant women in particular. Cow's milk is not always available, especially during the dry season. One of our proposals is to use the dual purpose goat (DPG) to provide supplemental milk during this season. The reasons for this are obvious: their feed requirements are less, the investment is low and they can be cared for by women and children.

The important constraints associated with DPGs established during the extensive research conducted in western Kenya by the USAID Small Ruminant CRSP Project (Blond, 1984) exemplify the problems we will also confront in small ruminant improvement in The Gambia:

- Available feed resources will not support high daily milk yields common for DPG genotypes nor maximum reproduction.

- Does should have the genotype to produce at least 3 kg/day of milk during the first 2.5 months of lactation in order to provide milk for rearing twins as well as for human consumption.

- In order to remain healthy and produce to potential, DPGs definitely require better feed and management than native goats which are largely scavengers.

- Prospects of introducing forage crops in direct competition with food crops are not bright. Farmers have a strong orientation towards self-sufficiency in food crops.

- It was much more difficult to introduce a DPG than to introduce a maize variety. The introduction of the DPG required the introduction of several interventions at the same time. Foremost among these was sufficient feed followed by breeding, health, care of milk and others.

- Since such a package was more complex than simply changing a variety or any single practice, great care was taken in developing the innovation program involving both research and extension.

- Strategies are therefore needed to meet nutrient requirements from forages and crop residues without reducing food production.

It is apparent from the above research and that of the International Livestock Center for Africa, as well as the work in many national African institutions, that inconsistent feed supply is the biggest constraint to increasing yield of milk and meat. It follows that work

with small ruminants in the proposed project can not be productive until this constraint is resolved.

Blond, R.D. 1984 Partners in Research. Published by the Management Entity, Small Ruminant CRSP. University of California Davis, California 95616

PROJECT OUTLINE: PROPOSED ON-STATION SMALL RUMINANT COMPONENT

Justification:

One-sixth of the world's sheep population and one-half of the goats are found in tropical Africa. Most of these sheep and goats are owned by small farmers with very limited resources. The breeding and management of these animals is traditional, little effort has been made to upgrade them by the use of modern technology and the productivity per animal is low. However, because of their large numbers these small ruminants make a significant contribution to the economy and food supply in these countries. Their importance is often not seen in official statistics on commodities mainly because they are utilized by the farm family or within the village. Their widespread popularity is because they meet the small farmers' needs and resources.

The advantages of small ruminants in The Gambia are typical of other countries in tropical Africa. From 1975 to 1982 their numbers increased much more rapidly than other livestock or poultry. Values were a 77% increase for sheep and 99% for goats. Their low initial and maintenance costs place them within reach of the small farmer. Since the investment is low, the risks of loss are acceptable. Feed costs are minimal as the animals are grazed on marginal lands unsuited for cropping. The cost of labor for supplying feed or grazing supervision is also minimal since children can be given the tasks. The products from sheep and goats are convenient for local use and require no infrastructure, markets or external technologies for their utilization. Their meat and milk outputs come in small quantities which can be readily consumed.

Improving the performance of sheep and goats under small holder management in The Gambia offers a direct route to improving the diets and living standards of the rural people. Much of the technology for improving their performance is already in existence in more developed countries but a major research initiative is needed to adopt this technology to the farmers' needs and the environments found in The Gambia.

Objective:

To determine the feasibility of developing a dual purpose goat for the production of milk and meat and to develop a set of management recommendations for a cost-effective production system for both goats and sheep for the Gambia.

Specific work will be carried out in the following areas:

1. Station comparison of local goats and various experimental crossbreds sired by imported dual-purpose bucks.

2. Station development of a flock of native Djallonke sheep to assess current production parameters and potential results of management interventions.

3. Use of station animals in the evaluation of proposed management recommendations concerning feeding during the dry season, disease and parasite control, and housing or containment options.

4. Development of a package of recommendations for improvement of small ruminant production at the village level.

Implementation:

The Kenyan Small Ruminant CRSP project has been working on the development of a dual purpose goat using both European and African breeds. We propose the importation of 6 of these Kenyan four-way cross bucks of approximately 6 months of age. These bucks are based on two African breeds which may have a higher degree of trypanotolerance than other possible sources for crossbreeding. In addition, the Kenyan project can screen these bucks for CAE (caprine arthritic encephalitis) which has presented a problem with past importations of goats into Africa. We propose that these bucks be certified free of CAE, Brucellosis and Rift Valley fever.

Six local bucks of similar age will be selected on the basis of body weights as a random sample of the best available local breeding. These bucks should meet the same health standards and screenings as the imported bucks. All bucks will be vaccinated for PPR (peste des petits ruminants) and CCPP (contagious caprine pleuropneumonia) and treated for endoparasites when purchased.

A group of 40 representative local does will be assembled at the Yundum station and should be randomly assigned to breeding by either an imported or native buck. Breedings will be supervised individually and repeated to the same buck to insure knowledge of parentage. Offspring of these matings will be referred to as the F1 generation. In subsequent years, the original does should be assigned to the opposite breeding group: e.g. does originally bred to an imported buck should be bred the second year to a local buck to insure that genes from females have contributed as equally as possible to the F1 offspring. After two kiddings, these does will be sold as necessary to make room for their offspring. Goats will be bred to kid on a yearly cycle designed to provide milk when supplies from cattle will be at the lowest.

All males of the F1 generation will be wethered using a Burdizzo for the first years of the breeding experiment until evaluations of their potential are completed. Females of the F1 will be raised and bred to kid at one year of age. Half of each of the F1 breed groups

(crossbred and pure local breeding) should be bred to each type of buck avoiding father-daughter matings. Thus the next generation F2 will include four types of pedigrees: 100% local, 1/4 imported, 1/2 imported, and 3/4 imported. Since local adaptations may play a large role in survival, evaluation of the potential effects of crossbreeding should include comparisons of more than first generation animals. Statistical analysis to separate the effects of breed direct and heterosis effects will be possible with these combinations. Recommendations on the optimal cross or the superiority of the local breed will be possible based on the performance of these animals.

A flock of 40 Djallonke ewes and 8 rams will be assembled at Yundum using the same health screening as for the goats with the exception of CAE. Selection of these animals should include preference for white coloration due to the increased value of these animals for sale. Breeding records of these animals should be kept to insure knowledge of parentage for all subsequent offspring. Timing of breeding should be based on the Tabaski market with the intention of providing a 15-month old male for sale. This will result in approximately an 11-month lambing interval.

Test station measurement of all animals should include:

1) bimonthly blood smears for trypanosomiasis (possibly with assistance of the International Trypanotolerance Center).
2) bimonthly fecal sample examinations for endoparasites
3) weekly weighing
4) mortality with post-mortem findings
5) bimonthly ectoparasite inspections.

Measurements on the offspring of the experimental matings will also include:

1) birth weights
2) number of littermates
3) for males--weekly scrotal circumference as a measure of sexual maturity
4) for females
   a) fertility (#kidding/#exposed)
   b) birth weights and litter sizes (# born, #born alive)
   c) pre-weaning mortality of kids(#weaned/#born)
   d) offtake (kg kid weaned/doe bred)
   e) milk production (assessed by using a weigh-suckle-weigh technique on a weekly basis)

Since trypanotolerance is a trait of interest, the second group of F1 offspring should be moved to the YBK station for evaluation in a different environment including a higher exposure to tsetse flies. Some of the first generation sheep could also be moved to YBK as numbers increase.

Proposed forage and nutrition work at both stations will utilize these animals for nutrition trials as well as more extensive management trials of containment facilities. Intake trials will require group intakes on a number of small pens. Construction of small elevated pens with slatted floors using native materials is proposed for evaluation of the potential for using this type of housing. Current management techniques include the fattening of a small number of rams for the Tabaski market. Elevated housing is proposed as a method of parasite control, manure collection and labor savings by non-wastage of feed. These facilities housing 4 to 6 small ruminants could function as pens for feeding trials while being evaluated for their practicality as a management option. Contrasts will be made to the current methods of containing fattening animals.

Animals at the Yundum station would also be available for nutrition studies and management trials of various sorts. Weaning of both kids and lambs will occur at four months. Timing of breedings should be concentrated over a few months so that sufficient animals of similar ages will be available for trials. Various disease and parasite control programs will be compared using both adult and growing animals. The proposed number of animals to be maintained would allow equal numbers of each breed group to be used within treatment groupings. Thus the genetic evaluations and management trials could utilize the same animals.

Evaluations:

Recommendations based on data collected during the proposed research should include the costs of proposed interventions in breeding, feeding and reproductive management. Increased production should be balanced against the increased management inputs necessary. For this reason, careful financial and labor records should be kept of the costs associated with these trials.

PROJECT OUTLINE: VILLAGE SMALL RUMINANT PRODUCTION COMPONENT

Objective 1:

To obtain baseline data on production parameters and constraints to increased sheep and goat production at the village level.

Procedure:

Surveillance studies designed to obtain baseline data on production of small ruminants have already been initiated. It is recommended that this exercise be continued. Seven farming system focus villages: Abbakutta, Giroba, Kassange, Kerr Wally, Njaba Kunda, Sabbi and Sangajor Jiramba have been included in the data collection process. Representative animals in these villages have been tagged and offspring from these tagged animals will be incorporated into the observation group. Additional animals are to be added so that each village has 20 sheep and 20 goats in the observation group. A total of six visits will be made to each village each year, i.e. one visit every two months for data collection. Data on the following will be recorded during each visit: status, weight, reproductive status, health and current feeding. In addition fecal samples will be taken for endoparasite examination, examination made for ectoparasites and blood samples and smears collected on two occasions during the year. These will occur during the rainy season and the dry season. Examination of fecal samples and examination for ectoparasites will be implemented immediately. Blood collection for serology and smears for blood parasites will be initiated after the establishment of appropriated laboratory procedures or arrangements have been made with cooperating laboratories or individuals. Wherever possible if an animal in the observation group dies, routine postmortem examination will be carried out, and tissues collected for histopathological examination.

Outcome:

Data collected over two years encompassing rainy season and dry season will be summarized and analyzed to provide baseline information regarding the impact of seasonal and nutritional factors on small ruminant production at the village level; prevalence and seasonal variations, if any, of ectoparasites and endoparasites and other diseases such as trypanosomiasis, PPR, and pasturellosis; and the reproductive performance throughout the year. This baseline information is necessary for the development of appropriate health and management packages to be introduced in subsequent years.

Objective 2:

To determine if improved housing and management and improved health care package (vaccination, parasite control, and sanitation) will improve production level of sheep and goats at the village level.

Evidence from studies on sheep and goat production in the Sahelian zone suggests that the main constraints to production include high mortality, low production indices and inadequate nutrition. In order to optimize the production of village flocks of sheep and goats, it is essential that improved management and health packages be introduced.

It is envisaged that an improved management and health care package will be developed based on the results of the village surveillance studies and on station development studies, thus the details of these packages must await these results. It is possible, however, that the management package will include improved housing, provision of clean drinking water, supplementary feeding and controlled breeding; the health care package may include routine vaccination for PPR, a schedule of antiparasitic drenching and treatments for ectoparasites.

The packages extended to village flocks will be evaluated for cost effectiveness, ease of integration into labor demands and feasibility of routine applications at the village level.

It is hoped that by the end of year 2, such a package will be available for extension to the target villages. It is recommended that the seven villages used in Objective 1 be used for testing. Attempts will be made to allocate sheep and goats in each of the villages in such a way that each package can be tested in each zone of the country. Experiments will be designed to test the effects of housing, supplementary feeding and health packages on production parameters of sheep and goats in the villages.

Outcome:

Data will be collected on the production indices of sheep and goats raised under improved packages versus control animals. The effectiveness of the improved technology on morbidity, mortality, weight gain, fertility and offtake will be determined by comparison among groups.

PROJECT OUTLINE: FORAGE AND NUTRITION COMPONENT

Justification:

Livestock production in The Gambia is greatly limited by seasonal variability of feed and forages. While sufficient natural pasture land and forage provide adequate nutrition for the ruminant animals during rainy season, the dry season is characterized by complete absence of green forage and/or inadequate feeding for all classes of livestock. During the eight months of the dry season, animals scavenge on agricultural crop residues and/or household refuse resulting in severe losses to animals. A 10 percent mortality rate has been reported in some villages during the dry season.

Although conservation of agricultural crop residue from maize, rice, millet, sorghum and groundnut was initiated and promoted by the Mixed Farming Project (MFP), total yield of usable crop residues was not sufficient to maintain the estimated 300,000 head of cattle for four months of the dry season (Technical Report #2). Furthermore, the increase in irrigated rice fields has decreased the area of flood-plains usually available for dry season grazing. Small ruminants are usually kept by women and poorer farmers in The Gambia. Traditionally, cattle are more valued than small ruminants; priority is given to cattle and draft animals in rationing the available crop residues. The high lignin content of the crop residues reduces their digestibility and small ruminants may not consume enough to prevent body weight loss.

We are in complete agreement with the MFP analysis that provision of dry season feeding is one of the most critical issues in the livestock production in The Gambia. Unlike the MFP, we believe that in order to reduce the nutritional gap, it will be necessary to combine the application of many strategies of feed conservation, budgeting and selection rather than an application of one uniform strategy. Therefore, the overall objective of our research efforts is to develop a dry season feeding program for small ruminants in The Gambia. It is also recognized that progress in this area will depend on active participation and cooperation with the forage agronomy personnel. Results from these investigations may provide a clearer feeding program/packages of feeding recommendations for small ruminant production in The Gambia.

The framework for the various component experiments is to develop <u>resource management</u> through hay making, feeding of industrial by-products, cut and carry methods, further consideration of deferred grazing and cultural methods involving legume intercropping. <u>New resource development</u> will involve germplasm screening for adaptability to The Gambia followed by animal trials to establish nutritional and grazing potential. The fundamental aim is to integrate each of the useful technologies into the farming system.

Component 1

Overall Objective:

To develop a dry season feeding program for small ruminants through research.

Specific Objectives:

To develop conservation methods for available feed through hay making.

To assess the quality of hay made from some local grasses and improved legumes.

To determine the biomass yield and regrowth potential of the grass/legume species.

Rationale:

The critical shortage of feed for livestock in The Gambia underlines the need to develop a better means of conserving the available forage. There is abundant natural grass species in The Gambia that could be harvested during the growth period for hay. The MFP identified some species of grasses and legumes as possessing the potential for further development in The Gambia (Technical Report #2). These include Andropogon guayanus, Cynchros ciliaris, Stylosanthes scabra and Stylosanthes hamata. Our objective is, therefore, to develop hay conservation methods for these species and some annual grasses which are common throughout The Gambia. These annual grasses are Panicum maximum and Hyperrhania species. This study is designed to evaluate hay made from grasses and legumes cut during the growth period and conserved for dry season feeding of small ruminants. Hay making presents a less complicated technology that may be easier to adopt by village farmers than other forms of forage conservation. In Kenya, this has been successfully introduced among the village farmers, and feed conservation in the form of hay has been adopted. Though the crop residue project initiated by the MFP program did show some measure of success, results indicated that crop residues fed alone did not prevent weight loss in cattle (Technical Report #11). However, crop residues supplemented with a higher quality forage in the form of hay will improve the quality and quantity of dry season forage for small ruminants. Gambian farmers have learned by experience that their animals breed during the latter part of the rainy season when they are well fed. However, the animals run the risk of greater nutritional demand during late pregnancy and lactation occurring in ewes/does during the dry season. It is not known whether this demand could be met by dry season feed supplementation.

Methods:

The experiments are to be carried on station (Yundum and YBK). During the first year, the plots of A. guayanus, C. ciliaris, S. scabra and S. hamata will be established. Where established stands exist, investigations will be conducted using the established plots. Pure stands of grass and legume species will be cut at bloom just before the onset of flowering, windrowed, wilted and baled manually with the aid of open wooden boxes specifically constructed for that purpose. Hay will be bailed when it is dry enough for storage, determined by twisting hay in the hand and making sure that there is no evidence of moisture on the twisted stems. Bales of hay will be preserved in sheds made of local materials and walled in with locally made fence materials. Feeding trials will commence during the third trimester of gestation with five days adjustment period. A total of 48 animals will be randomly assigned to experimental treatments as set in the design. Mineral salt licks and water will be provided ad libitum. Experiments will terminate at the end of lactation (4 months). Laboratory analysis of dry matter, crude fiber and protein will be determined from the forage sample as cut and as fed. A 75, 50, and 25 percent supplementation (DM basis) of grass hay will be met by either of legume hays (S. hamata & S. scraba).

Design: 4 x 3 Factorial Experiment

Item	Level of Legume Hay (% DM) 75	50	25
A. quayanus			
C. ciliaris			
P. maximum			
H. species			

The data will be summarized and analyzed to determine the success of preservation through hay making and the performance of a pregnant ewes and lambs fed grass hay supplemented with legume hay.

Animal Measurements:

Body weight before and during experiment (weekly)
Gestation Length
Litter Size

Birth Weight
Lactational Yield
Weaning Weight

Feed Intake (Fed 10 % above daily requirement to allow for ad libitum intake).

Grass:

Biomass Yield
Dry Weight Yield/Fresh Weight
Regrowth Potential

2nd Year: During the second year, trials will be conducted on-farm with the promising legumes, identified during year 1, intercropped with cereal crops.

Component 2

Overall Objective:

To develop a dry season feeding program for small ruminants through research.

Specific Objectives:

To evaluate the use of agro-industrial by-products as a supplement for fattening weaner lambs for Tabaski market.

To determine the cost benefits of agro-industrial by product feeding.

Rationale:

There is a commercial production of ground nut cake and rice bran as by-products of ground nut and rice processing in the country. These are largely exported for foreign exchange. Sesame seed cake has the potential of becoming important agro-industrial by-product as sesame crops expand in The Gambia. Wet brewers grain from the brewery is available locally though quantity may be limited. The study is designed to determine whether or not these by-products could be cost effective as a feed supplement for fattening lambs; to capitalize on the large Tabaski market and stimulate offtake of livestock (small ruminants).

Methods:

A total of 48 weaner lambs will be utilized for the experiments. A 4 x 3 factorial experiment will be conducted at which 30, 50 and 75% protein requirement will be met from agro-industrial by-products sources. Forage, either in the form of grazing or hay will be supplied ad libitum. Animals will be fed by-product supplementation each morning and then released for grazing or forage feeding. Animals will be vaccinated and dewormed as per routine on the farm and will be fed to market weight (35 kg).

Item	Levels (%) 30	50	75
Wet Brewers Grain			
Rice Bran			
Sesame Seed Cake			
Groundnut Cake			

Measurements:

Animals: Body weight before and during trials (weekly).
ADG, Feed Intake
Feed Efficiency
Cost Benefits

Laboratory: Crude protein
Crude fiber
Ash
DM
Aflatoxin content

Component 3

Overall Objective:

To develop a dry season feeding program for small ruminants through research.

Specific Objectives:

To assess mutual benefits of legume tree and cereal intercropping in compound gardens.

To introduce intercropping of legume and cereal crops into the crop-livestock farming system of the Gambian farmer.

To compare the performance of goats supplemented with legume trees (Cut and carry) with those supplemented with groundnut hay.

Rationale:

Forage agronomy is not expected to be a part of the cultural practice in The Gambia in the near future, because livestock production has always been regarded as self-sustained and little or no effort has been made to provide for their feeding. However, the carrying capacity for the available forage and range land appears to have been reached and therefore integration of forage agronomy into the overall cultural practices of The Gambian farmer must be explored for the benefit of crop-livestock production.

As human population increases in The Gambia, there is bound to be reduced range land and therefore a more intensive system of livestock production has to evolve. Legume trees and crops may become important sources of forage for the cut and carry method of feed supplementation. Information is therefore needed on development of this strategy for managing feed resources in The Gambia.

Legume tree intercropped with cereal has the potential of improving soil fertility as well as providing forage for livestock feeding. There are promising species of Leucaena already established in The Gambia by the MFP Forage Agronomy Project at both Yundum and YBK stations. Intercropping Leucaena with cereals (maize) in compound gardens is one way of integrating crop and livestock farming. Because compound gardens are fenced-in, the Leucaena plants would be protected from free roaming ruminants animals during the first year of development.

Method I:

The most promising cultivar of Leucaena will be planted in the same row with maize, millet and sorghum at three different plots in target villages. Single-row cropping of Leucaena at high density (40 cm x 1m) with cereal will facilitate the weeding operation, both crops being weeded at a single time. Leucaena seeds will be planted two weeks before cereal crops. Appropriate fertilizer and urea will be applied to the plots. Moisture content of soil will be taken at intervals during the growing season and compared with control plots where pure stands of cereals are maintained. Amount of N_2 in soil [will be taken on experimental plots] before cropping and after cereal harvest. Cereal crop yield during the first year will be recorded. Leucaena will offer no competition to cereal crops in year 1 & 2. Year 3 and subsequently, yields of both cereal and Leucaena pruned during the growing season will form the basis of cut and carry system for small ruminants. Two groups (8 each) of mature does and/or draft animals will be fed the available crop residue (maize stover). One group will receive 50% of DM requirement from Leucaena plants cut and carried to the animals tethered in compounds. The other group will be supplemented with groundnut hay. Animals will be watched closely for weight loss resulting from possible mimosine toxicity. Chemical

composition of diet as fed will be analyzed. At the end of 6 weeks body weight measurements will be taken.

Method II:

Treated seeds of cowpeas and/or pigeon peas will be planted on different plots at target FSR/E villages.

Pigeon pea will be intercropped with cereals at a high density (50 cm between rows of cereals and pigeon peas) and cut once during the growing season to avoid yield reduction to cereals. A second forage cutting at cereal harvest will be carried out. Harvest will be dried and conserved for use in feeding trials. In year 2, pigeon pea will be managed as an improved fallow, yielding periodic cuttings of forage. At the end of year 2, pigeon pea will be harvested for grain and for wood. Comparison will be made on crop yield of pure cereal stand and cereal/pigeon pea yield and weed suppression.

On farm trials of cow pea, intercropping with cereal will be evaluated. At harvest, cereal crop yield of pure cereal and cereal/legume stand will be recorded. Crop residue yield from both cereal and cereal/legume mixture will be harvested and stored for dry season feeding trials. Three groups of six to eight ewes/does will be subjected to the following treatments and fed 10% above daily dry matter requirements.

1) Legume/Cereal Residue (50/50% DM basis)
2) Legume/Cereal Residue (25/75% DM basis)
3) Cereal Residue (100% DM)

Animals will be weighed before the initiation of experimental treatments and weekly thereafter. Experiments will be carried out for a period of 4 to 6 weeks as close to the end of dry season as possible. At the end of experiments animals will be released and exposed to mature ram/buck for breeding. Number bred and time of breeding will be recorded. Statistical analysis will be accomplished using a split plot design. On-station research on legume/grass intercropping will be conducted evaluating in detail the fertilizer and space requirements.

Component 4

Overall Objective:

To develop a dry season feeding program for small ruminants.

Specific Objective:

To test exotic cultivars as well as local species of grasses and legumes for adaptability in The Gambia for pasture development.

Rationale:

Tests that were initiated by the MFP Project should be continued on both the foreign and local species of grasses and legumes for their potential adaptability and development in The Gambia. The on-station agronomic evaluation of these cultivars should form the basis for future animal trials using the most adaptive species to test their grazing and nutritional potential.

Method:

Two exotic species of Galapogonium sp. and Zonia desmantus and local grass/legumes; Alycecarpus sp., Alycecarpus rugosus, Crotalaria sp. and Gliricidia sp. will be established for on-station germ plasm observation for a period of three years. Selected species will be analyzed for chemical composition (DM, crude protein, crude fiber and ash) followed by seed multiplication and animal trials. Measurements to be taken include stand spread, height, canopy spread during rainy and dry seasons.

At the end of year 3, promising cultivars will be further established into experimental plots. Gliricidia sp. and Crotolaria sp. will be harvested and stored as hay for dry season supplementation. These new cultivars will be compared with the improved legume species as protein supplements for mature goats. Other proven species will be tested for either grazing and/or for cut and carry method.

Component #5

Deferred Grazing Evaluation:

It is recommended that before any further extension or development activity related to deferred grazing is carried out, an evaluation of results to date in this area be made by an independent team comprising expertise in sociology, economics, range management, agronomy and animal production. Ideally, this should occur within the period of late February to May 1987 to permit evaluation at a time when deferred grazing plots should be showing their maximum utility. We recognize the very considerable effort and dedication which range management scientists and their pasture assistants have invested in research on crop residues and deferral of grazing for feeding of heifers, and their enthusiasm to continue these lines of research on which they have embarked is understandable. However, we wish to explore how basic issues of land tenure, cattle ownership and offtake and acceptability are likely to affect the long-term utility of these strategies before deciding on the appropriate level of support for their maintenance or extension. The MFP socioeconomic evaluation (Technical Report #16: Chapter 8) determined that deferred grazing

would need continued high-level government inputs to sustain the demonstrated short-term benefits and that the strategy faced problems of incompatibility with traditional practices. However, the MFP final report identified deferred grazing as meriting further attention.

The questions we would wish the evaluation team to address include:

1. Have deferred grazing plots provided an economically justifiable contribution to cattle production?

2. What animals are the beneficiaries of the deferred grazing? Is this input being applied to the most critical sector of the producing animal population?

3. How has deferred grazing been accepted in the villages where it was introduced? What is the level of current participation or non-participation?

4. Would deferred grazing be acceptable to other villages or others in the same villages in the absence of free fencing?

5. How would current land tenure practices affect acceptability (continued or extension) of deferred grazing.

6. Would small-scale fodder banks for small ruminants be more or less acceptable and/or economically justified? Consideration should be given to the different gender roles in small ruminant production.

If the report recommends continued studies on deferred grazing, specific animal trials will be conducted, further exploring the use of deferred grazing for small ruminants to determine the most appropriate grazing period.

Component #6

Follow-up on Range Inventory Data:

The range ecology component of the MFP compiled range inventory data for approximately 500,000 hectares in URD and MID. The whereabouts of this data in The Gambia is not known and analysis of the data have not yet been made available. Inquiries will be made with the MFP base in Colorado and if necessary with Scotty Deffendol in Lesotho to determine the whereabouts and status of this data. Similar inquiries will be made concerning the associated cartographic studies. If necessary, an appropriate level of collaboration to accelerate the analysis will be worked out.

Inquiries will also be made concerning the support needed to provide conservation of the herbarium developed by the MFP in collaboration with the DAHP range scientists.

Utilization of Research Output:

Although different research projects are planned under the forage and nutrition component, these are aimed at developing a feeding package that is capable of sustaining small ruminant production in The Gambia on a continuing basis.

We recognize the need to initiate research on the forage and nutrition components of the proposal as early as the 1987 rainy season. However, it must be emphasized that without a technical assistance in forage agronomy in implementation of research objectives, this essential component of small ruminant studies may not be carried out successfully. It must also be pointed out that the forage component of the experiments may be modified to some extent by the forage agronomist when one is identified and in place.

The results generated from on-station work will undergo further tests at the farmer's level utilizing Farming Systems Research and Extension (FSR/E) methodologies. Based on the information generated from on-farm trials, a set of feeding packages for sheep as well as goats will be developed. It is hoped that the same feeding trials will be done with the new cross-bred goats from Kenya to establish management and husbandry differences, if any, between the new breed and the local stock. At the end of the trials, successful technologies, measured by the extent of adoption by farmers, will be formulated for dry season feeding of small ruminants.

Laboratory Facilities

The present laboratory facilities at DAHP are not equipped to provide analytic support for forage and nutritional work. Large numbers of samples are expected to be generated from forage and other nutritional studies and these will be systematically assayed in the laboratory. The requested equipment and supply list is basic and is meant to provide the scientists with a means of interpreting research results. As work is anticipated in both Yundum and YBK stations, it is hoped that the laboratory facility at Abuko, soon to be vacated by ITC, may be used to house the forage and nutrition laboratory for both stations and other analytical needs of DAHP. The facility would be renovated to supply air and water to the laboratories. We hope to work closely with the soils laboratory personnel because of the similarities in the equipment. Also close cooperation will be sought with the ITC laboratories.

Proposed schedule for ruminant and forage work:

Dates:	Work:
1/87-12/87	Assembly of ewes, rams, does and local bucks at Yundum
	Upgrade of fencing and physical facilities at Yundum including water, telephone and office.
	Institution of a regime of measurements as outlined for the original animals.
	Village survey work in progress.
	Establishment of forage plots of legumes and grasses at Yundum and YBK
	Initiation of intercropping trials in compound gardens in target villages.
1/88	Visit of DAHP personnel to Kenya to observe dual purpose goat management packages and documentation as well as village trials.
1/88	Procurement of imported bucks
	Separation of ewes from rams to wait for later synchronized matings
3/88	Begin experimental goat matings
6/88	Begin experimental matings of sheep
7/88	Cutting and hay making on-station/forage evaluations
8/88	First F1 goat kids born
11/88	First experimental lambs born

12/88 (Cont.)	Weaned F1 goat wethers available for feeding and management trials
	Feeding trials with agricultural by-products.
	Village trials of health packages based on village survey results.
1/89	Begin hay feeding trials.
3/89	Matings of original does to opposite breed. Matings of F1 does to bucks.
	Weaned lambs available for feeding and management trials.
5/89	Second round of sheep breedings
8/89	First F2 kids born
	Second set of F1 kids born
	Sale of 1988-born F1 wethers
10/89	Second lamb crop
12/89	F2 and F1 wethers for trials at Yundum
	Evaluation of experimental goat crosses for male growth characteristics
	Weaned F1 kids moved to YBK Leucaena trials with cut-and-carry system
2/90	Weaned lambs moved to YBK for trials
3/90	Matings of F2 does to bucks selected based on growth characteristics to be best cross.
6/90	Pigeon pea trials on station
8/90	Kidding of F2 does

12/90 (Cont.)	Data evaluation of F2 females based on dual purpose criterion including reproduction, growth and milk yields.
	Cowpea hay and residue feeding trials
1/91	Selection of a small number of bucks of the breed composition evaluated as optimal for trials at the pilot villages.
	Management packages based on results of trials at Yundum and YBK assembled with extension documentation.
2/92	Improved cultivar trials on station including evaluation under grazing and lab analyses
1/91-12/92	Pilot trials of management packages and experimental goat crosses.

A Proposal for Prioritizing Animal Traction Research

It is recognized that research on animal traction has potential to increase productivity in all sectors of Gambian agriculture. A multidisciplinary approach is essential in determining priorities and in execution of research to allow optimal integration of all components of the animal draft system.

We wish to emphasize that a national commitment to draft power must include the use of draft on the research station for field operations, transport, post harvest processing and water lifting and irrigation. We are aware that the replacement of the internal combustion engine by draft power on station would entail a fundamental change in attitude and would complicate research station management (training and care of animals, timing of field operations, etc.). Yet we firmly believe that this would reduce operating costs in the long run and would ensure that research is operating under constraints similar to those faced by the farmer.

Objective: Increase agricultural production through animal traction (ANTRAC).

Problem Analysis: To update and expand knowledge base on animal traction.

Procedures:

1. Formation of a multidisciplinary ANTRAC working group under the guidance of the FSR/E Steering Committee. The working group will be comprised of the following:

    a. Agricultural Engineer
    b. Animal Scientist
    c. Agronomist/Soil Scientist
    d. Sociologist/Agricultural Economist
    e. Extension Representative

2. Review of past studies and relevant current work. Evaluation of existing equipment prototypes.

3. Rapid reconnaissance survey, to be accomplished within a period of three months, will be done with the active participation of the working group. This will allow them to gain first hand experience in farm level animal traction use and to focus their technical skills on specific problems. From the analysis of the survey results research priorities will be determined.

4. A formal survey will follow analysis of the rapid reconnaissance survey and will comprise units of observation to be incorporated into the National Agricultural Statistical Survey to provide greater coverage and long-term surveillance trends in animal traction.

Rapid Reconnaissance Survey

Outline of areas to be investigated:

1. Ownership and use

    a. Ownership of draft animals within davadas
    b. Management decisions concerning draft uses
    c. Extent of draft ownership.
    d. Extent of rental market for animals and/or equipment
    e. Ownership and use of different equipment

2. Health

    a. Major health problems by species
    b. Use of veterinary services, frequency and cost
    c. Expected working life by species
    d. Traditional health care practices

3. Nutrition

    a. Decision making concerning feed allocation.
    b. Frequency of feed supplementation
    c. "Hungry season" strategies
    d. Purchases of animal feeds and sources

4. Draft Animal Supply

    a. Source by species and current trends
    b. Use and management of female draft animals
    c. Price trends (purchase and resale values)
    d. Training methods and schedule by species. Problems encountered

5. Work schedule

    a. Transport

        - breakdown by species and by season

    b. Field operations

        - Soil preparation: equipment and animals employed, crop involved duration of work
        - Seeding: use of SuperEco by species and crop
        - Weeding - equipment (3 tine and 5 tine) by species and by crop
        - Harvesting - use of groundnut lifter
                     - use of 200mm and 350mm lifters by species
        - Prevalence of horses and donkeys working in pairs

c. Current use of draft power for post harvest processing and water lifting
d. Other uses of draft power

6. Institutional support

a. Impact of VEW of draft usage
b. Impact of DEC (MFC) of draft usage
c. Current role of animal handlers

Research Design and Implementation

A tentative list of research themes would include:

a. Animal Health and Nutrition

- equine mortality
- draft cow management
- supplemental feeding

b. Equipment Development, Modification and Evaluation

- mechanical rice cultivation (tillage, seeding, weeding)
- fertilizer application
- post harvest processing
- ridge planter
- ridge plow modification
- yoke design
- water lifting

These research topics will be prioritized based on the results of the Rapid Reconnaissance Survey and a detailed budget and workplan will then be developed.

Three-month work plan

Week 1: First meeting of FSR/E steering committee
(Ag. Eng., Agronomy, SWMU, Extension, Extension Aids Unit, DAHP, PPMU, SAPU representative)
Agenda: Nomination of working group and criteria for reconnaissance survey

Week 1: First meeting of ANTRAC working group
Elaboration of reconnaissance survey

Week 2:	Trial run of reconnaissance survey Modification of survey questionnaire
Week 3:	Second meeting of FSR/E steering committee Review of revised survey with pilot results Trek program for survey execution
Week 3 - Week 8:	Survey execution
Week 9 - Week 12:	Survey analysis

Socioeconomic Studies

The animal production participants will need the collaboration of sociologists and economists in addressing several issues. We share the concerns expressed by the Mixed Farming Project Socioeconomic Study that very careful attention must be placed on defining criteria for "improved livestock production." We believe that this still has to be worked out for small ruminants in The Gambia. All socioeconomic and market analysis efforts by MFP were weighted heavily towards cattle. Much of the incentive for small ruminant production is held within the intrahousehold and intravillage strata where it is essentially invisible to market analysis. The small amount of data available in the MFP socioeconomic analysis (Technical Report #16) support the concept that the economic efficiency of small ruminant production may be far higher than cattle in the same village. The same report also reiterates that profit and income are not the only incentives for livestock production. With the greater participation of women in small ruminant production than in cattle production, an assessment is needed of labor patterns as well as decision patterns and other non-economic factors affecting this sector of livestock production. Before proposing the introduction of adapted technology for more productive animals requiring a greater degree of input, we need to understand the balance of inputs and outputs in the present system. Presently outputs appear low but are offset by extremely low management inputs. Will our "improved" technology give a better rate of return? How can we measure its "success"? Understanding all the forces at play in determining allocation of labor, feed or water, sale, slaughter and consumption, offtakes of milk and its usage and management of small ruminants will be key to understanding the potential acceptability of new technologies such as the introduction of dual purpose goats, and what means of introduction may facilitate extension.

Although much of the incentive for small ruminant production is apparently at the intravillage level, it will also be important to understand the market patterns on a larger scale. At the present time, trade at Jumos includes animals from as far as the Mauritanian border. What are the economic factors affecting this trade? To what extent does it interact with local trade and to what extent is it a superimposed Senegalese phenomenon which happens to occur in The Gambia? How does the Tabaski market, both in Senegal and nationally, affect sheep production at the village level? What are the market opportunities for which certain types of production could be developed?

Many similar social and economic questions apply to poultry production. Of particular concern before development of a commercial poultry industry would be an analysis of markets for eggs and broiler birds. Recent poultry development activities in Senegal have underlined the need to be assured of a market before embarking on the production cycle (Appendix C: Jane Ellis).

Course of Action:

Our recommendations for long-term technical assistance include a research associate sociologist, a research associate economist and senior short term technical assistance in both disciplines. We also recommend counterpart training in both disciplines.

The charge to the sociologist would thus be to evaluate social, cultural and economic incentives and constraints affecting the acceptability of the livestock improvement measures proposed for sheep, goats, the forages to feed them, and for the poultry interventions. Secondly, in conjunction with the economist, we would like to see quantitative measures developed which could be used to assess the effect of the proposed interventions both in production at the village level and in national and international markets.

Additional Proposals

1. Station Rehabilitation

Both Yundum Sheep and Goat Station and YBK have considerable physical deficiencies. To support research activity at these stations, rehabilitation of key installations and additions of some other components will be essential. It would appear that plans have been made within the proposals presented to UNDP by DAHP. We have been unable to determine the status of these proposals. In principle, GARD should support the necessary renovations to make these stations workable, but should not duplicate other funding. In order to allow development of research to continue we recommend the following course of action:

1) Work should begin immediately on rehabilitation of the office building at Yundum Sheep and Goat Station. Our inspection suggested that the building is structurally sound and that renovation work on false ceilings, floors, windows, paintwork, and the provision of some basic office furniture (desks, chairs, cabinets) would make the office functional.

2) An estimate should be obtained for installation of a telephone in the above office building. If acceptable, installation should be done as soon as possible.

3) An estimate should be obtained for a new well at Yundum Sheep and Goat station and for piping water to delivery points. If acceptable, work should begin as soon as possible.

   Materials and supervision of estimates and implementation should be provided by GARD and labor managed as for other office renovations at Yundum.

4) Estimates should also be prepared in conjunction with Agricultural Engineering for installation of an animal-powered water lifting device at the well. This estimate will be reviewed in conjunction with other draft animal developments as priorities are established for research.

5) Estimates will be made, based on the office renovation carried out in #1 for renovation of additional buildings as staff living quarters.

A decision on the execution of work in #5 will be made when information is available on the status of the UNDP funding. Plans for basic sheep and goat housing and further subdivision of the existing barn are included in the component proposals. Sources of funding for further housing must be considered if UNDP funding is not available.

In addition to the renovation of the Yundum sheep and goat station facilities, it is recommended that YBK station be upgraded to house some sheep and goat trials. The MFP project established forage observation plots at the station, and it appears that some species of Leucaena, Stylosanthes and Andropogon were doing better at YBK. Since YBK has established stands of these species, it is recommended that hay experiments be carried out at the station. This will afford us the opportunity of evaluating the environmental influence on a country-wide basis. Therefore, the facility at YBK station should be revitalized to handle some of the on-station trials involving feed conservation. This will not preclude the studies at Yundum Station.

It is understood that a relatively modest capital outlay could effect the necessary physical plant renovations at YBK. Additional funding would be needed to rehabilitate the borehole and generator. As is the case at Yundum, decisions on proceding with renovations will be taken when more information on availability of UNDP funding is available.

2. Laboratory Support System

After visiting the facilities of DAHP and talking with workshop participants, a problem was recognized which is not uncommon in other developing countries. Within the Ministry of Agriculture there are several laboratories and other facilities (Soils, Feeds, Veterinary Diagnostic laboratories, hatchery) which depend on the functioning of sophisticated equipment, tools and instrumentation (spectrophotometers, balances, microscopes, incubators, refrigeration equipment, etc). Among GARD's plans are the further provision of equipment and it is likely that over the years other sources of funding will make it possible to acquire yet more instruments. Acquisition of such equipment often comprises a substantial proportion

of a research or development budget. It would appear, however, that there is no uniform plan for maintenance and repair of this equipment. We encountered several items standing idle because they were "broken" but there were no means of identifying the source of failure. In some cases a service agent can be found in Dakar, in others the nearest or most accessible is in London or the J.S. Dealing with such agents is costly, requires foreign exchange and does not always produce the desired results. Non-functioning and malfunctioning equipment is also costly in terms of the inability to deliver results. In a country such as The Gambia where there may be only one of each type of equipment, mechanical or electronic failure can bring a complete research program or analytical service to a halt.

We believe that within the framework of strengthening and institutionalizing agricultural research, a very important element of the support infrastructure which needs to be developed is a management system for scientific equipment repair and maintenance. In some respects the development of a coordinated system for equipment management is as basic and logical a component of a research system as development of a coordinated library system. It will probably not be appropriate to aim at correcting all equipment failures in-country, but a system needs to be worked out for problem diagnosis, execution of feasible repairs, solicitation of spare parts and referral of complex problems. Another important area where the same expertise is required is in advising on the selection, acquisition and setting up of new equipment. Given the size of The Gambia and the sparsity of laboratories within each department, in order to provide coverage for the full range of equipment types, it may be most appropriate to combine forces on this issue with other users of scientific instrumentation (hospitals, ITC, Gambia College, possibly MRC) and develop a centralized service system. We believe that a laboratory support system would contribute substantially to the present efficiency of research, its sustainability and to the assurances to future donors that equipment can be set up correctly and function for years to come.

Proposed course of action:

We recommend a short-term consultancy by an instrumentation specialist from the University of Wisconsin Instrumentation Service Center to help analyze the situation, develop a management plan and identify technical training needs. Some instrument calibration and rehabilitation could also be carried out by this consultant. The Instrumentation Service Center has had successful consultation experiences on similar problems in Indonesia, Egypt, Kenya and other countries. Prior to this visit, preliminary and exploratory discussions should be held with other institutions using scientific instruments (as indicated above) to find out how they currently handle service and repair and whether they would have an interest in joining forces with the Ministry of Agriculture. An inventory of equipment within Ministry laboratories and other participating units should be collected before the STTA visit.

We propose that this consultation should be carried out in the second half of 1987. Given that needs for technician training will be identified, the earliest possible date should be selected.

3. Proposal for inputs to livestock assistants training

An area which was touched on during workshop discussions but which needs further attention is how GARD can contribute to the new Livestock Assistants Program at the Gambia College. It is understood that funding has been made available by FAO to strengthen this program and that the curriculum will be a combination of general education inputs by the Gambia College staff and specialized inputs by DAHP staff. GARD should explore ways that it can assist with adult education teacher training for DAHP staff, teaching aids, and direct teaching inputs. Most of the senior livestock officers at DAHP passed through the Livestock Assistants Training Program; we should regard it as the first step in the training of future livestock oriented researchers, research assistants and the base upon which any further in-country training programs should subsequently be built.

Technical Assistance

Several events, which interact with the base from which livestock related research within the Gambian Ministry of Agriculture must grow, make long-term technical assistance from GARD of particular importance. The Department of Animal Health and Production is anticipating a structural reorganisation some time in 1987. A transition will occur in the foreseeable future from leadership by a FAO-sponsored expatriate directorship to a totally Gambian administration. The Mixed Farming Project provided considerable leadership in research during its tenure, but has not left a legacy of planning and design capability. The development of the International Trypanotolerance Center is proceeding rapidly and has resulted in secondment of several professionals from DAHP. Because of its focus on one disease and one subsector of livestock production and aspiration to International Center status, the ITC development has made it harder for DAHP to maintain balance in its inputs to both services and research nationally. The effect of all of these events, combined with the relatively low level of professional training and operational budget support, have had a fragmenting effect on DAHP efforts. We are proposing to offer degree training to several candidates in the department, which, while having obvious long-term benefits, will complicate the in-country operations still further in the short term.

We see as imperative, therefore, the rapid provision by GARD of both long-term and short-term technical assistance for livestock related research. The long-term assistance should consist of an animal scientist, forage agronomist and research associates in

sociology and economics. The first two will be charged with providing continuity and support during the internal transitions and the development period of Gambian counterparts. This core team would be supplemented by short-term specialist inputs and short-term visits designed to promote communication and coordination with the US participating universities, with the long-term intent of strengthening the institutional relationship with the Gambian research system.

Long-Term Technical Assistance

Proposed inputs are summarized in Table 5.

Animal Scientist: A faculty level animal scientist with primary broad capabilities in ruminant nutrition and management, but capable of day to day facilitation of poultry research should be sought. Extensive experience with design and implementation of on-station and on-farm research in developing countries, preferably Africa, will be needed. This individual should be in place in The Gambia as soon as possible. However, as this proposal will almost certainly entail a search process, the tour of duty would probably start in late 1987 or early 1988. Provision must be made for continuation of the long-term assistance after the initial 2-3 year tour of duty.

Forage Agronomist: Inputs into forage agronomy must begin before those in animal science and ideally before the 1987 growing season. The research proposals call for development of forage resources ready for testing on-station as the dual purpose goats and sheep and goat management techniques are evaluated. Some aspects of the proposed forage work call for on-farm work which will take more than one cropping season to reach maximum utility. Partnered with a senior animal scientist, a junior-level forage agronomist with field experience with legumes and intercropping in West Africa is recommended. Breadth of experience and versatility will be as important in this individual as in the animal scientist. Support of the present counterpart forage agronomist as he works into a leadership role will be an important function as will fostering the good communication between agronomists and animal scientists seen during the planning workshop.

Sociologist: The justification for this long-term assignment is indicated in the proposal section. At present there is not a Gambian trained to provide the necessary inputs. The studies called for need to deliver results while extension packages for livestock production are still in the formative stages. An important attribute of this person will be the ability to establish the necessary rapport at the village level, and particularly to gain the confidence of the less vocal Gambian women, to understand their role in decision making and

the implications to them of change in small ruminant and poultry management. Thus, it is recommended that a research associate level sociologist be assigned as soon as possible.

Economist:

The research discussed at this workshop would likely lead to recommendations for greater inputs to Gambian livestock with resultant greater output. Economic research is needed to determine whether this will be worthwhile for farm families. An economist should obtain a rough indication of the current inputs that Gambian farmers give livestock and the current returns. This can be done through a series of farmer interviews at several key times during the year to capture differences during, for example, the dry and rainy season and also when herding costs are high at the end of the dry season. Purchased inputs such as feed and health care should also be assessed. The economist should also interview researchers and review the literature to determine probable costs and returns under more intensive, biologically "improved" systems. Comparison of the current and improved systems should focus heavily on sensitivity analysis to identify factors that are critical to making the new systems more or less worthwhile to farmers.

Short-term Assistance

Proposed inputs for the first 18 months are summarized in Table 6.

The counterparts in poultry in The Gambia will have the capability to carry out the proposed program, provided the training inputs suggested are carried out and periodic short-term technical assistance is available. It is envisioned that once the long-term animal scientist is in place, they will provide routine facilitation and communication. The poultry programs can be initiated in 1987 with 2 STTA visits which will be repeated in subsequent years to reinforce the LTTA.

STTA visits by both additional animal or veterinary scientists and forage specialists will provide specific expertise and consultation as needed. An example of this would be to provide technical assistance in establishing forage laboratory testing as a follow through to the technical training proposed. STTA's will also serve to reinforce communication with the U.S. campuses. Senior STTA visits will be needed in support of research associates in economics and sociology.

The above recommendations for technical assistance have not addressed needs in the area of draft animals. Inputs here will be worked out when the rapid reconnaissance survey results have been analyzed.

Short-term technical assistance may be requested from other institutions and projects such as the Kenya CRSP and ILCA. In the initial year it is recommended that Dr. Patterson Semenye, who has provided leadership in development of the Dual Purpose Goat Program in Kenya, visit both the University of Wisconsin (while in the U.S. on other business) and The Gambia to consult on the potential for establishment of dual purpose goats there.

It is unlikely that the animal scientist can be in The Gambia before late 1987/early 1988. In order to follow up on data collection and other short-term activities arising from the workshop, it is proposed that Dr. Homan visit The Gambia in late May-early June. This would allow further assessment of inputs to draft research, given the results of the reconnaissance survey, as well as discussions of details for short- and long-term training, follow up on discussions of livestock assistants training, interaction with nutritionists, follow-up on renovations at Yundum and documentation accession.

Table 5

Possible Long-Term Assistance

	1987	1988	1989	1990
Animal Scientist Senior Faculty		(----------)(--------		
Forage Agronomist Research Associate	(----------	----------	----------	)
Sociologist Research Associate		(----------	----------	)
Economist Research Associate		(----------	----------	)

Table 6.

Possible Short-Term Technical Assistance 1987

	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Forages		xxx	xxx	
Range Evaluation Team		xx		
Homan		xxx		
Wentworth		xxx		xxx
Shapiro*				
Pope				xx
Semenye	US			xx
Ezekwe			xxx	

*Livestock Economics, timing to be decided.

Information Needs

Documentation

In direct support of the proposed research a list was assembled of areas on which additional background information would be needed. It was recognized that this would be a research support mechanism in which ongoing communication with the U.S. participant universities would be helpful. The expatriate participants were surprised to find among Gambian counterparts a relative lack of awareness and interest in published resources. We attributed this to the fact that there has been relatively little opportunity for Gambians, even those who have studied abroad, to really learn how to use the literature, particularly in preparation for a new research effort. Our counterparts should take advantage of all trips to the United States to familiarize themselves with information resources they can access through GARD. In addition to the support which GARD can offer, the literature referral service now provided by ILCA will help alleviate the problems of inaccessibility of literature. Photocopies from the University of Wisconsin of approximately 40 articles relating to small ruminants and poultry development in West Africa were left with the DAHP training coordinator Ena Corrah for incorporation into the DAHP reading room.

Ongoing assistance will include collection of relevant new research papers when they are published.

Another problem we noted was that few of the workshop participants can read French at a level sufficient to permit their utilization of station reports and publications from adjacent countries. Among our training recommendations is a French technical reading class to be conducted at Abuko or Yundum. The Alliance Francaise in Banjul currently offers classes to Government employees, but the logistics involved in getting to class on a regular basis discourage many would-be participants. Development of this skill must be repeatedly stimulated by having the francophone West African literature available. This should also lay the ground work for later development of enough language skill to network effectively in the region.

In addition to literature covering specific topics, a list of regular publications, a short list of journals and some initial suggestions for important books to have available was developed. We await with interest the report of Mary Bailey's consultancy and will be discussing with her how we may best integrate livestock components into the framework of library resources. In the meantime the journals listed will be reviewed for actual content, to try to ensure that those recommended are appropriate for The Gambia.

Networking

Three types of activity need to be considered under this heading: participation in regional conferences, visits by Gambian scientists to specific stations and projects and increasing GARD familiarity with training opportunities.

Participation in structured conferences and workshops will allow Gambian scientists to gain familiarity with research being carried on in the region and establish initial links with counterparts in an efficient and effective way. Advantage should be taken of workshop and conference opportunities which offer the chance to hear good research presented and debated.

A specific recommendation in this category is that Tayib Jaiha and Aminatta Njie attend the Goat Production Conference to be held at the University of Ife in July 87. This is being organized by workers at Ife and their counterparts from Wageningan and should attract a good international group.

The pros and cons of techniques seen in operation at a particular station need to be examined discriminatingly and their relevance to The Gambia weighed to avoid possible duplication or inappropriate technology transfer. To be most productive, visits to specific stations or projects should be delayed until a little clearer thinking and research progress has developed in the proposed areas in The Gambia. Advantage should be taken of senior expatriate researchers in joint visits to specific projects. The prolonged nature of livestock research is such that it is harder to "take it all in" on one well-timed visit than would be the case with crops projects, and this is particularly the case for inexperienced researchers.

In developing short-term training options in specific areas of livestock production, it would be useful to have a greater degree of familiarity with institutions elsewhere in West Africa. This was one of the primary goals of the visits originally proposed by members of the STTA team prior to this workshop. A certain amount of information can be accumulated by correspondence and recommendation but will not permit the same degree of understanding as a first hand chance to visit with people on-site. We hope that Dr Pope's visit, planned for 1987, to Nigerian ILCA stations in his capacity as AID liaison will allow the opportunity to bridge some of these gaps.

Training Inputs Proposed

Our recommendations for training inputs in support of animal related research are based on our own data collection on the educational background of participants in the workshop and other staff members. Overall, there are few individuals in DAHP and the associated sections of other departments with research training.

Three of the workshop participants hold MS degrees (in animal science, nutrition and economics). An additional member of DAHP is currently enrolled in a MS program in sheep production. Seven more are trained to BS level. The Department has eight veterinarians (including the Director and Assistant Director but excluding those seconded to ITC). We are not aware of additional individuals with degree training but recognize our data may be incomplete. These individuals cover not only research but all other functions of the Department such as veterinary services. Our intent in making recommendations is to 1) provide training in disciplines where this has been lacking 2) strengthen disciplines in which all degree training is held by one individual to the point where a critical mass exists 3) develop a follow-up by providing training to additional junior staffers and 4) make sure the necessary expertise is available for carrying out the priority research. We advocate that selection of institutions for degree programs should be determined by 1) their having a good and appropriate program and provided this criterion is satisfied, 2) that training at one of the counterpart U.S. universities will serve to strengthen the institutional associations and hence the long-term communication and support systems for Gambian researchers. The involvement of faculty at these institutions ensures their interest in the progress of Gambian students enrolled in the degree programs. A third criterion in developing all types of training will be to establish linkage with other African institutions.

Nomination of individuals is not our prerogative but we will make recommendations based on our observations in The Gambia and advocate that selection be based on academic aptitude and potential to benefit from training and to contribute to research programs.

Master's Level

Poultry Management

At present there are no Gambians with degree level training in any aspect of poultry production. As one component of a training plan to strengthen research and extension capability in poultry production, we propose a Master's program enabling an individual with demonstrated interest in poultry to build on a general agriculture BS background and develop expertize and leadership capabilities in poultry research. To encourage strengthening of institutional linkage and to allow the individual to maintain contacts with ongoing research projects in The Gambia through dialogue with STTA's, we advocate that this program should be offered at the University of Wisconsin. Emphasis could be placed on poultry management, hatchery management or avian pathology. These are all areas of importance to both village and commercial poultry research in The Gambia. Because research in poultry is just beginning in The Gambia we feel it would be most appropriate for the research component of this degree to be done in the United States. We propose that this program should commence in the Fall of 1987.

Animal Science - Ruminant Management

As is the case with poultry, we feel that a balanced program should include training inputs at several different levels. We see an acute need for more BS level training but feel it is important to develop leadership capability and more familiarity with actual research which a BS program would not provide. A Master's program with emphasis on ruminant nutritional management is recommended. This program could start as early as the Fall of 1987. Omar Jallow is scheduled to return at the end of the year and so the absence of this candidate would not create a major depletion of human resources. In the third year of the Master's program, the proposed sheep and goat work in The Gambia would be reaching peak activity.

Sociology

There is no Gambian researcher trained to the MS level in sociology. The research programs in livestock and crops would benefit from greater sociological inputs.

Bachelor's level

Extension Methods, Emphasis on Poultry

As indicated in all the component poultry proposals and in the livestock sector policy paper, communication of information on management technology is of fundamental importance to development of the poultry industry. The need for programming and organizing extension efforts was recognized during the workshop. We propose that an appropriately motivated individual should receive training in the Continuing and Vocational Education Department of the University of Wisconsin. Programs in this department are designed to be combined with a strong disciplinary bias, in this case to poultry. Selection of a candidate with appropriate prior educational experience might allow this program to be completed in less than the usual 4 years. Although the emphasis will be on poultry, this person will be equipped to assist in programming and development of other aspects of extension. We see this as strengthening the essential linkage which can ensure translation of research to production and recommend that this training should start in the fall of 1987.

Animal Science

We are concerned not only with training to ensure the execution of the research currently proposed, but also with developing a "second generation" of trained animal scientists who will expand the capabilities of the Department in the short term and will assure the continuation of the research process over the years. We propose two additional BS level programs:

In the first instance Aminatta Njie, who has completed a Diploma program at Egerton College is eligible to upgrade this to a BS in their newly developed degree program. She should be encouraged to explore possibilities for returning to Egerton for completion of her BS. This would be accomplished in 1-1/2 years from her present standing at Egerton. If this is not possible an alternate way of building on her current training to the BS level should be sought in the U.S.

A second BS candidate should be sought from among the junior level staff and enrolled either in a general animal science degree program or in an animal science program with a reproductive biology emphasis in the U.S. We will research suitable programs and seek assistance in identifying capable candidates. This program should start as soon as possible, but realistically will more likely start in the Fall of 1988.

Forage Agronomy

We concur with Dr. Gritton's recommendation for additional degree training in forage agronomy. At present only one individual has degree training to the BS level in forages. To develop a critical mass we propose two additional BS programs. To avoid over-depletion of the section, one of these should start in the fall of 1987 with the second following in the fall of 1990. In identifying constraints to animal production in The Gambia, nutrition and the provision of year round feed were considered of primary importance and our research priorities reflect this. Academic programs in forage agronomy should include experimental design and data analysis.

Economics

There is a scarcity of researchers at the BS level in all fields, including economics. If more such researchers were in the research system they could assist with work on the economics of livestock.

Table 7.

Possible training Inputs

Degree Training Proposed:	1987	1988	1989	1990
To MS				
Poultry management	(----------	----------	----------	----------)
Animal Science	(----------	----------	----------	----------)
Sociology	(----------	----------	----------)	
To BS				
Extension Methods	(----------	----------)		
Animal Science		(----------	----------	----------
Forage Agronomy	(----------	----------	----------	----------
Economics		(----------	----------	----------
In Kenya* Animal Science	(----------	----------)		

*If not possible to complete BS in Kenya this would be a high priority in US, with possible additional study.

Table 8.

Short-Term Trainings Proposed*

	1987	1988
Poultry Extension	xxxx xxxx xxxx	
Poultry Diagnostics		xxxx
Monogastric Nutrition	xxx	
Feeds quality	xxx	
Vet Lab Diagnostics		xxx
Agroforestry	xx xx	
Lab Maintenance		await result of consultancy
Administration	xxxxx	xxxxx
Adult Education		await further information
Kenya Extension		xxx

*More may be added subsequently for later years

Poultry Extension

With the emphasis on village and commercial poultry production in the component research proposals, we see a necessity to provide rapid upgrading of technical skills and abilities in extension communication before the proposed research programs can be effective. This is in addition to the longer range plans for degree training to provide solid leadership. We propose to bring three other individuals to the U.S. for a short (3-4 week) "tailor made" training course in the late summer of 1987. This would include attendance at the Salisbury Poultry Disease Workshop (an intensive three-day practical course), rotation through laboratories and intensive tutorials and field work with poultry extensionists. The timing would allow the STTA visit to the Gambia to ensure follow through and application of the newly aquired skills. We feel that we can better cater to the specific needs of The Gambia by putting together such a program rather than by identifying a short course directed to a more general audience perhaps with more interest in industrial scale production.

Veterinary Diagnostics

We see a need for training a DVM to provide leadership and supervision of the veterinary diagnostic laboratory. This individual would provide liason between the field and the laboratory, selecting the procedures to be used and interpreting the test results in terms of treatment and epidemiologic implications. This individual would be responsible for some gross pathologic diagnosis and training should place particular emphasis on poultry diseases. A short-term training will be designed to provide intensive practical experience in diagnostic pathology, laboratory techniques and laboratory management. We see the diagnostic laboratory as a key tool in epidemiologic research both for ruminants and poultry. This training should be delayed until the outcome of the Department reorganization is clearer and the core group of veterinarians who will remain in the Department has been established.

Monogastric Nutrition

As efforts are made to develop rations for poultry and swine which incorporate local ingredients rather than depending on imported feedstuffs, it will be important to have the laboratory capability to perform the feed analyses. Short-term training in practical aspects of monogastric nutritional techniques will be offered in the first semester of 1988 to an individual with an appropriate base of laboratory experience.

Feeds Quality

A final decision on the format of this training will be made after the STTA has had a chance to work with counterparts in setting up the feeds laboratory. At this point technical competence will be assessed and decisions made as to whether "on-the-job" training in specific techniques is adequate or whether technicians would benefit more from either attendance at an ILCA short course or a short practical training in the US or elsewhere in Africa. Conversations with the laboratory director indicate that at least some additional training will be required and that this should be in the form of hands-on practical laboratory work.

Alley Cropping and Agroforestry

The forage and nutrition component proposals include a substantial component of intercropping of legumes and cereals as one strategy for efficiently combining forage and human food production. While we are not specifically recommending alley cropping, much of the technology of alley cropping will be applied. The Livestock Team recommended that a forester and a forage agronomist attend a two-week IITA workshop in April 1987, which is an efficient way of briefing them on this technology prior to its implementation in The Gambia. Dual attendance by representatives of these disciplines should serve to bridge potential communication gaps in integrating the necessary inputs in The Gambia. We will attempt to find alternative schedules or programs for this short-term training.

Administration

Strengthening of the research system calls not only for support of individual scientific disciplines but also of the research administration within the department. The reorganization to establish a research division makes this timely. We are making enquiries to determine the best way to offer short-term training addressing management and planning of research, project design and proposal writing. This would involve two key individuals in the restructured department over the next two years. This is likely the most important step we can make towards assuming optimum utilization of material and human resources in future research efforts.

Extension Methods in use in the Kenya CRSP program

To maximize the extent to which we are building on the technology already developed within the SR-CRSP program we propose that one Gambian animal scientist should spend a period of 3-4 weeks becoming familiar with techniques used and problems encountered in management of the dual purpose goats on-site in Kenya. As shipment of the goats

to the Gambia will require accompaniment by a qualified animal scientist, we suggest that this training period in Kenya immediately precede shipment.

Short-term Training Recommendations Pending

Adult Education

We recommend further discussions to define training needs which will strengthen DAHP's ability to contribute to the livestock assistants training program.

Laboratory Maintenance

Included in our proposals for technical assistance is a consultancy to help identify training needs in establishing a laboratory support system. We anticipate training recommendations will be made by this consultant

SHORT-TERM PLANS: LIVESTOCK INPUTS TO GARD

January - March 1987

In The Gambia

1. Small Ruminants

   a. Continuation of village prospective studies of production parameters. A protocol is attached (Appendix D) which will be reviewed by the Farming Systems Steering Committees in January.

   b. On-station, at Yundum Sheep and Goat Unit: It is advocated that a regular production recording system be introduced with the same objectives and components as the village based recording system.

   Both these components will be initiated in the first quarter, provided steering committee approval is forthcoming, and will be continued throughout the year.

2. Draft Animals: The attached component research proposal for animal traction research includes a three month workplan for carrying out a rapid reconnaissance survey which will be the basis for focussing future directions of draft animal research.

3. Training: It is recommended that French Technical Reading classes be initiated at Abuko. Contacts will be established with the Alliance Francaise to work out how this may be done.

In the U.S.

1. Information: The process of collection of the information identified as necessary by the workshop and review of the suggested journals for relevant content will begin.

2. Dr. Patterson Semenye of ILCA and Winrock will visit with the Livestock team in Madison and review the plans for dual purpose goat developmert.

April - June 1987

1. Consultancy: Evaluation of the Deferred Grazing demonstrations of MFP

2. Training: Participation of Abdoulie Danso and Musa Bojang in the IITA Alley Cropping and Alley Farming training course April 13-24, 1987.

3. STTA visit: Late May - Early June: Homan to review village data collection progress, plan follow-up to draft animal survey, discuss possible inputs to Gambia College based livestock assistants courses, follow up on range review, meet in Senegal with Dr. Olivier Faugere to follow up on contact made by Jane Ellis.

4. Initiate forage agronomy activities.

5. Initiate poultry activities.

July - December 1987

1. Networking: July: Participation by two DAHP participants in Goat Production Conference at the University of Ife.

2. Consultancy by Laboratory Support Systems specialist.

3. Poultry: Research startup and STTA visit(s) by Wentworth.

4. Arrival of Research Associates in Sociology and Economics and possible STTA by senior sociologist and economist.

5. Renovation work at Yundum.

6. STTA visits in Forages an Nutrution..

7. STTA: Visit by Dr. Pope to ILCA stations in Nigeria (funding from elsewhere) and as part of GARD to the University of Ife and The Gambia. Coordinate with visit by Dr. Semenye from Kenya to review goat production potential in The Gambia.

In US:

1. Training: Arrival of initial Gambian degree training candidates for Fall semester.

2. Training in feeds analysis and follow up STTA visit.

3. Poultry Extension short-term training.

January- June 1988

1. LTTA: Animal Scientist arrives in The Gambia.

2. Initiation of experimental phase of goat and sheep development programs on station.

DISCUSSION AND CONCLUSIONS

We believe that the outcome of the planning workshop is far different in several ways from that which would have resulted from a series of visits by individual livestock STTA's. The complexity of the agricultural environment dictates that approaches to sustainable livestock improvement involve integrated application of a variety of disciplines. Interdisciplinary group interaction was engendered by the workshop.

The workshop approach stimulated participation and interaction by both Gambian and expatriate scientists. The research proposals developed are neither GARD nor Gambian initiatives but a real combination emerging from the melting pot of ideas and experiences which we saw in Bakau. All the participants undeniably learnt from each other and left with the feeling that we had all worked together as a team. Several of the Gambian team members indicated that this was the first time they had been in at the initial stages in research planning. Obviously if GARD is to succeed in institutionalizing agricultural research, this is an experience with which they must gain yet more familiarity. As the research proposed is carried out, they should feel an increased sense of involvement and satisfaction in knowing they were instrumental in its conception and design. We saw, too, that during the workshop there was an increasing degree of communication, understanding and acceptance of opinions between individuals from different departments. This problem oriented way of getting to know our counterparts was also very helpful when it came to analyzing who would be appropriate candidates for additional training. There are undoubtedly additional promising candidates whom we did not have the chance to meet. Many more ideas were generated than were finally incorporated into our proposals. We hope and expect that the long-term animal scientist will bring yet more. We have tried to set general directions and provide specific examples of how the objectives may be brought closer. We would not wish to preclude inputs into the design by the long-term technical assistants.

We recommend that the process of communication started in the workshop be encouraged to continue by means of an annual review session for all livestock related activities. This would be a one to one and a half day conference which would review progress, reinforce goals, incorporate new ideas and modifications, and lay out the sequence of events for the coming year. This type of activity now occurs in the ARAB meetings but we feel a specifically livestock review would strengthen the team approach we see developing. This would be primarily a Gambian exercise although hopefully it could be organized when one or two STTAs or LTTAs were in country. GARD is in a position to offer the key catalyst that will be needed in developing this sense of direction and teamwork.

An area where we believe we share a concern with all associated with the agricultural research system is that of incentives for

involvement in research. Excellence and effort in research must be rewarded and execution of research should not place additional financial burdens on those involved. We hope that the restructuring process will adequately address this issue.

Relative to our colleagues in crop-related research, and despite the recent MFP inputs, it appears that livestock related research activities are at an earlier stage of development. Agronomic research at Sapu has gone on for over 20 years. While recognizing the necessity of the current efforts for further strengthening, this time span has generated a degree of organization and familiarity with the process of research, and an older more experienced professional staff, which we do not see in livestock. This may also account for the feeling that within GARD, crops related research has gotten off to a faster start than livestock. At times we encountered a certain amount of resentment of this by livestock department counterparts, but it is undoubtedly a "chicken and the egg" situation in which initial involvement will lead to further involvement; we reiterate our encouragement to get organized and get involved.

One area where this is particularly true is the FSR/E activities. Although the STTA team has some reservations about the amount of time and human resources tied up in this exercise and the appropriateness of on-farm trials in livestock research, farming systems almost everywhere in The Gambia involve livestock. Where there is not livestock representation in the FSR/E steering committees and field teams, we urge renewed efforts to correct the balance.

In making these comments, and in development of the component research proposals, the underlying premise is that integration of crop and livestock activities is essential to the long-term sustainability of agriculture in The Gambia. A balance of a variety of livestock and cropping activities provides the best nutritional output, the best use of the available resources, the best ability to respond to continuing environmental stresses and the best risk avoidance strategy.

We wish to stress that a variety of livestock activities are needed. Our proposal are directed to small ruminants and poultry in recognition of the fact that these fill different economic and nutritional niches from the cattle production which has received most of the attention in the past. As a team we find it difficult to see how measures to encourage production of cattle can have a long-term benefit until a strategy can be developed to curb the growth of herd size. This would not be a strategy based primarily on production practices but must address the more fundamental social issues of land tenure and a trust in the banking system. Until farmers have something to gain by restricting herd size in terms of status, economic risk avoidance or control over individual access to feed resources in subsequent years, we will continue to see more cattle on less land, further reduction in carrying capacity with further degradation, needless wastage of animal protein resources through dry season mortalities and increasing vulnerability to epidemic disease.

This thinking is the reason, in large part, for our reservations about investment in range management activities. Coupled with this is a recognition of the level and duration of professional inputs needed to carry out meaningful research, the extension of which is still subject to land tenure practices and concepts of wealth. It could be argued that, by avoiding the issue, we are not going to make it go away; our concern is that inadequate inputs may make the situation worse and that the fundamental problems are not in the hands of the animal or range scientists. Resources must be focussed first on areas which have high probability of yielding returns. As cropping activities in The Gambia diversify, we see small ruminant production moving more and more to a cut and carry system, and our forage production recommendations have this potential long-term outcome in mind.

The proposals we are presenting for goats, sheep, animal traction and forages are mutually reinforcing. This is true of the extension packages they will ultimately combine to form, and of the process of their execution; research animals need to be fed and forage experiments must include feeding trials. In each case we have selected objectives in line with the developing livestock policy, GARD's objectives expressed in the project paper and the group perception of constraints to production, and we have laid out an experimental format for testing alternative technologies. In several of our proposals we are building on other AID funded research. In the dual purpose goat proposal we will be experimenting to see if we can adapt the work done in the AID-Small Ruminant CRSP project in Kenya to the Gambian environment. Our proposals for intercropping will draw on experiences in similar activity in AID projects elsewhere in West Africa. The ground work done by MFP in focussing attention on the need for strategies to provide dry season feed and in making farmers aware of the value of crop residue conservation and in screening candidate forages on-station will greatly facilitate our work. We will be adapting and extending some of their findings with Stylosanthes and Leucaena, conservation methods and intercropping. After hearing the results of a review of the deferred grazing work by MFP, we will review whether follow-up work is appropriate. As it is, the areas on which we plan to build are those which MFP's own socioeconomic evaluation rated highly.

The sheep and goat work we advocate be carried out on station initially. By its very nature of 'experimental' work, we do not know what the outcome will be. We are optimistic but are not prepared to go directly to an on farm setting. A delay of probably two years will occur before the sheep and goat work is ready for farm trial. It is even more difficult to get reliable data with mobile livestock in a village setting than with stationary crops and, both in the interests of sound technology transfer and institutionalization of research, we need to develop well designed experiments rather than demonstrations of an alternative technology for the species. This delay will be to our advantage, however, in allowing the sociologic findings to be incorporated into our strategy for going on-farm and deciding to which target groups should the technology be introduced and what are the

keys to acceptability. The component proposals have the potential to benefit both commercial and village production and to indicate possible ways of developing intensive sheep raising operations.

The pigeon and duck demonstrations do deviate from this philosophy and here we are following MFP's advice as to the worth of exploring small-scale interesting opportunities. The village poultry proposal does call for immediate on-farm testing of alternate strategies of management but again this is within a controlled experimental design.

We have steered away from recommending large scale breed improvement plans. Recognizing the flock size and timespan needed to make significant progress through our own breeding programs, we are choosing to capitalize on work already done by SR-CRSP in the case of goats and many years of breed development and selection for disease resistance in poultry. In the case of sheep we choose to work on maximizing the genetic potential of the presently underexploited Djallonke. Similarly we have restricted field observations of production to the minimum needed to provide a baseline of comparison of experimental results and of similar studies in adjacent areas. The work done by Leforban, Faugere and Landais to be published shortly, will contain observations on approximately 100,000 sheep in villages throughout Senegal and are supplemented by observations of reproductive performance from the Kolda station (approximately 70km south of Sapu).

In order to make on-station work more relevant to field situations, one recommendation included in the preamble to the proposal for further work on draft animals, is that traction and field work on-station be provided by draft animals. On-station work may be more controlled but we should make efforts to make it as close to the situation in which it is to be applied as possible. Use of tractors is not a realistic option for Gambian farmers at present and use of draft power has yet to reach its potential. This will also offer us possibilities for research on draft animals on-station.

The relative lack of emphasis on draft animals within our present proposals does not indicate a lack of importance or interest, but rather the lack of previous work on which to build. We recognize the very considerable efforts on the part of the agricultural engineers but agree that our understanding of the animal component is far less developed. Good research inputs to the animal draft system can have benefits for a wide range of agricultural activities and we hope that when the rapid reconnaissance survey results are analyzed we will be in a better position to better prioritize our research, training and technical assistance recommendations.

As our predecessors in MFP, we recognize that water availability is of paramount concern to livestock producers in The Gambia. Water is a constraint not only to animal survival, but at a far lower threshold, to optimum milk and egg production. We hope that research within the animal draft proposals can include some water lifting

systems. The Gambia could benefit rapidly from transfer of technology for water lifting which has been developed and utilized extensively elsewhere. However this will not provide all the answers for provision of water for stock and inputs from outside the Ministry of Agriculture will be essential in addressing these problem.

Throughout the workshop exercise we emphasized that we should develop research priorities without being constrained by the potential sources of funding. It is important now that communication be established with World Bank, UNDP and PVO livestock specialists to discuss ways in which we can combine forces to optimize the use of the available resources.

In leaving The Gambia after the workshop, the feeling we have is that there is a tremendous amount to be done to strengthen livestock related research, through collaboration in executing the proposals we describe, training, technical assistance and other kinds of support which we can provide through the GARD mechanisms. We are enthusiastic about the potential for making a significant contribution to food self-sufficiency. We are impatient to proceed with the tasks we have identified and look forward to continuing to work towards these goals with our Gambian counterparts.

APPENDIX A

Schedule for Livestock Team

Overall plan:

Phase 1: Orientation of GARD team to Gambian agriculture.

Phase 2: Workshop. Review of ongoing programs, analysis of available information and identification of constraints, research domains and tentative component research.

Phase 3: Development of detailed research recommendations, review of proposals with interdisciplinary teams, preparation of final proposals, protocols, and training recommendations.

Monday 1 December

8:00 a.m.: David Gibson, Lawrence Bruce and Bintu Nying
Administrative briefing
Logistical briefing on orientation trek
Mile 7 Office

9:30 a.m.: M.S. Sompo-Ceesay and Elon Gilbert
Overview of GARD activities and integration of livestock component
Technical briefing on orientation trek
Dept. Agriculture, Cape St. Mary

1:00 p.m.: Introduction to DAHP counterparts
Dr. Sidney Quartey, Dr. Omar Touray, Jebel Sowe, Tayib Janha, Patricia Andrews, Ena Corrah, Mama Janneh.

2:30 p.m.: Introduction to ITC
Prof. Ian McIntyre and staff
Short overview of ITC activities

Tuesday 2 December

8:00 a.m.: Poultry Group
Abuko: Poultry Unit & Kunkajang village
Poultry production counterparts: Patricia Andrews, Ena Corrah, Mama Janneh, and Momoudou Manneh

Tuesday 2 December (Continued)

8:00 a.m.: Ruminant Group
Abuko: Briefing on Range Management Program
Counterparts: Joof, Panga, Calo, Njie, Sowe.
Visit Yundum Sheep and Goat Project site
Counterpart: Tayib Janha

P.M. Visit Yundum forage agronomy trials: Musa Bojang.

Wednesday 3 December

7:00 a.m.: Depart Mile 7 for Trek
Jebel Sowe, Ena Corrah, Aminatta Njie.

Somita MFC and visit Kassange Village
Briefing: Village FSR/E activities and data collected by:
Livestock assistant B. Sanneh and Research Assistant, Abou Kolley

Overnight at Sapu Guesthouse

Thursday 4 December

8:00 a.m.: Over view of activities at Sapu station
By: Bakary Sonko (PAO) and Albert Cox (PSO)
and Dr. Ibrahim Diallo (RELO)

9:30 a.m.: Bansang ITC Site

Visit YBK station: Lamin Jobe

Visit to Sare Ngai Village

Return to Mile 7

Friday 5 December

Visit with Department of Forestry: Abdoulie Danso
Visit Agroforestry trials at Sotokoi

Saturday 6 December

8:00 a.m.: Visit ITC Kombos station with Prof. McIntyre

Sunday 7 December

7:00 a.m.: Depart Mile 7 for Kerr Wally and Njaba Kunda villages
Visit Farafenni lumo
Counterpart Jebel Sowe
Return to Mile 7

Monday 8 December

Team members spent time with individual counterparts.

APPENDIX B

GARD LIVESTOCK RESEARCH PLANNING WORKSHOP

Friendship Hostel, Bakau.
9-19 December 1986

Tuesday 9 December

7:30 a.m.: Breakfast

8:00 a.m.: Opening Session

9:00 a.m. Review of ongoing projects and existing proposals
FSR/E Livestock Activities: Tayib Janha
Forage Agronomy: Musa Bojang
MFP Deferred grazing and residue feeding: Alieu Joof
PPMU activities: Ken Johm

Lunch

Agroforestry activities: Abdoulie Danso
Report of Poultry workshop: Patricia Andrews
Report on earlier draft animal study: Papa Cham

Wednesday 10 December

7:30 a.m.: Breakfast

8:00 a.m. Findings in Senegal/Burkina Faso: Jane Ellis
Information gathered in The Gambia: Jane Homan
Proposals for sheep and goat improvement, feeding and nutrition: Momoudou Mboob
Overview of FSR/E; Elon Gilbert

Lunch

DAHP future: Omar Touray

Objectives of livestock production in The Gambia
Initial problem analysis

Thursday 11 December

7:30 a.m.: Breakfast

8:00 a.m.: Analysis by disciplinary subgroups.
Identification of production constraints, component research needs.

Lunch

Continuation

Friday 12 December

7:30 a.m.: Breakfast

8:00 a.m.: Subgroups without producer representatives
Outline proposals

Lunch

3:15: p.m. Core Group
Research methodologies discussion.

Saturday 13 and Sunday 14 December

No formal group meetings were held on Saturday or Sunday. Individuals and small groups worked on proposal preparation.

Monday 15 December and Tuesday 16 December a.m.

7:30 a.m. Breakfast

8.00 a.m. Review outline proposals in subgroups. Integrate components into second draft. Review feasibility, compatibility, integration with other agricultural research efforts.

Lunch

Continuation

Tuesday 16 December p.m.

Discussions with interdisciplinary group. Relation of livestock component research to other research and farming systems activities.

Wednesday 17 December

7:30 a.m.: Breakfast

8:00 a.m. Integrate information and suggestions from interdisciplinary discussion into draft proposals
Work on budget

Lunch

1:00 p.m. Review group: Drs. Quartey, Gilbert, Senghore, Gaye, McIntyre, B. Touray, Sompo-Ceesay.
Review priorities, integration with other research efforts.

Thursday 18 December

7:30 a.m.: Breakfast

8:00 a.m.: Subgroups refine and finalize proposals. Information needs defined.

Lunch

Wrap-up conference

7.30 p.m. Dinner

Friday 19 December

8:00 a. m. Transport for participants to leave hostel

CORE GROUP OF PARTICIPANTS

Omar Touray	Jebel Sowe
Tayib Janha	Papa Cham
Patricia Andrews	Ena Corrah
Mama Janneh	Aminatta Njie
Omar Njai	Momoudou Mboob
Njaga Njie	Musa Bojang
Alieu Joof	Abdoulie Danso
Adama Ceesay	Ken Johm
Anna Richards	Frank Holdbrook
Dawda Sarr	Andrew Jones
Bernard Wentworth	Mike Ezekwe
Gretel Dentine	Art Pope
Bill Bosu	Tom Remington
Jane Clark Ellis	Jane Homan

SUBGROUPS

Poultry:

Patricia Andrews	Ena Corrah
Momodou Manneh	Mama Janneh
Njaga Njie	Anna Richards
Bill Bosu	Adama Ceesay
Bernard Wentworth	

Ruminant/Forage:

Tayib Janha	Omar Touray
Aminatta Njie	Ken Johm
Musa Bojang	Momodou Mboob
Omar Njai	Alieu Joof
Frank Holdbrook	Bakary Sanneh
Art Pope	Bill Bosu
Gretel Dentine	Mike Ezekwe

Draft:

Jebel Sowe	Papa Cham
Dawda Sarr	Tom Remington
Andrew Jones	

PRODUCER REPRESENTATIVES

Momodou Bah and Kebba Joof: Kerr Wally

Sinajo Colley: Kassange

C.B. Bojang and Mabinty Janneh: Kunkajang

LOGISTICAL COORDINATION

Caroline Mbye and Connie Tucker

APPENDIX C

BUDGET

Available Upon Request

APPENDIX D

PROTOCOL FOR CONTINUATION OF PROSPECTIVE SURVEY OF VILLAGE SHEEP, GOATS AND CHICKENS. 12.19.86

Objectives of this prospective survey were detailed at the start of data collection. Assembly of quantitative data on weight gains, health status and reproductive parameters of animals in traditional management systems will help to provide an understanding of seasonal factors, nutritional needs and other production parameters at the village level. This will also help to form a basis for extrapolation of data from studies in adjacent countries and to establish a baseline for evaluating impacts of future interventions.

Procedures:

Continuation of sampling in Farming Systems Focus villages with modifications to the protocols used to date, as detailed below:

1. Villages in which sampling will continue are: Abbakutta, Giroba, Kassange, Kerr Wally, Njaba Kunda, Sabbi, Sangajor Jiramba.

2. Frequency of sampling: every two months, a total of six visits to each village each year. Visits will be coordinated wherever possible with those of the multidisciplinary team.

3. Offspring from tagged animals should be tagged at birth and incorporated into the observation group. This has not been done so far and an effort should be made to trace and tag those born to study animals over the last two months and to include them in the study group. If any village then has less than 20 sheep and 20 goats additional animals should be added to reach this target level.

4. Nutritional condition and height measurements should be discontinued.

5. More effort should go into the accurate recording of current feeding.

6. Measurements will continue to be done by livestock assistants. Senior livestock officers will periodically check data collection procedures, including duplicate weighings.

7. Data will be recorded in the field on the sheets provided. All data will be transcribed into a bound record book to be retained by the livestock assistant. Original data sheets will be sent for computer data entry. Data entry will be done as promptly as possible to facilitate feedback to the collection point.

8. To facilitate management of both data collection and processing, visits to the seven target villages will be distributed over each two month collection period. A schedule will be developed and circulated to livestock assistants and data entry counterparts to facilitate spacing and timeliness of each visit.

9. Chickens presently included in the survey will be checked and losses, deaths, sales etc. recorded. No additional chickens will be added. In each compound where small ruminants are inspected a count of the total population of chickens will be recorded at each visit.

11. These data collection procedures will continue for at least one year. Periodic updating of analyses will permit any additional fine tuning and summary feedbacks to all participants.

12. Once availability of diagnostic reagents and laboratory processing techniques have been assured, additional routine procedures proposed will include:

a. Fecal samples: to be collected three times per year: at the start of the rainy season, the end of the rainy season, and mid dry season. These samples will be processed by fecal flotation and parasite counts and species recorded.

b. Animals will be examined for presence of ectoparasites at the same time as the fecal collections, numbers recorded and specimens collected for identification. When skin lesions are present a skin scraping will be collected for identification of ectoparasites and fungal infection.

c. Blood samples: to be collected once per year for serum and smears. Sampling will be done on these occasions with the assistance of a veterinarian. Sera will be used to assess immune status to major diseases (peste des petits ruminants, parainfluenza 3, brucellosis, contagious caprine pleuropneumonia and caprine arthritis encephalitis).

d. Routine necropsy of poultry and small ruminants.

APPENDIX E

REPORTS PRESENTED TO INTRODUCTORY SESSION OF WORKSHOP

Tayib Janha:	FSR/E Livestock Activities
Musa Bojang:	Overview of Forage Agronomy Activities
Alieu Joof:	Range Management Program
Ken Johm:	PPMU Activities (summary from oral presentation)
Abdoulie Danso:	Agroforestry Activities (summary from oral presentation)
Patricia Andrews:	Report of Poultry Workshop
Papa Cham:	Overview of Animal Traction Research
Jane Ellis:	Review of Small Ruminant and Poultry Research and Activities in Senegal
Jane Homan:	Information on livestock gathered to date in The Gambia
Omar Touray:	Future of Department of Animal Health and Production. (Summary of oral presentation)

FSR/E Activities

Tayib Janha

On behalf of the Director of Animal Health and Production, I would take this opportunity to welcome the participants in the workshop starting with the Permanent Secretary-Ministry of Agriculture/Chairperson, members of the Research planning Mission from the University of Wisconsin-Madison, the interdisciplinary team from the Ministry of Agriculture, and above all the producer representatives. I do intend to be concise in the presentation of the Livestock FSR/E activities from the beginning of the rainy season to date.

Before I get into the FSR/E (Farming System Research/Extension) activities on the livestock subsystem; I would briefly outline the main areas of activities by the multidisciplinary agricultural research team in the Gambia Farming System tentative strategy of approach. In order to develop a farming system structure, a consultant by the name of Dr. Frederico Poey was invited in May, 1986 to come up with a strategy to strengthen the farming systems approach to research and extension in The Gambia. Dr. Poey's objectives and methodology were seen as a vital starting point and since then have been implemented. The objectives and methodology proposed by Dr. Poey may be available through the GARD project.

The strategy devised by Dr. Poey lead to the regionalization of The Gambia into two researchable domains; mainly the western and eastern regions, respectively. The research/extension regional activities would serve in:

a. the orderly diagnosis of farmer's constraints and the maximization of resources in designing and implementing research alternatives;

b. increase the number and types of exploratory and refinement on-farm trials;

c. to establish among extensionist and researchers a self-motivating feedback mechanization.

Dr. Poey structured the regional organization into two teams:

1. the FSR senior teams composed of senior level staff from research and extension at each station (Sapu and Yundum).

2. the FSR/E field teams composed of representative of research, extension, livestock, socio-economics and NGO and other institutions.

During 1986/87 FSR/E activities concentrated mostly in the following areas:

1. Farming household crop subsystem,
2. The development of effective team work,
3. Farming Systems zoning exercise by Professor Posner,
4. Diagnostic Survey and analysis of constraints,
5. Plans for 1987/88 cropping season.

These plans of activities by the multidisciplinary team reflected the reality of the transitional phase from the reductionistic approach to research in The Gambia to the complementary approach (the Farming System).

As little is known about the basic production cycles of small ruminants and poultry in The Gambia it would be realistic for the livestock research sector to be active in the descriptive and diagnostic survey/analysis of constraint phase in 1986.

The Gambian Agricultural Research and Diversification project (GARD) intended to concentrate its support on small ruminants (sheep and goats) and poultry improvement with major emphasize in adaptive research. In this respect, two of our partners from the University of Wisconsin-Madison Research Planning Mission visited The Gambia and were furnished with the secondary information needed to formulate hypothesis regarding potential researchable areas under the domain of sheep, goats and poultry research. On the basis of this information, the University of Wisconsin-Madison livestock Research Planning Mission sent Drs. Tom Yuill and Jane Homan for a 2-week mission to The Gambia in September of 1986. Dr. Jane Homan spent another four days in The Gambia after the departure of Dr. Yuill on 30th September, 1986.

The objectives of this "Yuill-Homan" trip were as follows:

1. Review the three proposals with DAHP (Department of Animal Health and Production) personnel,
2. Formulate a plan to accrue additional information needed for development of specific research plans,
3. Assess the in-country infrastructure available to support livestock sector research,
4. Carry-out detailed workshop planning with GARD and DAHP staff.

In order to fill the gaps or validate or refute the hypothesis submitted to the secondary data collection phase, Dr. Jane Homan and Tom Yuill, in consultation with DAHP personnel and GARD developed two programs of activities:

1. An Informal Reconnaissance (Sondeo) survey questionnaire was developed to determine farmer objectives, attitudes, and practices.

Under the "Sondeo" survey the criteria we looked for in the non-intervention villages were:

a. areas with different environmental characteristics
b. market access
c. ethnic makeup
d. cropping activities.

2. A preliminary prospective study was initiated in certain villages to establish production parameters.

RESEARCH INFRASTRUCTURE:

Seven senior animal scientists from the Department of Animal Health and Production were selected by the Director to form an interdisciplinary team in the areas of sheep and goats, poultry and draught animal research. Four of these personnel represented the Department in formulating an agenda within the three livestock "sub-systems" in the Western region. The other senior representatives were entrusted with the same responsibilities for the Eastern region. Additional responsibilities of the senior interdisciplinary team were administrative, logistics, and budgeting.

The field team was composed of ten Livestock Assistants/Inspectors. Six were assigned to the four focus villages within the Western region. Two out of the group of six would be responsible for one or two villages, collecting data and all other relevant information within the focus village(s). The Eastern region was covered by four personnel concentrating their efforts in three villages. They were assigned the same duties as that of the Western region field team.

In the case of "Homan-Yuill" mission's activities Dr. Quartey, the Director of Animal Health and Production, proposed the addition of draught animals to the other two livestock subsystems of the Sondeo exercise.

During the Homan-Yuill mission the Sondeo questionnaire was first pretested in Boiram, Taifa and Kunkujaing villages and subsequently carried out in Faraba, Sare Wurring and Pacharr villages. A prospective production parameter study is being carried out at Kassange, Sangajor Jiramba, Abbakulta, Giroba, Sabbi, NjabaKunda and Kerr Wally. Information gathered was shared by the University of Wisconsin-Madison Research Planning Mission team and the Interdisciplinary team of the Department of Animal Health and Production.

It was our intention that data collection be the responsibility of the FSR/E Field Team in the future. Monitoring and analysis of such data would be part of the responsibilities of the Senior interdisciplinary FSR/E team.

ACCOMPLISHMENT:

Our activities during the past four months has been centered on Sondeo exercise and small ruminant, poultry and draught animals production parameters studies.

The Sondeo exercise in the non-intervention villages has been completed. The production parameter focus village sites have been identified and follow-up exercises are being carried out. The FSR/E field team may continue the data collection in the focus villages up to 15th December, 1986.

The Gambian Agricultural Research and Diversification Project has provided the livestock research sector with the following logistical support during the course of the exercise:

a. Transportation
b. Stationeries
c. Fuel.

CONSTRAINTS

During the course of our activities we encountered constraints in the following areas:

1. Administration and logistics (GARD)
2. Lack of time by participating farmers as this was the period of high labor demand for harvesting,
3. Gathering of livestock in a group for the production parameter study
4. No production parameter study for draught animals
5. Bartering of livestock was not taken into account in our prospective study program
6. Untimely arrival of the prospective study team in the focus village(s)
7. Poor financial incentives to research practitioners
8. Uncoordinated communication network
9. Policy constraint.

Such constraints were the results of lack of understanding of the proper linkage that should have been developed between the Administrator and the practitioner prior to the implementation of the Farming System program. Therefore, I think it would be appropriate

for the workshop participants to address the significance of reorienting all those who are in one way or the other associated with the farming system program. The farming system cannot be successful without the proper understanding of the interrelationship between the indigerous and exogenous factors governing its environment.

Before closing I would like to stress the point that the farming system environment is the embodiment of the agro-ecosystem and the socio-ecosystem in which an interdependency and an interrelationship between the subsystems within the farming system dictates the farm household's development perception. In order to understand the critical bottleneck in Gambia's agricultural production system the farm household's perspective must be the core in the development of the adaptive research system in The Gambia. Therefore, an interdisciplinary and a multidisciplinary approach to the problem of the farm household is a matter of great importance if an adaptive research is to be promoted successfully.

In conclusion, it is essential for us to understand that livestock integrated into the farming system of the household in The Gambia is the catalyst in the development of crop commercialization.

AN OVERVIEW OF THE FORAGE AGRONOMY PROGRAM

A PAPER PRESENTED AT
THE LIVESTOCK WORKSHOP
DECEMBER 9, 1986

MUSA BOJANG

FORAGE AGRONOMY PROGRAMME

INTRODUCTION

This paper presents an overview of the forage activities since its inception within the Mixed Farming Project (MFP). Prior to MFP, some work had been done on a few grasses and legumes by officers of the Agriculture Department in charge of the Livestock Farm at Yundum. As a result of a change in policy, the livestock farm was ceded to the then Veterinary Department, and in the transition, I guess the agronomic component of the farm records was no longer interesting to the livestock specialists and indeed got lost over time. Hence the agronomic work on forage was discontinued until MFP started. As part of the terms of reference of Mixed Farming Project, a forage program was initiated with five objectives.

1. Introduction of adapted legume cultivars for use on fallow lands.
2. Promoting better use of crop residues through improved harvesting storage and feeding.
3. Evaluation of crop residues and promising legumes through feeding and grazing trials.
4. Multiplication of seeds of promising cultivars.
5. Training of personnel (extension staff) to deliver improved technology in forage production to farmers and livestock operators.

ACTIVITIES

Dr. Don Hendrick, a forage agronomist, was hired in the first phase of Mixed Farming Project to initiate the objectives spelled out in the original design. The program started with difficulties in assigning a permanent Gambian counterpart.

Eventually 15 accessions were planted in locations representing three major soil associations in The Gambia. The sites were Yundum, Sapu and YBK. Seed sources have been drawn from Australia, South America, Philippines, Nigeria and Cameroon. Seeds were primarily legumes such as Stylo species, Aeschynomene spp and Leucaena.

In 1982 planting was done in early July with stand and weight measurements taken until plant maturity in September for early

maturing varieties extending into late December 1982 and early 1983 for the maturing varieties. In fact two species, Stylosanthes scabra and S. sympodialis remained green until April at Yundum. Leucaena stayed green the entire time except for a brief wilting period at YBK in May. South American cultivars of the three species of Stylosanthes - hamata, scabra, and sympodialis out-performed the Australian commercial seed - hamata humilis and scabra at about 2 to 1 in yield and were substantially taller at the end of the growing season. Leucaena performed better at YBK and Sapu than at Yundum but young plants of the Philippine seed source which survived heavy grazing by harvest at Yundum grew well in the 1983 season.

In 1983, planting was expanded to seven locations representing each Division. Unfavourable weather including severe drought in July at most sites gave disappointing results. However, the 1982 planting did well in their second season during a difficult period of most crop plant.

Harvesting, drying and storing of crop residues began in late October, 1981 and continued through 1983. It was found that maize and sorghum stovers should be cut immediately after grain harvest and left standing with the butts down until transported to the feeding site. Groundnuts should be windrowed immediately after lifting to preserve the 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 mature animals but since it requires heavy machinery during harvesting and chopping, it is not practical for the small farmer.

Livestock feeding trials to evaluate crop residue were conducted in 1982 and through to the end of MFP. All feeds used including groundnut hay, gamba grass hay, rice straw, maize and sorghum stovers, and maize and sorghum silage were found to be valuable dry season forages. All residues with exception of the two stovers enabled one- and two-year old heifers to maintain their weights to six weeks. Chemical analyses indicated that groundnut hay mixed with stovers would probably prevent weight losses that otherwise occur.

Seed multiplication from CIAT and Australian accessions in order to provide enough seed for expansion started at Sapu in 1983/84. Since then Sapu has been our primary site for seed multiplication.

The forage production and management component concentrated on some of the specific objectives mentioned in the first half of the Project. However, with staff changes in the second half of the Project and concern for input delivery to farmers and the methodology of delivering the package to farmers, it became crucial to re-define

the objectives of the forage program. It has often been argued that forage per se might not progress off from station level to farmers level. Critics argue it has never been part of the agricultural system for farmers to plant "grass", even though there is evidence of farmers gathering and storing crop residues to sell to small ruminant operators at high prices when the grazing areas have little or nothing to offer.

In the light of some of these arguments, Dr. Sandra Russo, the Forage Agronomist in the second half of the Project, together with her colleagues, designed experiments leaning towards on-farm delivery, though there was a continuation of some of the on-station work done by the predecessors. Forage work was devoted to

- experimental trials utilizing adapted forage legumes - intercropping trials
- crop residue feeding trials
- grazing trials
- village level livestock feeding programs
- herding studies

Intercropping trials. Introducing forage legumes into the traditional cropping system is a fine art. It must be done without seriously reducing food grain yields in the same year even though it may raise them in subsequent years, and without intolerably adding to the farmers' labour requirements. The advantages of legume intercropping are multiple provision of groundnut cover and weed control, provision of nitrogen to soil and cereal and most importantly, provision of a feed resource for grazing. Several intercropping experiments of forage legumes with maize were conducted to study the planting arrangements that will give an optimum yield of grain, stover and legume hay. A few of the experiments failed in the two years due to faster growth of the legumes which smothered the corn seedlings. These same experiments have been repeated this cropping season with slight modification. A metre-strip was opened up in already established legume plots to reduce the effect of plant competition. The results of the experiment are yet to be analyzed.

Grazing trials. The best measure of forage productivity is in terms of animal performance. This is expensive and often not possible to monitor due to lack of controlled area or lack of animals. The evaluation of pastures through animal production must generally involve compromises between desirability of studying a total system of adequate scale and resources available.

There are several stages involved in testing new varieties of forage species. After small-plot introduction trials before extensive studies, the pasture should be evaluated to prevent promotion of undesirable species which could eventually become weeds. For example, a pasture species may not withstand moderate grazing but could be useful in systems using rotational grazing.

There are two approaches to the study of pastures and their utilization by animals. The first is concerned with pastures and the second with animals. Determining the relative palatability or acceptability of a range of pasture species would be an example of the first case. In the second case, normal measures of animal performance, e.g., weight gain, milk production, etc., necessitate longer-term trials in order to evaluate the effect of pasture species or animal production.

In the forage testing program several pasture legume species were subjected to intermittent grazing to determine their relative palatability. Animal preference was measured by time spent per individual plot of a species. Work oxen were used two at each site - Yundum, YBK and Sapu. Sheep and goats were also used.

It was difficult to get reliable data on small ruminants due to the handling problem and the timing of experiment. There was enough green vegetation around the plots which the animals were accustomed to that kept them from eating the introduced legumes. However, grazing trials with work oxen, sheep and goats have pinpointed a few most preferred by livestock and indeed these are legumes adapted to The Gambia.

A collaborative effort with the range management unit and livestock owners associations in the villages of MID and URD on deferring and improving range lands and saving crop residues in the dry season has been successful. Farmers outside the study areas have been gathering, storing and feeding crop residues on their own.

A herding study was conducted in four villages to collect information on herd ownership and management, distances travelled to water, grazing pattern and plants consumed. Crop residues provide a significant proportion of the feed supply while grasses are the most abundant forage eaten in bush lands.

Ongoing Program

The forage program this year is limited to on-station trials approved at the ARAB meeting. Some are a continuation of the trials conducted by the forage agronomist in M.F.P.

Intercropping Leucaena and Maize

In 1985 an attemp· was made to intercrop maize into leucaena plots by cutting off the leucaena plants and planting maize in between one metre rows. The leucaena grew so well that it shaded the maize. A different crop geometry needs to be tested in which rows of maize are planted between widely spaced rows of leucaena. The objective is to determine the best planting arrangements for maize and leucaena.

- evaluate the effect of leucaena on maize grain yield
- evaluate the effect of total maize and leucaena production (biomass).

In another trial, cereals -- including maize, sorghum and millet, were intercropped with various species of legumes at three levels of N applied (0, 50, 100 lbs). The objective is to evaluate

- N content of the soil
- Organic matter content of soil
- Grain yield
- Biomass production (stover and hay)

Introductory screening and multiplication of legumes and grasses are being conducted at Yundum. Cultivars are evaluated on biomass production (Stand count, height and canopy spread), seed production, and drought tolerance. Adapted cultivars are further multiplied for seed production at Sapu.

Suggestion for forage research

The ultimate objective of forage research and development is to strengthen the livestock system. For convenience, it is necessary to break down forage research into two components.

- plant/soil interface
- plant/animal interface

Plant/soil interface

- Germplasm evaluation
-

Testing, screening and multiplication promising legumes and grasses

- Intercropping trials
-

Cereals (maize, sorghum and millet)

With forage legumes

- To evaluate the effect on grain yield, total biomass produced for livestock the residual effect of the fixed N on subsequent crops

- On-farm research

Mixed grass/legumes pastures

- Study the best grasses and legume species capable of producing a compatible pasture, parameters to be measured
- Competitiveness of legumes in grass mixture
- Canopy spread
- Height
- Seed production capability

Fertilizer trials

- Simple fertilizer trials on the biomass yield of forages and nutrient constituent, collaborative effort with animal nutritionist and the soil chemist to determine if any deficiency symptoms might arise from soil conditions.

Plant population studies

- Planting distance and biomass yield
- Row planting vs broadcasting
- Seed production

Feed preservation studies

- Harvesting, e.g.. time of cutting forage for hay production
- Storing - moisture content at the time of storing etc.

Plant/animal interface

Grazing studies -

(1) Carrying capacity studies Collaboration with the Range Unit

(2) Response of grasses and legumes to grazing stress

- ability to regenerate under various planting distances and grazing conditions
- continuous grazing vs rotational.

(3) Evaluate animal preference for introduced legumes.

Crop residue feeding trials - Only one class of livestock was used for feeding trials in the previous years. This should continue using sheep and goats of various ages and all sexes.

It will be necessary at this point to conduct a joint trial with the animal nutritionist.

Collaboration with other Units

The forage agronomy program could cooperate with the range management group in developing fodder banks in the villages on the deferred grazing and crop residue feeding program.

Another area of cooperation will be with Soil and Water Management in planting low growing legumes and sod forming grasses to serve as feed for stock and for conservation on seriously destroyed lands.

Recommendations

1. Forage production is tied into providing feed of suitable quality to livestock to improve performance. There is a need to be able to analyze forage and feeds to determine the nutrient content in response to the daily minimum requirement for animals. Some of these need to be corrected in the field. Adequate feed and forage analyses facility is required.

2. Staffing

   As a result of the history of forage work in The Gambia, emphasis on training forage specialists has not been pursued vigorously. There is a need to strengthen the activities of forage program through staff development. Currently there is a forage agronomist working with two research assistants limiting activities to only the south bank of the country. To allow expansion to a range of environment within the country, it is necessary to train two more Forage agronomists at the B.S. level and one at the M.S. level.

The Deferred Range and Crop Residue Feeding Program

Alieu Joof

The deferred range and crop residue feeding program was started in 1983/84 dry season by the Mixed Farming Project as a technological package for farmers to alleviate the nutritional stress that livestock go through during the dry season. This program also brought together scientists from other related fields to work in a multidisciplinary approach to find solutions to the nutritional deficiency during the dry season Since the range component was the only one dealing directly with the livestock owners, it was then charged with the implementation of the technological package.

Boiram, a Wollof village in the Fulladu West Division of the MaCarthy Island Division, was chosen as the test site. The reasons for the selection of Boiram was that the villagers showed keen interest in the activities of the Mixed Farming Project through their participating efforts and because Boiram also experienced a cattle fattening scheme and thus had an edge over other villages in livestock development projects. Other villages that participated in the Boiram livestock feeding program included Njoben, Allulay, Fass, Boy Paul, and Sare Buti. These villages contributed by providing labor for the range reseeding program and the fencing of the deferred range area. Other contribution is the provision of crop residues.

Crop residues collection started immediately after harvest. The maize plants were cut and bundled together and stocked in the field with the ears still on the plants. After the ears dried up they were plucked off and the maize stover was transported to the communal feeding area and stored on raised platforms. Other crop residues stored included sorghum stover, rice straw and groundnut haulms. An MFP tractor was used to haul these to the feeding site since farmers could not transport these because a high percentage of them had problems with their donkey carts-i.e no tyres.

A ten hectare plot had been fenced and reseeded to Andropogon gayanus and Cenchrus ciliaris. This would serve as the deferred range in conjunction with the crop residues.

Forty heifers of 1 year to 2 1/2 years were selected from the participating farmers herd. All these were dewormed, vaccinated against anthrax and blackquarter and ear-tagged. Twenty animals ran under the usual traditional system and the other twenty were put under the crop residues feeding regimes. A fortnightly recording of both group body weights was made. Feeding commenced in January 1983 with the maize stover and sorghum stover which lasted up to the end of

March, after which they were turned out to the range area for two months (April-May). They returned to the feeding area in June to be fed the groundnut haulm and rice. They rejoined their respective herd at the end of June. There was no marked differences in body weights between the group fed with crop residues and those under traditional management during the months of January to and February. The reason for this was hypothesized to be that there was still abundant forage during this particular time. Weight differences started to be pronounced from March onward; with the fed group weighing more than the control group. The farmers were able to notice this difference.

Problems encountered during the first year of the feeding programs include

(1) Water - No provision for water was made at the feeding site and women had to haul water from the village well which is a distance away from the site. This proved very laborious. Shortage of labor was also a constraint because farmers were also involved in the Jahaly-Pachar Rice Irrigation project. The distance between participating villages and the feeding area caused participants to show little interest in the feeding scheme. Participants also complained that the number of animals involved in the program was too small to warrant the labour efforts. Transporting the crop residues to the feeding site proved a burden since small farmers did not own donkey carts and those with donkey carts had one problem or another with them.

During the second year feeding trial, the Mixed Farming Project tried to address these problem by providing drinking troughs at both sites; at the range and feeding area four empty drums were purchased to haul enough water to last for a few days. The transport problem was tackled by providing farmers with tyres at a minimum cost. Since travelling to and from the feeding site was a problem, participating farmers opted for a village supplementary feeding program.

In 1984/85 the feeding program was extended to Pinia/Choya (M.I.D.) South bank, Sukuta (M.I.D.) North Bank and Makamasireh (U.R.D.) North Bank. Feeding trials commenced in March. The Pinian-Choya feeding program collapsed due to the burning of the crop residues by wild fires. Sukuta feeding trial with 22 heifers started in April. Animals were dewormed and vaccinated. Monthly body weight was recorded, though there was no control group to compare body weights. An accessway to the river was constructed to alleviate the watering problem and a herder was contracted by the LOA to feed and water the animals. It was more difficult to implement the Makamasireh feeding program because of the acute shortage of water in the area. Villagers were unwilling to share water with the livestock and the distance to the river was too great. All the above villages have a deferred range area of 10-15 hectares.

In 1985 nine village storage units were constructed by participating stockmen using fencing material provided by MFP. An estimated 28,063 kilograms of crop residues were stored and 139 heifers were fed. These were all in Wuli and Kantora districts of U.R.D. In 1986 the village supplementary feeding program expanded from nine to twenty-eight villages.

Village Supplementary Feeding Programs

		Pasture Assistant
Wuli/Kantora District	15	Momodou Jobe
Fulladu East "	1	Omar Jammeh
Niani "	1	Momodou Fofana
Fulladu West "	5	Malang Saneh
Sami "	1	Demba Manneh
Nianija "	3	*Seedy Fatty
Niaminas "	2	Lamin Jallow

* Retrenched and this vacancy not yet filled. The pasture assistants are responsible for the implementation of these programs.

The crop residues program has reached the stage where villagers are now storing these residues in their back yards rather than a central communal feeding site. Little work has been done since the end of the Mixed Farming Project due to lack of mobility of the range unit and the lack of fencing materials to maintain these structures. The rising cost of fuel has impeded pasture assistants from performing their duties effectively.

PPMU Activities in Relation to Livestock

Mr. Ken Johm gave an oral presentation. The main points are summarized as follows.

PPMU comprises four divisions the directorate, documentation, economics (which oversees the NASS and GADS data systems), policy (concerned with sectoral analysis, commodity analysis, program analysis and project analysis). PPMU is preparing a livestock policy paper for the March donors conference, in consultation with DAHP. Development of this paper focuses on the need for a change from increasing government intervention, in the face of a worsening trade balance, lack of assurances of foreign aid, and need for debt servicing. This was seen as a priority by the World Bank, which has stressed the requirement to address sources of recurrent support, growth, and structural reform, especially to ensure provision of services and information, and privatization wherever there is not a comparative cost advantage for government involvement.

Basic questions to be addressed in livestock policy are whether emphasis should be on specialized or integrated operations, on cattle or small ruminants and the effect of spreading resources, whether extension should be directed to target groups or to all, and the impacts of short term versus long-term projects. The livestock policy paper looks overall at the subsector and trends in population numbers and demands. Overall objectives include:

- diversification of crop mix and integration with livestock
- stopping drain on soil fertility
- reduce public involvement

Inputs specifically favored are increased government regulation of public health and food quality inspection, research and extension which produce measurable increases in production, increased private involvement in direct production activities. Major constraints are seen as nutrition, disease control, marketing systems and institutional services. More specifically constraints in the area of poultry are the supply of day olds, management skills, supply of feeds and disease. For small ruminants: dry season feed, absence of extension packages and the seasonal nature of demand. Milk production: genetic limitations of the local breed, nutrition and disease; swine: demand, genetics, feeding systems; Beef: dry season feeds, disease, traditions (the wealth concept), administrative price fixing, and inefficient pricing policy, inadequate abattoir facilities and low offtake rates Specific proposals will address needs for private involvement, involvement of farmers organizations, credit and banking facilities, and research yielding quantifiable results applicable to farmers.

Overview of Agroforestry Activities

Mr. Abdoulie Danso stressed that, whereas other participants were presenting the results of earlier research work, in the area of agroforestry there was little previous activity to report. He outlined the differences between agroforestry, sylvipastoralism and agrosylvipastoral systems.

Organized forestry management in The Gambia started in the 1950's and more recently has been supported by an AID funded project. Most efforts have been focussed on establishment of gmelina plantations and to a lesser extent, under the AID project on establishment of village firewood plots. AID funding of this work has now ended.

Efforts related to agroforestry have included small scale 1985 plantings of Acacia albidia, Eucalyptus, Telona grandis, Psropis Africana and Psropis tamoruga with plantings of groundnuts and rice. A proposal to start some alley cropping trials was recently submitted to GARD by Buba Bayo.

Report of Poultry Workshop

Ms. Patricia Andrews presented the findings of this one-day workshop held at the Management Development Institute on 9 August 1986. The workshop brought together 84 participants including representatives of the Department of Animal Health and Production, Gambia Cooperative Union, International Trypanotolerance Center, Gambia College, women's and youth organizations and 16 poultry farmers. The principal conclusions of the workshop follow.

POULTRY FARMING WORKSHOP ORGANIZERS' REPORT

OBSERVATIONS AND RECOMMENDATIONS

POULTRY MANAGEMENT

- Any prospective farmer should register with the Department.
- Periodic visits to Poultry Farms by the Department's staff.
- The Department should create a Quality Control Unit.
- Periodic training of Poultry Farmers.
- Government allocates surveyed land for poultry farms.
- The Department of Animal Health and Production should inform, visit and advise on building construction.
- Farmers should inform the Department of Animal Health and Production approximately 3 weeks before arrival of day-old chicks.

POULTRY FEEDING AND NUTRITION

1. The Cooperative Union should review the present price of poultry feed with a view to reducing it. This would reduce the poultry production costs and thus bring down the price of eggs and poultry meat.
2. Government should continue to maintain a favorable price for maize thereby encouraging farmers to produce more maize.
3. Government should strengthen the Nutrition Unit of the Central Veterinary Laboratory through the provision of equipment, chemicals, reagents and training opportunities for its staff.
4. The Nutrition Unit of the Central Veterinary Laboratory should prepare an inventory of all non-conventional feed resources available locally in order to determine their nutritional values and incorporate them in the preparation of poultry feed.
5. The Gambia Cooperative Union should purchase mineral and vitamin premixes from manufacturers without going through intermediary companies. This would cut down the price of poultry feed.
6. All Commercial feed mills should be registered by the Department of Animal Health and Production to ensure quality control.

7. The GPMB should improve its storage facilities/procedures to minimize aflatoxin contamination of the agro-industrial by-products being used in poultry rations.

8. The GPMB should allocate adequate quantities of its agro-industrial by-products (groundnut cake, rice bran and cotton seeds) for the use of local poultry industry. This would prevent the recurrence of the prevailing situation whereby all such by-products have been exported and available locally.

DISEASE POLICY

1. Well-trained top level poultry pathologist.

2. More qualified poultry technical officers who will be able to visit more often.

3. Adequate mobility provided by Department so more direct information can be obtained which can be monitored on a regular basis.

4. Poultry owners and attendants to be trained by the Department through seminars and workshops. They should attend certain basic courses in Husbandry and Disease Control perhaps 4 (four) times in a year/quarterly.

5. Registration of every farmer with the Department. The Department should plot a map of all known poultry farmers in each district so that whenever there are reports of disease they know where to quarantine and implement a vaccination program.

MARKETING

The group learned from the morning's deliberations that:

- government has no policy regarding poultry product marketing (products eggs and broiler meat)

- there are problems of getting the product ready for marketing - presentation

- producers are not in a position to better present their produce (broilers). This is due to lack of a processing plant. To alleviate this problem the Government should establish a small processing facility sponsored by the Gambia Cooperative Union, donor agencies, and farmers

- consumer cooperatives are good networks of outlets for products (eggs and broilers)

- central processing and storage facilities are necessary and must be properly managed. Problems of this nature must be identified by producers who should initiate such endeavors. Government and donor assistance could follow

- farmers could form a cooperative which in turn could get the cooperative to process feed and establish a processing plant. Purchasing birds from cooperative members which then in turn be selling to the consumers will also help a quality control system must be initiated, in other words the birds must be graded according to the standards set by special inspectors (Village level poultry production marketing at this level is different)

- for hygiene and ease of marketing purposes it is important to establish a processing plant;

- vehicle will be invaluable in transporting broilers and eggs to hotels, hospitals and other institutions;

- personnel from the Department of Animal Health and Production should obtain feedback from the general the public on poultry production;

- the main point is a Central Marketing Organization.

TRADE POLICY

- The Government needs to protect this industry and have assurance that hotels will buy. Government must make the farmers aware that a market exists for their poultry products. The Association also needs to get the Government's commitment soon.

- Evaluate the number and capacity of existing feed mills in the country and determine the poultry feed requirement of farmers.

EQUIPMENT

Government needs to examine the possibility of removing customs duties on all poultry equipment such as

- Feeding troughs
- Feed Mills
- Incubators
- Brooders
- Drinkers
- Veterinary Medicine
- Plumbing machine

GARD'S LIVESTOCK WORKSHOP DECEMBER 9 - 19, 1986

HELD AT THE FRIENDSHIP HOSTEL

BAKAU

AN OVERVIEW OF EARLIER STUDIES CONNECTED WITH DRAUGHT-ANIMALS IN THE GAMBIA

BY

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(1) INTRODUCTION

Most of the work done so far in The Gambia involving draught animals has been directed at implementing the country's basic mechanization strategy, the main objective of which has been to increase production of all the country's main crops through appropriate mechanization practices.

The strategy consists of introducing mechanization in stages from the simplest traditional practices, through appropriate intermediate stages, to the highest possible level. The selection of an appropriate farm-power source for the systems to be adopted was of paramount importance in the list of earlier considerations to be made. Of the two options considered (animal draught and tractorization), animal draught was selected and used to power the single-purpose ridge-cultivation implement evaluated and introduced in the early 50's, as the first stage in the country's animal draught promotion program.

In the strategy's second stage, studies were directed at introducing a simple multi-purpose implement package for performing most of the operations necessary for production of the country's main crops and it was envisaged that tractorization could be examined in the third stage.

Stage 4 (the final stage) of the strategy will be the introduction of a package similar to that in stage 3 but with a greater power source, if considered feasible.

Elevation from one stage to another would be determined by farmers' land and financial resources, their willingness to change, the state of the country's economy and technological achievements and pricing and credit policies prevailing.

(2) DRAFT ANIMALS AS A FARM-POWER SOURCE

The process of identifying appropriate intermediate stages in the country's mechanization process was a complicated one. In the industrialized world, intensification of crop production can be easily achieved with the use of high-powered labour-saving systems, coupled with the other desirable inputs, the economic use of which is often made possible, inter-alia, by abundance of farmland, easy access to capital and the relevant technologies and services. However, the complexity of The Gambia's environmental and socio-economic climates led to the adoption of draught animal systems for four basic reasons

2.1 Three categories of draught animals (oxen/cows, horses and donkeys) are readily available in the country and their maintenance (housing, veterinary care and feeding) does not call for too heavy a capital outlay or foreign exchange input.

2.2 Draught animal systems permit use of simple farming equipment, which could be economically produced and serviced locally.

2.3 Some categories of draught animals have a high economic value even at the end of their useful life as draught animals.

2.4 Selection of the second alternative (tractor - power) would have had socioeconomic implications for the country.

(3) DRAUGHT ANIMAL STUDIES

3.1 Institutional Framework

Much of the earlier studies on draught-animal use was coordinated at the level of The Directorate of Agriculture, in close cooperation with the agricultural extension and animal health services. In later years, the keen interest shown by farmers in draught-animal use prompted the setting up of an Agricultural Engineering Unit to conduct Research and Development, with a view to providing long-term solutions to the country's mechanization problems and, in particular, to address the issue of animal-draught mechanization research, the promotion of which was seen as the most appropriate means of overcoming the bulk of farm-level constraints in crop production, in the existing circumstances.

The Unit's work on animal-draught research covers crop production and processing and close cooperation has, over the years, been maintained with the Department of Animal Health and Production, to ensure that the health and nutrition aspects are catered for.

3.2 Earlier Animal-Draught Research

3.2.1 Studies conducted during the 1950-60 period

The use of animal draught was first attempted in the country in the early 50's. In the mid-fifties a school was set up to train farmers on aspects such as yoke making; training and operation of draught animals; adjustment and use of animal-draught

equipment; health and nutritional aspects of draught animal maintenance; advantages of using fertilizer and improved seeds; seed dressing and crop rotations.

The training was based on oxen because the draught requirements for the single purpose implement in use for land preparation at the time ranged between 70 and 150 kg., the actual draught being determined by soil type and consistency level, condition of the equipment's soil engaging components, implement settings and adjustments.

Later, in 1960, an attempt failed to introduce stage 2 of the animal-draught mechanization process (introduction of an animal-draught multi-purpose implement package). The designs tested at the time proved unacceptable, due to a variety of reasons. Much of the animal-draught research undertaken in the 50's and 60's consisted of brief studies of technical performance of new equipment vis-a-vis traditional systems, acceptability by farmers, matching existing designs of equipment with the most prominent draught power available at the time - oxen.

Farmers who attended sessions in the training centers (mixed farming centers) brought along and trained their own draught animals and at the end of the training period were issued equipment on loan. As animal-draught technology became widespread, more training centers were built to help improve farmer-education on draught-animal use, and by the mid 60's 18 schools had been established in the country.

3.2.2 Animal-Draught System Studies in 1970-74

During the early 70's further work was embarked upon, with Technical Assistance from the National Institute of Agricultural Engineering (N.I.A.E.) in the United Kingdom. The studies were aimed, inter alia, at reaching stage 3 of the country's mechanization process.

The researchers made comparisons between different animal-draught cultivation techniques and also between ranges of animal draught equipment for land preparation, weeding and harvesting, using groundnuts as a test-crop. The main parameters monitored were time taken in field operations; dates of emergence; plant populations; plant growth; intensity of weed competition; soil erosion; net crop yields and nuts left in the soil after lifting.

Assessments were made of machine suitability; ease of handling and power requirements for field operations; mechanical failures and design faults. Also, a comparison was made between traditional head yokes and alternative harnessing systems.

The studies undertaken were replicated on-station in different Divisions in the country, and as corroboration of the main trials, direct comparisons of selected cultivation and weeding techniques were made with on-farm trials conducted in each of the country's 5 Divisions.

The cultivation studies consisted of various treatments to compare ploughing, ridging and tine cultivation and also examined the effectiveness of various weeding operations conducted after different land preparation methods.

Infiltration experiments were also conducted to compare rates of infiltration of rainwater into the soil with various animal-draught cultivation systems. All the normal field operations were carried out during the growing season and measurements taken using double-ring infiltrometers on flat plots. For ridges, measured quantities of water were added to the furrow between ties and the time used for complete absorption measured.

Infiltration rates were in the range of 0.5-1mm/min and there were no significant differences between the treatments.

It was found that surface cultivation had little effect on the rate of infiltration.

3.2.3 Animal Draught Research 1974 - 75

Research during this period was aimed at determining the most suitable animal-draught equipment package for upland crops production through comparisons of primary cultivation and weeding techniques and other essential field operations, using groundnuts as a test crop. The experiments were replicated in 4 Divisions. The studies conducted in 1975 used cotton and cereals, as well as groundnuts, as test crops and were aimed at verifying the findings of the 1973/74 studies.

3.3 Conclusions and Recommendations from the 1973-75 Studies

3.3.1 Production of groundnuts should be done on-the-flat due to the absence of animal-draught seeders and weeders for ridge cultivation. Also the experiments showed that there were no significant differences in groundnut yields between ridge and flat cultivation.

3.3.2 Crop cultivation in the uplands can be done using one of three cultivation methods i.e., direct drilling, tine cultivation in 2 directions or ploughing.

3.3.3 Weeding should be carried out with spring tine A - blades and hand-hoeing conducted around the plant where necessary.

3.3.4 Harvesting of groundnuts should be by the animal-drawn lifting device, followed immediately by windrowing, for accelerated drying to occur.

3.3.5 It was concluded that the most appropriate set of animal-drawn equipment for The Gambia is the Sine Hoe package for groundnut, cereal and cotton production. The package should be equipped with a 9" plough, 5 spring tines (for cultivation and weeding operations), a sweep-blade groundnut lifter, a ridging attachment and an extension bar. The selection of components from this package would depend upon the crop to be cultivated. Use of the animal-drawn super 'Eco' seeder was also recommended.

3.3.6 It was recommended that each training center (mixed farming centre) be equipped with sets of the new range of implements.

3.3.7 Attempts should be made to control soil erosion by ploughing across the slope or on the contour and similar conservation practices should be adopted to make on-the-flat cultivation successful.

3.3.8 Special emphasis should be placed on an improved diet for draught animals by conservation of forage and the feeding of a cereal ration with minerals during periods of work.

3.3.9 Nose ropes should be adopted for effective control of draught oxen and the use of single operators encouraged.

3.3.10 The recommendations from the animal-draught studies should be published in an extension bulletin and a film produced.

3.3.11 The availability of animal-draught equipment should be taken into account during future agronomy trials and before agronomic recommendations are made.

3.4 Current and Future Programs

Work being done currently is concentrating on consolidating the animal draught mechanization program and also studying the preparatory stages for further advancement in the country's mechanization process.

In particular, attention is being focused on the following aspects

3.4.1 Institution strengthening — adequate mobility, equipment for operating bases and staff training.

3.4.2 Provision of the software aspects of animal-power mechanization — spare parts; training for farmers; agricultural extension workers and rural artisans; veterinary care, adequate housing and nourishment for draught-animals.

3.4.3 Making provision for those operations in the crop production process that have so far not been catered for in previous studies such as ridge cultivation, rice cultivation, cotton drilling and fertilizer application using animal draught equipment.

3.4.4 Improve harnessing methods to ensure that the available draught power is utilized to best advantage.

3.4.5 Liaison activities with other Government Agencies concerned with draught animal research on key aspects, such as health and nutrition of animals.

REVIEW OF SMALL RUMINANT AND POULTRY RESEARCH AND ACTIVITIES IN SENEGAL

BY

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Introduction

In 1981, the small ruminant population in Senegal was estimated to be 3,170,000 head (2,070,000 sheep and 1,100,000 goats). The total meat (lamb, mutton, and goat) production was 8,000 metric tons with a per capital consumption of 1.4 kilograms. (Source FAO Production Yearbook, 1981)

Senegal has three main breeds of sheep Peul-Peul, Touabire (mouton maure a poil ras) and Djallonke. There are also 2 minor breeds found in Senegal Warale (Peul-Peul x Touabire) and the long-haired Moor sheep.

The Peul-Peul sheep are found in the Senegal River valley and throughout the sylvo-pastoral zone of northern Senegal, living in the same areas as the Zebu cattle. Peul-Peul sheep are of average size height 64.8 cm and weight 28.6 kg (Denis, 1975). They have short hair and can range in color from almost all white with black or rust-colored red spots to almost all black or rust. Males have spiral horns. Horned females are not uncommon. The Peul-Peul provides good quality meat, fattening easily with a moderate amount of feathering, and with a carcass yield of 48 to 50 per cent. Ewes are poor milkers with a daily milk production of 0.2 to 0.25 liters. Lactation generally lasts 5 to 6 months.

Originally from Mauritania, Touabire sheep generally live above 15 degrees north latitude in the south Saharan and Sahelian zones. The Senegalese Touabires are found along the Senegal river from St. Louis to Bakel and south as far as Kaolack. The average ram is 75-90 cm tall and weighs 30-45 kg. The ewe stands approximately 65-80 cm and weighs about 22-28 kg. (IEMVT, 1980) The Touabire's coat is white or mostly white with black or rust spots. Males have large horns that curve outwards. The Touabire also provides good quality meat with a carcass yield of 40-45 per cent. Touabire fatten easily and can weigh up to 80 kg. Because of its large size and white coat, Touabire rams are the preferred "type" of sheep to sacrifice at Tabaski (Feast of Aid el Kebir) when a ram can be sold for as much as 200,000 CFA. Ewes are poor milkers, giving 0.2 - 0.4 liters per day.

The Djallonke is found in southern Senegal below 14 degrees north latitude (southern Sine-Saloum, Casamance, and southeastern Senegal). The Djallonke have short hair coats, predominantly white in color, often with black or rust spots. Fall (1982) found that the white coat is becoming more common because people are selecting the all-white or mostly white animals to raise for holiday sacrifice.

These trypanotolerant sheep are small, with an average weight of 20-30 kilograms for female and 25-35 kilograms for males. Ewes rarely give more than 0.25 liters of milk per day, and lactation lasts for approximately five months. Djallonke ewes are known to be prolific with regular twinning and frequent triplet births. The Djallonke provide good quality meat with carcass yield of 46-48 per cent, but carcass weight is low (10-15 kg average).

Warale sheep are a cross between Touabire and Peul-Peul. This cross has the high quality meat found in the Peul-Peul, and the larger size and marketability of the Touabire. Long-haired Moor sheep are quite rare in Senegal, existing only in the Dakar area. The coat is white or sometimes brown-black with white spots. The hair is 4-7 centimeters long. The sheep are a little smaller than the Touabire with an average weight of 30-35 kilograms.

Two main types of goats are found in Senegal the Sahelian goat and the West African dwarf goat (or "la chevre du Fouta-Djallou"). The Sahelian goat weighs between 25 and 35 kilograms and is relatively tall. The buck's average height is between 80 and 85 centimeters while that of the doe is 70 to 75. Does are prolific and good milkers (0.8-1.2 liters per day with a fat content of 60-65 g/l). Goat milk is consumed fresh in rural areas of Senegal and near urban areas is used to make cheese. The carcass yield ranges from 44 to 47 per cent often with abundant abdominal fat. Goat meat is more often consumed in rural areas of Senegal.

The West African dwarf goat is trypanotolerant and lives in the same areas as the Djallonke (south of 14 degrees north latitude). These goats are small (40-50 cm) and weigh 18-20 kilograms. Does are prolific with two to three kids per gestation, but they are poor milkers with and average daily production of 0.25 to 0.4 liters. The carcass yield varies between 44 and 48 per cent. Castrated males fatten easily and have good quality meat.

Traditional Methods of Production

In the Sahelian zone of Senegal small ruminants are often herded with cattle, moving as the seasons change in search of forage and water. In the agricultural zone -- the Sine-Saloum, Thies, Diourbel, Casamance, and Senegal-Oriental -- small numbers of goats/sheep are kept around a family's compound. Larger herds are taken out to pasture during the day and kept in an enclosure (millet stalks, thorny branches) at night near the compound. During the dry season, animals are left free and eat what they can find, and are watered at the nearest well in the evening when they return to the compound. During the rainy season, an individual in the family takes the goats/sheep to an area where there is grass and attaches them to a stake with a 4 to 6 meter cord. In mid-afternoon, the animals are moved and in early evening returned to the compound to drink. In some villages, a shepherd will be hired to watch the small ruminants of the village for the duration of the rainy season. A shepherd may keep up to 500 head. An enclosure is built for the animals near a well. Around noon the shepherd takes the animals out to eat and returns when the sun sets. Shepherds work from July to December and are paid 125 to 150 CFA per animal (double if births occur). The shepherd is housed by the village chief, but is not fed. Shepherds are usually given a small plot of land on which they cultivate peanuts or other crops during the mornings.

According to Faye and Mbodj (1976), men own 60 per cent of the sheep in Senegal. Women own 89 per cent of the goats, however. In total, 34 per cent of the small ruminants in Senegal are owned by men and 66 per cent are owned by women. Other researchers (Thiongane and Mbaye, 1985) have found that while women may take more responsibility for the day-to-day care of small ruminants, the actual ownership often belongs to the head of the family. Small ruminants are kept by most rural families for family celebrations (baptisms, marriages, etc.) and for religious holidays (Korite and Tabaski). Before a religious holiday, an effort may be made to fatten the animal designated for sacrifice. Except for special occasions, small ruminants are not consumed by the family that raises them. A goat or sheep may be sold if the family needs money or traded for a heifer if the family has 8 to 10 extra goats and sheep.

Small ruminant research in Senegal has been conducted almost exclusively on the three major breeds of sheep (Djallonke, Peul-Peul, and Touabire). The majority of this research has taken place at research stations -- Dakar-Hann, Sangalkam (near Dakar), Dahra (Sine-Saloum), Bambey, and Kolda (Casamance). Studies have been conducted on the reproductive and growth potential of these three breeds and on the diseases and parasites that affect them.

There have been two village-based studies. One in 1979 by Tchakerian in Boulel (near Bambey) and another study is ongoing at present in villages throughout Senegal.

Tchakerian studied Peul-Peul sheep (groups of 35 ewes and one ram) in a village setting under semi-sedentary conditions. The sheep grazed natural pastures after harvest and during the dry season and were put in enclosures at night. The objective of his study was to establish a breeding herd and to market the lambs at approximately 12 months of age at the adult weight. The control group received no feed supplementation or other special care. Observations were made on the age at first lambing, lambing interval, and fertility rates. The experimental group received feed supplementation (peanut hay, millet stalks, and concentrate of cereal and peanut cake with mineral supplement) as a function of the time of the year (when natural forages were low) and as a function of the nutritional needs of the animals (maintenance, gestation, lactation, etc.).

The results of the study are as follows

	Control	Experimental
Age at first lambing	24 months	11.5 months
Lambing interval	12 months	7.3 months
Fertility rate	100%	164%

Lambing interval for the ewes that received feed supplements was

7 months	40%
7-8 months	36%
8-9 months	16%
9 months	8%

Mortality rate for lambs (0-6 months) was 12 per cent. Five per cent of the ewes had twins. Average birth weight was 3.1 kilograms for males and 2.9 kilograms for females.

Although their results have not been published yet, the small ruminant study by Leforban, Faugere, and Landais (1985) have some preliminary data on village-based small ruminant production that contradicts some of Tchakerian's data. According to O. Faugere (personal communication, 11/86), their preliminary findings indicate that control ewes' (no treatment or feed supplementation) age at first lambing, lambing interval and fertility rate is quite similar to Tchakerian's treatment group. Tchakerian used only 35 ewes with one ram as an experimental group. In the Leforban, Faugere, and Landais study, the sample is of thousands of small ruminants located all over Senegal.

The Leforban, Faugere, and Landais preliminary report (1985) summarized their research methodology and presented some preliminary findings. There are six treatment groups for each village or group of villages. Each group consists of 500 to 800 head of goats and sheep. All animals are identified by ear tags. The treatment groups are as follows

Group 1 Parasite control - 2 times/year (April/May and August/September)
Group 2 Vaccination PPR, parainfluenza III, pasteurellosis, and sheep pox
Group 3 Vaccinations and parasite control
Group 4 Control (no treatment)
Group 5 Feed supplementation - 100 days from May to August
Group 6 Vaccination, parasite control, and feed supplementation

Parasite control is aimed at gastro-intestinal parasites (strongyles and tenias) and also coccidiosis. Vaccinations concern only pulmonary infection (viral and bacterial) PPR, parainfluenza III, pasteurellosis, and sheep pox.

Mortality of sheep in three villages showed that in Ndiange (north) the mortality was 8.54 per cent and heaviest in July/August, especially among young animals (6 months). In Kaymor (Sine-Saloum), the mortality was 5.5 per cent with heaviest losses in April/May due to sheep pox and pneumonias. In Kolda (Casamance), the mortality was 11.2 per cent with heaviest losses in March due to pneumonia and diarrheas. Goats in the same villages had mortality rates of 8.85 per

cent in Ndiagne with heavy losses in July/August due to diverse causes; in Kaymor 7 per cent with losses in March (PPR), August (diverse causes), and November (PPR). (41 of 75 deaths were young -- less than 6 months of age.) In Kolda, the mortality of goats was 21 per cent with losses in March (PPR) and June (PPR) (63 of 153 dead were less than six months old.) A more complete report on the findings of this study is due to be published in early 1987.

Reproduction Parameters

The following table is a summary of the reproduction research that has been carried out at the Centre de Recherches Zootechniques (CRZ) de Dahra, and the CRZ/Kolda.

Parameters	Peul-Peul	Touabire	Djallonke
%fertility	75	79.3	117
%fecundity	78.5	82.7	152
%prolificacy	104.7	104.3	124
%abortion			2.4
%twinning	4.7	4.3	27
Ave. age first lambing	12 mo.	14 mo.	18 mo.
Ave. lambing interval	7.3 mo.	8 mo.	326 days
%sex ratio (males)	56.9	54.2	

Source Peul-Peul and Touabire data from Sow, et al., 1985; Djallonke data from Fall et al., 1982.

Since its creation in 1972, the "Centre de Recherches Zootechniques" (CRZ) in Kolda (Casamance) has raised N'Dama cattle and Djallonke sheep for meat production.

In 1982, Fall et al. published results from seven years (1974-81) of research on Djallonke sheep at CRZ/Kolda. Data was analyzed by ISRA/Dakar and ILCA/Addis Ababa. The age at first lambing is 18.8 months and the lambing interval is 326 days. Both parameters are significantly influenced by environmental and genetic factors.

A Djallonke ewe produces 1.33 lambs per year and has an average reproductive life of 4.2 years. Her life expectancy is 5.8 years.

The mortality rate of the lambs from birth to weaning (4 months) is 33 per cent, and from weaning to 12 months 19 per cent. There is higher mortality (36%) for lambs born in the rainy season (June-November) than for lambs born in the dry season (December-May). The latter have a mortality rate of 20 per cent. Adult ewe mortality is 14.8 per cent.

The average lamb weighs 1.5 kilograms at birth, and gains about 60 grams per day from birth to four months (weaning). The rate of gain for the period from birth to 12 months is 45 grams per day.

The general productivity of the CRZ/Kolda flock was 8.7 lamb weaned/ewe/year.

Fall et al. (ISRA, 1983) reported the results of research on Djallonke sheep from 1982 to 1983. In 1982-83, 107 lambs died but there were only 103 births registered, making the mortality rate for lambs more than 100 per cent. S.M. Toure of the Dept. of Virology, ISRA Hann (Annual Report 1983) found the high mortality among young Djallonke lambs at CRZ/Kolda during 1982-83 was due to many causes digestive (diarrhea and parasites) 28.5%, respiratory problems 27%, other illnesses 14%, accidents, absences 4%, and unidentified causes 26.5%. It was found that these deaths were influenced by the month of birth, season, number of lambs per ewe, and milking capacity of ewe. Fall et al. (1983) also found that many of the reproductive parameters were lower for 1982-83 than for the previous seven-year research period mentioned above. These difference is shown in the following table

	1974-81	1982-83
Actual fertility (%)	120	71.6
Apparent fertility (%)	117	66
Fecundity (%)	152	81.6
Twinning (%)	27	13
Abortion (%)	2.4	1
Age at first lambing	18.8 mo.	21.3
Lambing interval	326 days	307 days

In 1985, Sow et al. reported the results of five years (1975-1980) of research on Peul-Peul, Touabire, and Warale (Peul x Touabire) sheep at the CRZ/Dahra. Studies were conducted on the reproductive performance of the ewes with and without estrus synchronization, and on the growth potential of lamb from birth to weaning.

Ewes who were injected with PMSG and bred two days later had a fertility rate of 69 per cent versus 75 per cent for the control ewes. There was no increase in fertility rate with estrus synchronization. The rate of prolificity for Peul-Peul and Touabire ewes is 102 per cent. When estrus was synchronized, the prolificness rate varied from 107% to 180% for Peul-Peul ewes and 118% to 125% for Touabire ewes, but showed no seasonal variation.

The studies showed a significant seasonal influence on fertility rate. Peul-Peul and Touabire ewes are least fertile in the hot dry season (March-May). Peul-Peul ewes had a natural fertility rate of 53.8% and 60.7% with estrus synchronization during the dry season, whereas in the months before the rainy season (June-July) the fertility rate was 92% (75.3% with synchronization) and in the rainy season (August-September) the fertility rate was 85.3% (41.2% with synchronization). The Touabire ewes showed the same tendencies.

The mortality rate for lambs from birth to 30 days was observed at 6.9% for the Peul-Peul lambs and 10.4% for the Touabire lambs. For

the Warale crosses the mortality rate was 4.0%. From day 31 to 120 (weaning) the mortality rates for single lambs were 4.6%, 6.7%, and 3.0% for Peul-Peul, Touabire and Warale respectively.

With multiple births, the mortality rates observed were higher. From 0-30 days the rates were 23%, 25%, and 13.5% for Peul-Peul, Touabire, and Warale. From 31-120 days the mortality rates were 6.5%, 13.1%, and 12% respectively. The mortality rate for lambs from birth to weaning observed was 11.2% for Peul-Peul, 16.4% for Touabire, and 7% for Warale. The Touabire lambs have a significantly higher mortality rate throughout the year compared to the Peul-Peul and Warale lambs. Lambs born in the rainy season (ewe bred in hot dry season) have the lowest mortality rate, whereas lambs born in the cool dry season (December-February) have the highest mortality.

The following table summarizes the growth of lambs (four breeds) from birth to three months of age.

				ADG g/day	
Breed	Wt (kg)	30 days	90 days	0-30	30-90
Touabire male	4.3	9.4	13.4	172.6	73.3
Touabire female	3.5	8.9	12.8	180.0	65.0
Peul-Peul male	3.4	8.3	11.2	162.3	48.8
Peul-Peul female	3.4	8.2	11.5	159.0	65.0
Warale both sexes	3.3	8.8	11.4	173.2	67.4
Djallonke both sexes	1.6	4.8	7.9	90.0	60.0

(Source Sow et al.,1985, except Djallonke Fall et al., 1983)

Research continues at both the CRZ/Kolda and CRZ/Dahra on the sheep of Senegal. Both stations now sell excess breeding stock to area villages and follow their productivity. Both station help in collecting data for the Leforban, Faugere, and Landais study.

Imported Breeds

There have also been trials using imported rams to increase the meat production of local breeds. In 1982 Dr. Denis imported Lacaune rams to the Sangalkam experiment station and cross bred them with ewes bought on the local market (no specific breed). (The Lacaune breed is not known for its meat production, but for it milk, which is used in the making of Roquefort cheese.) The local ewes weighed an average of 24 kilograms at purchase and were wormed, vaccinated, and fed improved rations for one to two months before breeding The crossbred lambs weighed 3.8 kilograms at birth, compared to an average birth weight of 2.3 kilograms for local lambs (control group). The average daily gain (ADG) from birth to three months was 130 grams/day and 82 grams/day for the crossed and the controls respectively. Denis cited a problem with the feed supply that hindered the growth potential of the crosses. The crosses were slaughtered at 37.6 kilograms and the control animals at 29.4. Carcass weights were 18.7 and 13.1 kilograms respectively. Carcass yields were 50% for crosses versus 45% for controls. The leg was significantly heavier for the crosses (2.2 vs. 1.5 kilos).

Sixteen Moroccan rams (Sardi and Caussenard breeds) were imported into Senegal in May 1986 by PRODELOV (sheep raising project in Kaolack. The first crossbred lambs are now being born and within the next year data on them will become available.

Studies on the fattening potential of Peul-Peul and Touabire sheep were conducted in 1974-75 by Denis (1974) and Calvet and Denis (1975). The results are summarized in the following table.

	Touabire	Peul-Peul
Length of fattening	15 wks	15 wks
Avg. wt. at beginning	30.9 kg	26.0 kg
Avg. wt. after 15 weeks	46.6 kg	37.1 kg
ADG	126 grams	112 grams
Consumption index (kg DM/kg gain)	7.7	7.8
Carcass wt. (cold)	22.8 kg	20.4 kg
Cost per kg meat produced (1975/6)	357 CFA	361 CFA

The Touabire performed better in feeding trials than the Peul-Peul, but this advantage is compromised because the Touabire were more susceptible to parasites and diseases. The trials were conducted in Dakar which is quite different in climate and condition from the Touabires' natural habitat. Denis (1975) also conducted feeding trials using hormone implants (Ralabol by SOVETAL) and found similar results to those in the previous feeding trials.

Pathology

Other current research in Senegal on small ruminants involves identifying and controlling the prevalent diseases and parasites. The major health problems facing small ruminants in Senegal were summarized by Thiongane and Mbaye (1985) as follows:

1. Viruses: Parainfluenza III (often precursor of pasteurellosis; goats more resistant than sheep)

   Visnae Maedi
   Bluetongue (may affect 30-40% of sheep in Casamance)

2. Unknown cause: Paralysis of sheep in lower Casamance.

3. Rickettsiosis (Heart Water): prevalent in Niayes region and northern Senegal.

4. Peste des Petits Ruminants (PPR): prevalent from November-March; goats more susceptible than sheep. Effective vaccine available based on bovine rinderpest vaccine.

5. Pasteurellosis: (Pasteurella multicida) a major cause of mortality in sheep, can develop into contagious pneumonia. Vaccine of questionable effectiveness.

6. Sheep pox: effective vaccine available.

7. Parasites: Major ones are haemonchosis, coccidiosis, mange and liver flukes.

8. Malnutrition: predisposes goats and sheep to other diseases; accounts for 35% of the sheep mortality and 32% of goat mortality in northern areas of Senegal.

Vassiliades (1986) has just completed an inventory of parasites that affect ruminants in Senegal. The most important types to prevent are the digestive strongyles (Haemonchus contortus, Strongyloides papillosus, and Oesophagostomum columbianum) which affect 50%-100% of small ruminants in Senegal; the cestodes (Moniezia expansa) affect 20%-60%.

REPORT ON INTERVIEWS WITH RESEARCHERS AND PROJECT PERSONNEL

1. Notes from conversations with Dr. Olivier Faugere, DVM, Department of Veterinary and Animal Science, ISRA-Hann, Dakar. Nov. 3, 7, 12, 1986. Dr. Faugere is a French veterinarian who is currently doing village-based research on small ruminants in Senegal. Dr. Faugere said that his study if the first of its kind to document production parameters in the traditional setting. The study involves approximately 100,000 animals in villages in the north (sylvo-pastoral), central (Sine-Saloum) and southern (Casamance) regions of Senegal. Final results should be published in early 1987.

Although Dr. Faugere did not have any interim reports available, he did describe the protocol of the study. All animals are tagged, and detailed records are kept on each animal -- vaccinations, illnesses, births, weights, etc. All data is gathered by ISRA technicians and analysis is done on IBM PCs at ISRA using a program called Multilog. The animals are divided into six treatment groups which have been previously described. Dr. Faugere said that goats appear to be much more affected by PPR than do sheep. Sheep appear to be much more susceptible to respiratory infections. In the north ewes and does have fewer young, but these young appear to be more healthy than those born in the Casamance. Multiple births are quite common in the Casamance, but fewer young live beyond 6 months of age. Viability of young also depends on when the young are born. Those born between Nov-Feb (cool dry months) tend to live longer than those born either in the hot dry season (March-June) or the rainy season (July-Oct).

I asked Dr. Faugere if he knew of any other small ruminant projects in Senegal or of others doing research in this area. He said that there is a project in the Kaolack region called PRODELOV (B.P. 356, Kaolack, Dr. M. NDiaye, Director, and Dr. Cyrus Nersy, Assistant Director, telephone 41-19-30). He said that animals in the PRODELOV project are also part of the ISRA-sponsored research project. Dr. Faugere said that most other research on small ruminants had been done at the different research stations in Senegal, and that I should talk with Dr. J.P. Denis about his research in this area.

2. Notes on interview with Dr. Abdullah Niang, Assistant Director, Department of Animal Health and Production (DSPA), Dakar, telephone 22-00-26. 4 Nov 86. Dr. Niang worked with the USAID Livestock Project in Bakel (University of Michigan). I asked Dr. Niang if he knew of small ruminant or poultry projects in Senegal or about recent research in this areas. He mentioned the PRODELOV project in Kaolack, and he said that he knew many villages were doing "embouche ovine" (sheep fattening) for Tabaski, but beyond that he did not know of anything specific going on in the small ruminant area. For poultry he suggested that I contact SAAS ("Societe Agro-Avicole de Senegal") and AVICAP -- both commercial operations. He said that I was welcome to use DSPA's documentation center, but said that I might find more recent information at the libraries at ISRA-Hann.

3. Notes on conversations with Dr. J.P. Denis, DVM, Chef de Service Zootechnie, Dept. Zoo/Veto., ISRA-Hann, Dakar. Dr. Denis has been in Senegal for 20+ years. He did his doctoral research on the Senegalese poultry industry in the early 1960s. In the 1970s he did research on the productivity of local breeds of sheep. He also imported Lacaune sheep into Senegal from France for the purpose of crossbreeding. Most recently he has been involved with the COPLAIT milk production cooperative. This cooperative has imported Montbeliard cows into Senegal, for milk production and for crossbreeding with zebus.

I asked Dr. Denis about small ruminant research in Senegal. Dr. Denis's opinion is that enough research has been done on small ruminants. He said that goats and sheep have been counted and recounted, production parameters have been studied and restudied, as have the health/illness of small ruminants. He said that the market for sheep and goat meat is well known. There is a year-round market for lamb and mutton in all the urban areas of Senegal, especially Dakar. Production for the butcher market varies little throughout the year, except that during the rainy season more mutton than beef is killed. The price per head also varies little throughout the year. The seasonal market for sheep and goats might be an area to be investigated by development projects. The seasonal market includes the Moslem and Christian holidays -- Tabaski, Korite, Christmas and Easter -- plus other family events like marriages, baptisms, etc. Dr. Denis said that between 500,000-750,000 sheep are killed in Senegal for the Moslem holiday of Tabaski. Of these sheep 50,000-100,000 are imported from either Mauritania or Mali. The preference for large white rams at Tabaski makes raising Touabire sheep in the north a very profitable proposition. The southern areas of Senegal where trypanosomiasis exists can cross Peul-Peul with Djallonke sheep and the result will be a larger sheep than the Djallonke with trypanotolerance. Dr. Denis said that if the Peul-Djallonke crosses are raised in a trypano area then they will be trypanotolerant, but if they are raised in an area without trypanosomiasis that they will not be tolerant.

For Senegal to meet the demand of the seasonal market for sheep people who raise sheep will have to increase the sheep population and increase productivity. Dr. Denis said that increasing the sheep population could be accomplished by vaccinations and parasite control, but village farmers have to be convinced of the necessity to vaccinate their animals. Dr. Denis said that it has been his experience that most farmers understand the importance of parasite control (mainly because they can see the worms and ticks).

Increasing productivity can be accomplished by using the elementary rules of selection. As it stands now, farmers do not castrate males that are unnecessary for breeding purposes. Also females that do not produce lambs regularly or have other health problems should be eliminated from the flock. Dr. Denis said that most farmers raise small ruminants as a secondary activity and that these farmers for the most part are unaware of their flocks'

activities, unless they become ill. For goats, Dr. Denis said that there is a traditional market for goat milk in villages, and that in urban areas there is a market for goat cheese. Goats are preferred by some groups to slaughter at Korite and by others for Tabaski. Goat meat is the meat sold at most dibiterie (grilled meat stands). A study on goat milk and its market will be published by ISRA in 1987. Dr. Denis also told me that ISRA/LNERV will publish a book in 1987 on the nutritional value of locally available feedstuffs (by-products, grains, forages) and their value to the different species of domestic animals found in Senegal.

Poultry research I asked Dr. Denis about recent research on poultry in Senegal and he said that to his knowledge no one is doing poultry research in Senegal at this time. He said that all the diseases and production problems had been identified since the early 1960s and that poultry could be imported and raised in Senegal with financial success if a market could be found for the eggs and birds. Raising European birds in Senegal does not change their health, feed and housing needs, one simply has to follow the standards of raising poultry in Europe if one is to succeed with the same birds in Senegal. Dr. Denis also said that in the urban areas of Senegal these markets were controlled by large industrial operations and that smaller producers could not compete.

Village level production of local birds could be improved by simply feeding and watering the chickens regularly and protecting the young from predators (cats and birds of prey). Dr. Denis was against the "operation coq" where an imported rooster is introduced into villages to improve egg and meat production of the local hens. In his experience Dr. Denis said that there are more deaths due to illness of the first generation (the heartiness of the local stock is not passed on). Also he said that the improved crosses become more expensive because they require more feed and care than do the local chickens. In order to make a profit, the improved crosses must be sold at higher price than the local birds, but often a market cannot be found at the higher price.

Donkey traction To his knowledge, no one has done research specifically on donkey traction in Senegal. He advised me to check documentation from the research station at Bambey.

4. Notes on conversation with Peter Gallagher, Catholic Relief Services, Senegal. 6 Nov 86. Mr. Gallagher said that CRS had funded 10-12 poultry and small ruminant projects in the past. He was unable to provide documentation on these projects, but he did say that the projects had not worked out well. Whenever problems occurred during the course of a project, village groups found it easier to break up and split the remaining animals, feed, etc. among themselves rather than to continue the project. Also when dealing with groups, responsibility for the animals is too easily divided and thus, no one is really responsible. He said that CRS is very reticent to fund any

projects dealing with animals because of this. He advised me to contact CARITAS/Senegal, Overseas Education Fund, World Relief, Church World Service and Peace Corps.

5. Notes on conversation with Deborah Fredo, Overseas Education Fund, 2 Rue Dr. Theze, Dakar, telephone 22-14-85. 13 Nov 1986. OEF deals only with women's groups and in Senegal works through Maison Familiale. Most of OEF's projects are very small scale (less than $5000). OEF projects are 75% reimbursable and 25% is a grant to the village group.

Ms. Fredo told me that OEF had had a project in Ngodoba (a village in the Kaffrine area) where the women's group fattened sheep for the Tabaski market. The group of 16 women bought 16 sheep six months before Tabaski. Each woman was responsible for the care and feeding of one sheep. All animals were deparasited. The sheep were fed a combination of kitchen scraps, and locally gathered forages. Besides a little problem with the men in the village (who were opposed to the project), the women had no problems during the six month fattening period. The women sold their sheep at Tabaski and were able to reimburse their loan for the purchase of the sheep and to buy 8 head of cattle with the profit. The women are now fattening the 8 cattle, which will take 4 months and hope to purchase 8 more cattle to fatten. With the profits from the second cattle sale will buy 100 sheep for Tabaski 1987 with the profits.

OEF paid for the training of a monitor (extension agent) from Maison Familiale in animal health practices to help the women to keep their animals healthy. Ms. Fredo was very positive about the experience of the women in Ngodoba and hopes to encourage other women's groups to raise sheep for the Tabaski market.

OEF is just starting poultry projects in two villages in the Casamance. One project will be in Mayor (one hour from Ziguinchor) where women have constructed a collective chicken house. Their aim is to supply local villages with chickens. The other project will be near Kolda in Tankanto, where each woman will keep her own chickens. OEF also has animal traction projects that will start during 1987.

6. Notes from meeting with Abdoulaye Sy, Manager of AVICAP. 11 Nov 86. AVICAP is the largest cooperative (250 members) that imports improved flock (both layers and broilers) from France and Belgium. AVICAP began in 1981 and operates in the Dakar and Thies regions. Marketing their chickens and eggs is their most important problem. Mr. Sy also said that because the cost of feed and chicks is high, cooperative members have a very small margin of profit.

AVICAP buys broilers from their cooperative members for 900 CFA per kilogram. Broilers are commonly sold at 7-8 weeks of age, weighing 1.2-1.3 kilograms each, for around 950-1000 CFA per

kilogram. AVICAP sells broilers to the University of Dakar, to local hotels and to the general public through their retail stall at Marche Kermel in Dakar.

Sixty thousand to eighty thousand chicks (Hubbards, Hubros, Leghorns, Cornish and Rhode Island Reds) are imported monthly for a price of 140-150 CFA per chick. Day-old chicks arrive via air and are vaccinated for Gumboro, avian flu, Newcastle and Marek disease. Most cooperative members purchase feed from either Sentenac or Sanders feed mills. The commercial feed contains fishmeal, peanut cake, corn and wheat bran. Pullets are raised to the point of lay (five and one-half months) and then sold.

7. Notes on meeting with Talmira Hall, Africare/Senegal, BP 2272, Dakar, telephone 22-76-64. Africare has sponsored two village poultry projects in the Casamance of Senegal--one in Oussouye and another in Diakene Diola.

The project in Oussouye was designed as an egg production project. Africare bought 500 layer chicks and transported them to Oussouye. Africare also paid for the construction of the chicken house and for 6-8 months of feed (purchased in Dakar). More than 100 chicks died in transit from Dakar. After the layers began to lay, the villagers found that the market for eggs was not as large as they had anticipated and therefore had trouble making enough money to buy feed. Some of the layers were sold and now about 50 layers remain (16 months old at this point). Their eggs are sold to local markets.

The other project in Diakene Diola had broiler production as its objective, the target market being the tourist hotels in Ziguinchor and Cap Skirring. 130 of 500 chicks died in transit from Dakar. After 10 weeks only 260 birds were sold (the rest had died). Africare's policy is to provide construction and start-up costs for these projects (i.e., Africare pays for the coop, wire, cement, chicks, several months of feed, medicines), while the village group provides labor and the day-to-day supervision of the operation. Africare's involvement in the project ends after the first cycle (once the birds begin laying or once the broilers are sold). The village group is then left to continue the project with the money from the sale of eggs or broilers.

Africare also will have a couple of villages fattening sheep for Tabaski 1987. These villages are now building shelters for the sheep and stocking forages.

8. Notes on meeting with Mr. Gueye, Director, SAAS (Societe Agro-Avicole de Senegal), Rue Front de Terre, Dakar. SAAS is a Senegalese organization with 10 shareholders. Its purpose is to promote poultry production (both commercial and village level). SAAS imports eggs from Belgium and hatches them in incubators. Their facilities are sufficient to handle 90,000 eggs at a time, but they normally operate at only half capacity. Day old chicks sell for

140-160 CFA per chick. Chicks are sorted and sexed when hatched out and put in cardboard boxes of 25-50 chicks per box. SAAS's major customer is CARITAS/Senegal as well as some of the commercial producers in the Dakar area.

9. Notes on visit to Safina Agrocap (also known as Ranch Filfili), Sebikotane. 21 Nov 86. I spoke with Rabeh Filfili, one of the managers, and then toured the animal production facilities with Issa Diop, animal production assistant.

Ranch Filfili is a very large commercial operation. The Filfili family (two brothers) export some swine to other West African countries, but the bulk of their produce, eggs, and meat are sold in two large supermarkets the family owns in Dakar. The Filfili's have a government-granted monopoly on all cold cuts and processed meat products sold in Senegal. This means that no imported cold cuts or processed meat products are allowed into country. A local butcher may make his own sausages, pates, etc. but he can only sell them in his own shop.

Ranch Filfili has a feed mill and a meat processing plant as well as commercial freezers. It produces broilers, layers, swine, turkeys and ducks. Sheep and cattle are purchased on the open market, then fed out for 1-2 months for slaughter.

The ranch has 6000 to 8000 swine that are raised to produce processed meat products. Hogs raised for slaughter are a three-way cross of Large White, Landrace and Pietrain. Filfili's farrowing barn holds 400 sows and there are 18 boars on site. Boar semen is also imported from West Germany.

Sows must produce at least 16 piglets per year to be kept in production. Young pigs are weaned at one month and fed a complete weanling ration that is imported from Belguim. (This is the only complete feed that is imported; feed for the remaining swine and other animals is formulated and mixed on site. Some primary components of the rations may be imported, but most are bought locally.) Sixty to eighty hogs are slaughtered per week at an average age of 8-9 months old and an average weight of 100 kilograms.

Chicks are imported from Belgium and France. There are 15,000 layers (Schavers) laying at any one time. Their pullets lay at 21-22 weeks of age. Eggs are graded and packed on site, and retailed at the Filfili stores in Dakar. Ranch Filfili also raises 8,000 broilers at a time. One kilogram of broiler flesh retails for 1000 CFA at their stores in Dakar. Poultry are vaccinated against Newcastle and Marek's disease, and are treated regularly with antibiotics and coccidiostats. The poultry feed made on site contains fishmeal, peanut meal, corn, millet, wheat hulls, rice flour and a vitamin/mineral supplement. Mr. Diop told me that for the most part there are no health problems with their poultry. Houses are emptied

and disinfected between groups of chicks. Sick birds are isolated. Feed and water are distributed automatically, so even in the hottest periods there is always water available for the birds. The chicken houses are situated so that they are well-ventilated. The only problems in the raising of chickens is predators, mainly pythons and wildcats, that make their way through the chicken wire and into the houses. Ducks and turkeys are raised on a much smaller scale, approximately 2000 at a time. Sheep and cattle are bought locally or trucks are sent to village markets in the northern area of Senegal. Sheep and cattle are deparasited and then fed fattening rations for 1-2 months and then slaughtered.

10. Notes from the visit to the farm of Maximillian Puis, Pout (15 kilometers south of Thies), 21 Nov 86. Mr. Puis is a local farmer and former extension agent for CARITAS. He has 350 citrus trees -- mangoes, oranges, mandarins, grapefruit and papayas. He is a member of the AVICOOP (Thies) and raises Hubbard broilers (approximately 3000 per year). Mr. Puis said that he has problems with the chicks when they are delivered at the airport. I saw broilers in three different stages of growth. Mr. Puis said that he has no problems marketing his birds year round. Besides feed, he said that his major expense is coccidiostats and antibiotics which he uses regularly.

Mr. Puis also raises rabbits, but finds that they require a lot of work. He said that there is no real market for them except in Dakar and that the market is very seasonal. So he is phasing out his rabbit operation. At present he has 30 breeding does (New Zealands and Californians) and the average litter size is 4-5. Mr. Puis said that he has had problems both with keeping the animals healthy and with breeding them successfully in the hot season.

11. Notes on visit to "Institut National de Developpement Rural" (INDR), north of Thies. Interviewed Dr. Andre Buldgen, Animal Production Department. 21 Nov 86. The World Bank financed the construction of this school (air-conditioned classrooms, modern labs, etc.), the purchase of tractors and equipment, and now finances some of its operating expenses. Other funds come from the European Community, and the French and Belgian governments.

The school was built to train 200-300 students in agricultural engineering, though at present INDR has less than 50 students. The program of study lasts five years and each student spends time in each of the school's departments (two years of preparation and three years of study). There are eight European professors (French and Belgian). Most of the graduates of the school are to join the agricultural extension service, but a few that I spoke with hope to go to Europe to continue their study.

Dr. Buldgen said that one of the major projects of the animal production department at present is the preparation of a book that details the nutrient levels of locally available feed ingredients,

native pastures, local legumes and "improved forages". Some of the samples have been analyzed at INDR and many have been sent to Belgium. Dr. Buldgen said lysine and methionine content of local forages is very low. The book, which will provide more nutrition information, should be published within the next six months.

Dr. Buldgen is also doing feeding trials of imported chickens (Hubbards) to determine the best level of ME (metabolizable energy) for the climate. He has found that when feeding rations containing 2800, 3000, and 3200 kilocalories ME (commercially available feed as control) that the 3200 kilocalories ME ration works best in this hot climate. In his studies (four trials to date) he has found that on the 3200 kilocalories ME ration that the broilers can reach 1.5 kilograms in 45 days.

The department has own feed mill and rations are prepared using ingredients available on the local market (peanut meal, fishmeal, sorghum, corn, millet and rice hulls). The department's feed mill is also available for use by local farmers (Farmers are charged 5 CFA per kilogram for milling). Dr. Buldgen has formulated rations for broilers using different locally available ingredients and when a farmer comes to INDR he is told how much of each ingredient to bring and the feed is prepared for him.

Dr. Buldgen feels that local farmers should not be given credit for the purchase of chicks or the construction of coops, but rather that they should be given credit to buy the primary ingredients of feed for their rations, e.g., sacks of rice, millet, sorghum, corn. His reasoning is that if the chicks die, the farmer has no way of repaying his loan. If he has a loan only for the primary feed ingredients, however, the farmer can sell the grain to repay the loan even if the chicks die.

Dr. Buldgen will soon begin digestibility studies on local forages using sheep purchased on the local market. He said that Andropogon appeared to be the most promising of the local forages because it does not need water in the dry season and it can produce 20 tons dry matter per hectare. INDR has enough land to cultivate their own forages. They also have constructed bunker silos for storing corn, sorghum and millet.

12. Notes on interview with Mr. Ameth Diouf, INDR, Thies. 27 Nov 1986. Mr. Diouf has finished his studies at INDR and is completing his thesis on the poultry industry in Senegal. Mr. Diouf said the reliable figures on the Senegalese poultry industry are difficult to find and are often conflicting. Mr. Diouf said that there has been a 10% increase in poultry production per year since 1960. He said that 1985 figures showed 38 chickens per square kilometer in all of Senegal, which breaks down to 1,927 per square kilometer in the Dakar region and 155 per square kilometer in the Thies region. Mr. Diouf provided the following figures on the numbers of chicks imported from France and Belgium from 1980-84:

1981	780,000
1982	1,300,000
1983	1,627,000
1984	307,754

Mr. Diouf said that he obtained these figures from Senegalese customs records and that the reason the number of imported chicks declined in 1984 is because most chicks were bought for projects and thus were duty-free and not registered with customs.

Mr. Diouf cited a study by Mr. Kebe of St. Louis which found 134 poultry farms in Senegal with 65% of those, or 87 farms, located around Dakar. But Mr. Diouf said that the feed mill SSEPC has records of 80 poultry operations in all of Senegal (1980 figures) while his own survey found 192 poultry farms in Dakar and 248 in all of Senegal.

Mr. Diouf's opinion is that there are two problems with poultry production in Senegal: 1) a low level of technical skill exists and 2) the cost of feed is almost prohibitive to all but the biggest producers. In the Dakar and Thies areas that many of the people who actually own the operations may have technical skills, but that they are often either government functionaries or have full time jobs in the city. For them poultry production is a weekend pastime. This individual may select a young person in the village and put him in charge of the day-to-day operations of the coop. The young person most likely does not read or write and probably has had no previous experience raising poultry. Therefore, if problems arise during the week or if the owner goes 2-3 weeks without visiting the operation, most of the flock could be dead by the time help is requested.Mr. Diouf said that the other constraint to poultry production is the cost and quality of feed.

In his survey Mr. Diouf found that when a farmer decides to raise poultry he is usually successful with his first batch of chicks. Mr. Diouf thinks this is because the farmer is most likely to follow all of the advice he receives during his first operation. He said that he found several farmers who reported average weights of broilers of 1.5-1.7 kilograms after 45 days. The second time these same farmers raised broilers, the average weight dropped to 1.0-1.2 kilograms. The third time the results were even worse, and eventually these fa ·.. s give up. Mr. Diouf said that there is a tendency after one or two successes to cut corners and to not follow advice quite so closely. Also producers sometimes dilute the purchased feed with any grain or by-product that they can obtain cheaply. Because antibiotics and coccidiostats are expensive, they are often diluted to make the product last longer with obvious consequences. In interviewing producers he has found that many prefer to return to the traditional method of poultry production, where birds are left to fend for themselves and do not require any special attention. Also there is a traditional market in villages whereby a wholesaler ('pere poulet' or 'banabana') passes through the village and buys up excess chickens. This method saves villagers from having to find markets for their birds themselves, but they also receive a very low price per bird.

In his survey, Mr. Diouf found that introducing imported roosters into villages does not necessarily mean an improvement in the size, egg production or number of birds in the village. His study shows that after a few generations the improved blood is diluted and that quite often some of the natural resistance of the local birds is not passed on, leaving 'improved' birds that are more susceptible to parasites and illnesses.

Mr. Diouf feels that institutions like INDR can help village farmers to produce better poultry by helping them formulate rations that can be made locally and by teaching/showing them the basics of sanitation and health care. He said that experience at INDR has been very positive for farmers who have used their services, and that word had been passed around that INDR can help improve one's poultry production.

13. Notes on interview with Dr. Cyrus Nersy, DVM, Assistant Director, PRODELOV, Kaolack, telephone 41-19-30. PRODELOV was formed in 1980, funded at the end of 1983, and actually began operation in April 1984. PRODELOV has an operating budget from the French Cooperative Service (FAC). The project encompasses 456 villages in an area over 300,000 hectares. There are 8 trained animal production extension agents who are assigned in pairs to different areas of the project. The primary objective of the project was to improve the health conditions of the small ruminants in the project area.

In the first year of the project 132,000 small ruminants (100,000 sheep and 32,000 goats) were vaccinated against PPR and pasteurellosis and were deparasited with Ivermectin. The cost to the villagers was 155 CFA per animal. In 1985 only 70,000 animals were treated, and in 1986 only 10,000. Dr. Nersy said that village farmers do not appreciate the importance of vaccinating their animals, although parasite control is much in demand. He thinks that if the project is to continue with a vaccination campaign, these vaccines should be made free of charge and only charge farmers for parasite control (which they are willing to pay for). Dr. Nersy is also of the opinion that the vaccine available for pasteurellosis is ineffective and that farmers see that their sheep get sick and die from a disease that they are supposed to be protected against.

Dr. Nersy prefers to use Ivermectin to control parasites because it works against both endoparasites and exoparasites. However, since it only comes in injectable form, an extension agents must go to the villages and give the injections.

In the past few months the project has set up small veterinary pharmacies in villages with one or two individuals responsible for handling the medicines. These pharmacies include a broad spectrum antibiotic and an anthelmintic (ExhelmII). The farmer responsible for the pharmacy can make a small profit per dose.

The second objective of PRODELOV is to provide feed supplementation during the months of the year when there is no available forage or protein supplement. The project tried to stock forage (peanut hay) to keep the price constant for the village farmers, but once the project's stock was finished, the price went up and many farmers could not afford to buy the peanut hay on the local market. The project has also bought cottenseed by the truckload from a local textile mill, sacks the cottonseed in 50 kilogram sacks and resells it at the market price for cottonseed. (Villages can also have the feed delivered, thereby saving on transportation costs).

The project has encountered some problems with this system, besides just the logistics of buying large quantities of cottonseed and distributing it. There is a GOS sponsored program called "Sauf-garde de betail" or "save the livestock" where feed (mainly cottonseed and peanut cake) is distributed to villages at 15 CFA per kilogram. Cottonseed normally sells for 30 CFA per kilogram and peanut cake at 60 CFA per kilogram. Dr. Nersy feels that this system favors the urban consumer over the rural producer. Farmers would rather wait for the government subsidized trucks to arrive than pay a higher price for feed that is available, even if they lose a few head during the wait. Dr. Nersy said that farmers have to learn to pay a just price for feed and to learn to manage their money and available resources (many farmers sell their own peanut hay after the harvest to make money, but then buy peanut hay several months later, often at a higher price, to feed their own animals).

Markets for small ruminants? Dr. Nersy does not feel that rural villages can make a profit selling to the butcher market. He said that the Tabaski market is possible for most villages. In the kaolack region farmers raise millet and peanuts and that village women as a rule keep 2-5 small ruminants for family use (holidays, marriages, baptisms, etc.). If a family owns a larger number of small ruminants, they are often taken care of by a shepherd, along with the animals of other people in the neighboring villages. Because so many thousand sheep are imported at Tabaski, Dr. Nersy feels that fattening sheep for 100 days is possible and would be profitable for most villages. He said that the Moroccan rams were imported for the Tabaski market to cross with local ewes and produce offspring that will bring a premium price at Tabaski.

Why import Moroccan rams rather than select good Touabire rams from Senegal? Dr. Nersy said that he would have preferred to use Touabire rams first and then, if that did not give adequate results, look elsewhere for breeding stock. But others in the project felt that it was necessary to set an example by bringing in imported rams. Sixteen rams were imported and there are now 14 (two died of rickettsiosis). Village cooperatives that wanted to receive a ram had to provide forages and protein supplements for the ram. Their ewes had to be tagged, vaccinated and deparasited. Each ram is to service approximately 60 ewes. The village cooperatives took a credit for 250,000 CFA per ram, which is to be repaid (it is hoped in full) at

Tabaski 1987. PRODELOV hopes to produce 3000-4000 sheep for Tabaski next year, including the offspring of the Moroccan rams.

Dr. Nersy said that if village cooperatives are going to raise sheep for the Tabaski market that they 1) must have a credit system available to them for buying animals and feed supplements, and 2) animals must be selected (i.e., unneeded males castrated, and unproductive females sold). The credit system needs to be short-term loans (at least 100 days). Dr. Nersy said that villagers now have no such system available to them.

PRODELOV did a couple of fattening for Tabaski projects in 1986 just to see if short term credit would work. Two village cooperatives purchased 50 sheep each plus all the necessary feed for the 100 day fattening period. Each sheep was given 700 grams cottonseed, 200 grams peanut cake, and 1000 grams peanut hay per day. The average feed cost per head for the 100 day fattening period was 3500-5000 CFA. All sheep received Ivermectin injections before beginning the fattening period. The total cost for each village was approximately 1,130,000 for the sheep and feed for 100 days. The sheep weighed between 25-35 kilogram at the beginning and after 100 days weighed 40-50 kilogram with an ADG (average daily gain) of 113 grams per day. Four sheep died during the 100 day fattening period. The selling price for the sheep ranged from 30,000 CFA to 60,000 CFA (the break-even selling price was calculated to be 23,000 CFA).

14. Notes from interview with Dr. Mamadou NDiaye, DVM, Director, PRODELOV, Kaolack. 24 Nov 86. I asked Dr. Ndiaye why PRODELOV imported rams from Morocco instead of buying rams (e.g. Touabire) in Senegal. He said that the project wants to establish a breeding stock of improved blood lines, with the extra males being sold for the Tabaski market. He said that PRODELOV had requested that the "Centre de Recherches Zootechniques" (CRZ) in Dahra select Touabire rams for PRODELOV, but that such rams were unavailable. I asked Dr. NDiaye why it was so important to know the genetic potential of the rams when village ewes are of mixed breeds, and when the major market of these offspring is for Tabaski sacrifice. He said that the offspring of the Moroccan rams will have faster growth and consume less feed than those of the Touabire, and that the Moroccan rams were more the "type" preferred for sacrifice at Tabaski. Dr. Ndiaye hopes that within the next year that the CRZ in Dahra can provide 20-30 Touabire rams for PRODELOV and then he will compare th performance of the Moroccan rams' offspring versus that of the Touabire offspring.

PRODELOV imported 6 Sardi rams and 10 Caussenard rams from Morocco. The animals arrived by boat in Dakar on 27 May 1986. These rams are 16-19 months old, and weigh between 80-100 kilogram with fleece that weighs approximately 2-2.5 kilogram. At adulthood these rams will weigh between 105-130 kilogram. The ADG for the Sardis is 200 grams per day from day 10-30; and 185 grams per day from day 30-90. The Caussenard ADG is 240 grams per day from day 10-30; and 275 grams per day from day 30-90.

15. Notes on visit to PRODELOV village of Khayor (17 kilometers north of Kaolack). 24 Nov 86. Was accompanied by El Hadj Fall, PRODELOV chauffeur. Met MBane Diouf, president of the "groupement d'eleveurs" and several cooperative members. Saw their Caussenard ram who appeared to be in good health. The ram is housed in his own special pen and fed separately from the other animals. The ewes have just begun lambing and I was able to see 3 offspring who were obviously fathered by the Caussenard ram because they had curly coats. All ewes were tagged and were being fed their daily supplement of cottonseeds and peanut hay. The ewes were separated from the other sheep and goats of the village by a fence of millet stalks. There are 79 ewes that have been bred to the imported ram (the project calls for 60 ewes per ram).

16. Notes on interview with Mr. R. Vancoppenolle, "Projet de Developpement Integre des Villages" (Projet Villages Pilotes), BP 191, Kaolack, telephone 41-23-18. This six year (1984-1990) project is funded by the Belgian government and works through the CER ("Centre d'Expansion Rural") offices. There are 6 pilot villages where the project has activities that range from digging wells to raising chickens. For Tabaski 1986 three of the six villages fattened sheep. Twenty cooperative members in each of the three villages received enough credit to buy 2 sheep and enough feed for a 70 day fattening period. The average cost of one sheep was 13,000-14,000 CFA. Each cooperative member was responsible for his/her two sheep and they were housed at the compound of the individual. In one of the villages involved, women were responsible for the sheep and in the other two, men did the fattening. All sheep were treated for parasites. Each animal was given 1000 grams of peanut hay, 600 grams of cottonseed, 100 grams of peanut cake, and 200 grams of millet bran per day. The sheep gained an average of 10 kilograms in the 70 days, and were sold for prices that ranged between 20,000-26,000 CFA per head. The feed for the 70 days cost 5700 CFA per head, and parasite control was 50 CFA per head. Therefore, profits for the cooperative members ranged from 1300-7250 CFA per head. The individuals were responsible for finding their own markets for the sheep; therefore, if it was necessary to transport the animals, some of the profits were less. "Projet Villages Pilotes" will fatten sheep again for Tabaski 1987, but are encouraging villagers to provide as much of the feed as possible. The project is also going to distribute Touabire rams to the 6 villages with the hope of improving the value of sheep for the Tabaski market. By Tabaski 1988 the project will provide only the protein supplement and the parasite control for the fattening period, assuming that those interested in fattening sheep will have their own to fatten and will not need to buy sheep.

In Jan. 87 the project will distribute Rhode Island Red roosters to the 6 pilot villages. The roosters will be raised to the age of 6 months and will be vaccinated and treated for one year after they are put in the villages. Local hens will not be vaccinated or treated in any way. The hope is that there will be more chickens and eggs available for consumption in the villages.

17. Notes on interview with Adama Faye, Animal Scientist, Farming Systems Research Team, ISRA-Centre Sud, Kaolack, telephone 41-29-16. In the opinion of Mr. Faye, the biggest constraint to any kind of animal project at the village level is the lack of credit for farmers. Most farmers can pay for loans after the harvest or when they market eggs, chickens or sheep, but for most of the year farmers have a cash-flow problem. He said that animals have more parasite and disease problems in the rainy season, plus animals need feed during this time because areas where they usually graze are planted with crops. But this is the time of year when most farmers are having a hard time feeding their families and money is scarce. Mr. Faye said that projects must insist that farmers participate either by providing peanut hay for their animals, building structures or monetary participation. He feels that if farmers have a stake in the project outcome, then they will be more conscientious in the process of the project.

Mr. Faye feels that the research organizations like ISRA could try to coordinate with NGOs, so that their efforts are not duplicated. Both projects and ISRA could benefit from an exchange of ideas and experience. He said that there was project that introduced Rhode Island Red roosters into villages in the Kaolack area in 1979-80. But when the chickens were ready to be sold, the village groups could not find buyers for them, and that the groups were very discouraged. He said that ISRA had conducted a study that year that concluded that there was not a market for broilers except in Dakar, and had ISRA been consulted before the project started a failure could have been avoided. Mr. Faye said that now there are wholesalers who travel by truck from Dakar, Kaolack, and other urban areas to the local markets where villages can market broilers and eggs, but that just 6 years ago this did not exist.

18. Notes on conversation with Mr. Mboop, Responsable de l'Elevage, CARITAS/Senegal, Kilometer 11, Route de Rufisque, Dakar, telephone 34-05-28. Mr. Mboop is a Senegalese government agent who is assigned to work in the national office of CARITAS as an animal specialist. CARITAS is the development arm of the Catholic Church and they receive funding from the Catholic Church, the World Bank, Canada, USAID, and various NGOs.

Mr. Mboop told me that CARITAS has several chicken projects in the Dakar and Mbour areas. He said that some of the operations are owned by CARITAS and that others are operated by village cooperatives who repay the construction and equipment costs of the chicken houses to CARITAS. Most of the chicks involved in CARITAS projects are bought in Dakar at SAAS. He said that SAAS was more convenient than getting chicks at the airport from France or Belgium. He advised me to contact Mr. Clement Mbassene, the "responsable de groupement d'elevage," in Mbour (telephone 57-11-46).

19. Notes on visit to CARITAS agricultural training center at Nianing. 25 Nov 86. Canadian priests started this facility in 1975, and control is now being passed to the Senegalese government. Young men receive training here in agricultural skills -- gardening, livestock, and forages. At one point the center raised rabbits, layers, broilers, pigs and sheep. Now only a few sows are left.

After my visit to Nianing, I had a brief meeting with Mr. Clement Mbassene at CARITAS, Mbour. Mr. Mbassene is a government livestock agent who is assigned to work with CARITAS. I asked him about the Nianing facility and he said that it is in disrepair because control of the operation is being turned over to the Senegalese government and no one is really responsible for its management. I asked about CARITAS poultry operations in the Mbour area. Mr. Mbassene said that the CARITAS groups produce 10,000+ broilers per year and that their major problems are chick health, transportation and marketing. He said that their chick mortality can be as high as 15%, due to coccidiosis and pullerom. He said that he has tried to see each operation before the chicks are introduced to make sure that the facilities are cleaned and disinfected between groups of chicks.

20. Notes on conversation with Christian Blanchette, Canadian volunteer (small livestock specialist), 1 Dec 86. Mr. Blanchette worked with the CARITAS poultry projects in the Mbour area for one and a half years, and now works with SOS-Sahel. Mr. Blanchette said that CARITAS requested a volunteer in the Mbour area to improve the profitability of their poultry operations. He worked with three village groups. All three had previously gone 6 years without showing a profit from their poultry operation. Mr. Blanchette showed me one project reports from two of the villages (the third village is producing layers and their results are not yet available), showing a profit of approximately 200,000 CFA each in seven weeks of operation. He said that the village groups problems with management, marketing and bird health. After so many years of failure the village groups were not very motivated. Day-to-day operation had not been delegated to one or two individuals and, therefore, everyone and no one was responsible for feeding and watering the birds. The marketing problem was partially solved by approaching the tourist hotels in the Mbour area and guaranteeing a delivery date for broilers. The other marketing problem was that the groups were only asking for 600-750 CFA per broiler while the going rate is 950 CFA. It costs 780-840 CFA to produce a 1.2 kilogram per broiler in seven weeks, so previously the groups were selling their broilers at a price that could not cover production costs. Mr. Blanchette said that 70-80% of production costs for broilers is feed and that for egg production the feed cost rises to 85-90% of the cost of production. Medication account for 5-8% of production costs. Vaccines are inexpensive, but antibiotics and coccidiostats are expensive and must be used regularly. For the egg production project, the cost to produce one egg is 38 CFA. Eggs can be sold to a wholesaler for 40-43 CFA each and retailed at 50 CFA/egg. The producers can make 2-5 CFA profit/egg. Mr. Blanchette

said that the purchase and transport of chicks from Dakar can be a problem. To insure that one's chicks get the proper care on arrival the purchaser must be at the airport when the plane arrives and insist that the chicks be brought inside as soon as possible.

Mr. Blanchette feels that broiler projects can be successful even with the price of feed from 125-140 CFA per kilogram, but markets need to be sought before the chicks arrive. Also village groups need to designate one or two people who are responsible for the chickens.

Other persons contacted:

1. Mr. Ron Harvey, Agricultural Development Office, USAID/Senegal.

2. Mr. Bocard, Societe de Developpement de l'Elevage dans la Zone Sylvo-Pastorale (SODESP), Villa 46, Zone A, BP 10.282, Dakar, Tel# 21-54-72.

3. Ms. Mina Bail, Deputy Resident Representative, UNDP/Senegal.

4. Dr. D. Richard, Service d'Alimentation de Betail Tropical (ABT), ISRA, Dakar-Hann.

5. Dr. Roberge, Chef de Centre de Recherches a Sangalkam, Dept. Zoo/Veto, ISRA, Dakar-Hann.6. Mr. Christophe Soulard, Volontaire du Progres, Animal Production Specialist, Equipe de Suivi et de Post-Formation des Eleveurs de Labgar, BP 10, Linguere.

7. Mr. Ali Diop, Directeur, Centre Aviculture, Rte. de Rufisque, Dakar.

Recommendations

Poultry Production

It may seem like an obvious point, but for poultry production to be profitable for the local producer, marketing problems must be solved well in advance of starting production. Marketing is a problem for all but the very largest poultry producers in Senegal. Often these firms own their own marketing outlets (a supermarket, for example) so selling their animal production is just another link in their overall business structure. Unfortunately, this is not the case for the small, local producer. The question of selling his production must be solved well in advance of making the substantial investment necessary to start a profitable poultry operation.

Therefore, it would seem that the best recommendation for a small- to medium-size poultry operation specializing in "improved" meat and egg production would be to first identify potential buyers (tourist hotels, supermarkets, etc.) then sell to that market. If contracts can be negotiated in advance, so much the better. Selling exclusively in local markets where the demand for "improved" poultry is weak or non-existent, would make the chances for turning a profit very slim.

Further, small-scale producers could compete much more easily with the large-scale enterprises by organizing themselves into a cooperative capable of guaranteeing buyers regular, high-quality poultry products on a timely basis. This, of course, introduces a whole new set of management problems, but the potential is exciting.

If a market is unavailable or so distant that transportation costs are high, the local producer could still raise a few local birds for his own family's consumption or for sale in the local market. With a little improved management and health care, local chickens will produce more eggs and, thus, more, healthier chicks. The investment in time and financial resources would be minimal and there is good potential for producing a small surplus to be consumed at home or sold for income at a local market.

Sheep Production

Probably the best market available to sheep producers in Senegal is the Tabaski market. Sheep are relatively less expensive at other times of the year and many authorities think that producing for the butcher market is not a highly profitable operation for local farmers. However, both demand and prices are high around Tabaski (and some other holidays), and even more of a premium is paid for white rams.

It has been shown that an individual can buy sheep several months before Tabaski, fatten them, and sell them for a reasonable profit

just before Tabaski. A producer with a few sheep could also practice some elementary selection for those animals (white rams) that bring premium prices around Tabaski. For example, producers could sell their dark sheep, use the money to buy a white ram, then keep lambs that are white or mostly white. If a dark lamb was born, it could either be castrated, fed, and sold or simply kept apart from the selected herd for later consumption by the producer's family.

Goat Production

Demand for goat meat does not appear to be strong outside of the occasional local market or "dibiterie." Profit potential is marginal, making other small ruminants a more likely investment choice. Some local consumers prefer goat meat for Korite, but this market is of much less importance than, say, the Tabaski market for sheep.

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Livestock production information gathered in The Gambia. September 1986 - December 1986. Jane Homan

This summary presents the results to date of information gathering efforts in The Gambia arising from the September-October visit by Tom Yuill and Jane Homan and carried out in collaboration with Tayib Janha, Jebel Sowe, Ena Corrah, Patricia Andrews, Aminatta Njie and regional livestock assistants. It is emphasized that this is an interim report and particularly in the case of the prospective studies, data collection is at an early stage. In view of the lack of detailed quantitative data beyond the 1979 census which would reflect small ruminant and poultry production, two types of survey activity were initiated. A rapid reconnaissance "sondeo" was developed with inputs from the UW-VSU livestock team and the DAHP participants. This "structured conversation" was tested and carried out in 8 villages to assess different management strategies in use, attitudes to small ruminant and poultry production, perceived constraints and objectives. In later interviews some questions pertaining to draft animals were added. In the absence of other known criteria for village selection the 8 villages were targets of opportunity selected to represent a range of geographical location, ethnic make up, cropping practices and market opportunities. The sondeos were carried out by experienced livestock professionals to allow maximum information to be derived from follow up on unexpected replies, and to allow the exercise to serve as an orientation for those likely to be involved in developing research directions. The outcomes of the interviews are presented as a text assembled from the responses. With the small number available it is inappropriate to make quantitative or generalized observations about responses from one ethnic group or location. The salient points emerging overall are the diversity of responses between villages, the use of small ruminants as a "checking account" to cover immediate expenditures, the interest in milk and eggs as consumables, the rarity of sheep and goat meat available for consumption after Tabaski, the emphasis on water, nutrition and disease as constraints to production, the lack of perception of a concept of overstocking, lack of controlled breeding, disease and predation as constraints to poultry production, an apparent willingness to pay for good veterinary inputs and an apparent open mindedness to trying unfamiliar sources of protein and production systems.

The second series of data collection is a prospective study of production parameters of sheep, goats and chickens in farming systems focus villages. At the time this study was initiated in September, it was agreed that four villages would be included. This was subsequently increased to seven villages by the DAHP participants. While this has provided better geographic coverage, it has also increased manpower and logistical needs in the field and the data processing load. Villages included are. in the Western FSR/E region: Kassange, Sangajor Jiramba on the south bank, Kerr Wally and Njaba Kunda on the north bank; in the Eastern region Sabbi, Giroba,

and Abbakutta. In each village sheep, goats and chickens were tagged. Currently 71 sheep, 75 goats and 127 chickens are under observation. At the time of the workshop some villages have been visited three times and some four times. Information collected on follow-up includes weight, nutritional condition, reproductive status, feeding provided and reasons for leaving the study group (sale, death etc). It is premature to attempt any analysis but already trends are emerging showing weight gain and increasing reproductive activity in the wet season and information on sales and losses of poultry. Continuation of this data recording will provide a diagnostic tool to identify cycles of growth, weight loss, reproduction and nutritional need in relation to sources throughout the year. Graphical representation of this data may help in communication of results to villagers. Guidance will be sought during the workshop on continuation of this study, particularly with regard to frequency of follow-up visits and data to be collected.

Future of the Department of Animal Health and Production

Dr. Omar Touray, Assistant Director of the Department of Animal Health and Production (DAHP), reviewed the civil service restructuring process as it has affected the DAHP and plans for privatization of veterinary services in The Gambia.

Prior to the 1985 study of the civil service, DAHP had 541 permanent staff. In 1985, 143 were retrenched, these being mostly temporary staff and individuals not actually functionally assigned to the department. In September 1986, an additional 50 lay-offs of middle and junior level staff occurred.

There are eleven veterinarians in The Gambia (excluding expatriate employees of ITC). Two of these are in administration (Director and Assistant Director of DAHP). Of the remaining nine veterinarians, three are seconded to ITC. Six veterinarians thus provide field, clinic and public health services for the country. There are eight senior livestock officers.

The proposed restructuring would create three divisions within DAHP: Extension and training, with responsibility for disease control and animal production activities; Research, encompassing both animal health and production; and Public Health with responsibility for food hygiene and zoonosis control, particularly rabies.

Dr. Touray's presentation was followed by debate pertaining to supply of trained veterinarians, coverage of the national territory under the privatization scheme, assurances of regulatory control of endemic and exotic diseases, the future of the present livestock and veterinary assistants, and staffing of DAHP's remaining three areas of emphasis.