

**Mixed Farming
Technical Report**

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RANGE RESOURCE INVENTORY

by

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**GAMBIAN MIXED FARMING
AND
RESOURCE MANAGEMENT
PROJECT**

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

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MIXED FARMING PROJECT

July 1986

FINAL REPORT
RANGE ECOLOGY COMPONENT
MIXED FARMING PROJECT

PART II - RANGE RESOURCE INVENTORY - A SUMMARY

INTRODUCTION

The basic tool in planning range management programs is knowing what grazing resources are available, in what quality and quantity, and where they are located in relationship to each other and to other physical resources, such as human habitats, farm lands, stock water, forests, and roads. This type of information has not been available.

This portion of the final report deals with the Range Resource Inventory conducted exclusively in MacCarthy Island and Upper River Divisions, the two most eastern Divisions in The Gambia, representing some 494,000 hectares of land mass. (Appendix 3) Included is a series of nineteen maps at a scale of 1:25,000. The nineteen maps are indispensable, and are meant to accompany this report, but because of size and numbers their inclusion may be impossible. A permanent copy will be with the Range Unit of the Department of Animal Health and Production, Abuko.

Resources have been identified and quantified through extensive ground proofing.

Gambian Land-Use Classification (GLUC)

Livestock grazing areas in The Gambia are identified by four principal ecosystems and whether or not the land has been cultivated. Grazing practices are determined seasonally: 1) rainy season, 2) harvest season, and 3) the dry season. (Technical Report 14, May 1986, p. 23)

The four basic ecosystems are:

- Cultivated Lands - grazed by livestock following harvest
 - forage is principally crop residues with annual forbs and grasses.

- Fallow Lands - grazed year-round by all classes of livestock
 - burned by bushfire
 - forage is forbs, annual grasses, and shrubs

- Forests - accessible when cultivated and swamp land are not available
 - grazed year-round
 - burned by bushfire
 - low productivity
 - forage is weeds, annual grasses, and trees and shrubs

- Swamplands
- dry season grazing areas
 - high productivity
 - inaccessible during rainy season and high river flow
 - forage is annual and perennial grasses, and forbs

The four ecosystems in The Gambia have been further clarified into fourteen land-use classes. These land-use classes were identified by the Gambian-German Forestry Project in 1981-1983; 525 maps at a scale of 1:10,000. The fourteen Gambian Land-Use Classifications, or GLUC, are briefly described in Appendix 14 and 24, and with plant occurrence in Appendix 26.

MFP considers GLUC as a standard nomenclature for identifying ecologically similar types of land. It made good sense to use the GLUC as the basic land unit to identify and measure. However, conflicts in identification did occur in some units of the GLUC system. Separation of GLUC type 5 and 6, and type 8 and 9 proved difficult; as a result MFP has combined LUC types 5/6 and 8/9, to make total LUCs at eleven. (See Appendix 26) Hence the nomenclature changed to MLUC, Mixed Farming Land-Use Classification. Hopefully no undue pain will be experienced for so doing.

No Type 13, Water Surfaces, is included in this analysis. Since GLUC 13, Water Surfaces, has no forage value assigned, its presence is noted by no-value or zero for both surface area and biomass. The same is true for GLUC 1 and 2, Mangroves; because of severe swampy conditions, access by livestock is restricted.

MFP Resource Identification Strategy

MFP's mandate (PP/MFP, 1979) was to establish range resource information based on selected range sites. This would have meant a few small sites of several hundred hectares would have received a very thorough investigation with possibly no time remaining for a basic investigation over several thousand hectares. After deliberation, a four year plan was devised to collect information describing range resources in MacCarthy Island and Upper River Divisions. Both Divisions consist of smaller administrative units. MID is now organized into eleven administrative districts, or sub-districts, and URD is organized into seven administrative districts, or sub-districts. Each district or sub-district is well suited as a separate Resource Management Unit (District).

Field data collection and mapping took place from October to January each year. (Appendices 3 and 22) Initial data collection started in October 1982, one year before the GGFP final Land-Use Classification maps were available. The field collection system was not fully field tested and some changes occurred over the four year period. Most evident change occurred in the ability of field staff to identify and name plants. Not only did the biomass team, as it was called, identify land-use types by vegetative composition, quantify productivity by weighing sample plots, but the whole exercise was a training program for Pasture Assistants and Livestock Officers as well as an opportunity to collect plant specimens and establish a department herbarium.

Optimal plant development or Production Biomass is best indicated through measurements of quantitative biomass data closely following the termination of seasonal rainfall. Vegetation at this point is fully mature and easily identifiable. A limited followup measurement was made in April and May to determine the residual biomass, or that portion of plant development remaining after grazing and bushfire.

A sheep and goat (small ruminant) census was conducted by the Department of Animal Health and Production in 1979. The population of sheep was 145,959 and goats was 158,095 (Total 304,054). Based on that study, it is difficult to predict actual populations. An attempt at estimating what impact small ruminants may have on district stocking rates is figuratively estimated, possibly even a shot-in-the-dark. More detailed estimates are needed.

Thirty-three percent of the country-wide small ruminants are found in MID, and twenty-eight percent in URD.

Calculations were based on 1979 country-wide small ruminant figures, projected to 1984; proportions are taken from large ruminant population.

A UBT (Unitaire Bovin Tropicale) is an animal of 250 kilograms live weight. Six small ruminants (average 41 kilograms each) equal one UBT.

An Animal Unit (AU) and UBT are synonymous, both mean an animal of 250 kilograms live body weight. A standard is set for determining what an animal eats, or what feed is required. The Feed Rations are calculated at 3% live body weight (UBT) for an estimated maintenance ration.

TABLE: Estimated Numbers and UBT of Small Ruminants in MID and URD, The Gambia

<u>Division/District</u>	<u>Proportion %</u>	<u>Total Small Ruminant Pop.</u>	<u>#UBT Equivalent</u>
MID	--	---	16,839
Niamina Dankunku	4%	4,095	672
Niamina West	5%	5,118	839
Niamina East	10%	10,237	1,679
Fulladu West	37%	37,875	6,212
MacCarthy Island	.3%	307	50
Sami	11%	11,260	1,847
Niani	11%	11,260	1,847
Nianija	6%	6,142	1,007
Upper Saloum	11%	11,260	1,847
Lower Saloum	5%	5,118	839
URD	--	---	14,243
Fulladu East	47%	40,818	6,694
Kantora	15%	13,026	2,136
Wuli	25%	21,714	3,531
Sandu	13%	11,292	1,852

* 250 kilograms Live Weight (41 kilograms per small ruminant X 6)

All biomass, individual plant species, are identified and coded by growth form such as: agricultural crop species, grass or grass like, forb, shrub, tree,, etc., or unknown. Each plant is identified as to grazing preference, is it eaten by ruminants or not, or do we know? A key to identification of plants, grazing preference, whether or not specimens are in the DAH&P herbarium, and to what Land Use Classification they appear is presented in Appendix 26.

This eliminates the need to repeat LUC composition for each district. Not all species indicated occur in every district, but frequency of occurrence is consistent enough to include the species as general composition for that LUC.

Livestock Owners' Associations in each of the sampled districts were asked to assist the team(s) in the data collection process. They furnished field assistance in identifying plant material by local names and information on the utility of particular plants. They also assisted with logistics such as housing, water, and food preparation. More information on LOAs can be found in Technical Reports 5 and 14.

METHODOLOGY

The paper instrument used in collecting range resource inventory data is presented in Appendix 25, Range Resource Inventory/Data Collection Sheet I and II. Appendix 24 describes items on the Collection Sheet more fully and codes each item for computer entry and sorting. Notice that the coding sheet includes site specific codes for areas throughout The Gambia, and not just those areas MFP inventoried. This will facilitate any future range resource inventory data collection or followup to existing data.

The basic land unit identified and measured is the Gambian Land Use Classification or GLUC. Each of these fourteen units are described in Appendix 14 and in the text of Appendix 24 (page xxix). However, for this analysis only eleven LUCs are being used; numbers 5 and 6, and 8 and 9 are being combined, and number 13 (water surface) is not included in the land area analysis. Though limited amounts of GLUC 1 and 2 occur, it was found that domestic animals have little access to such areas because of boggy conditions. As a result, no biomass data was collected in these LUCs.

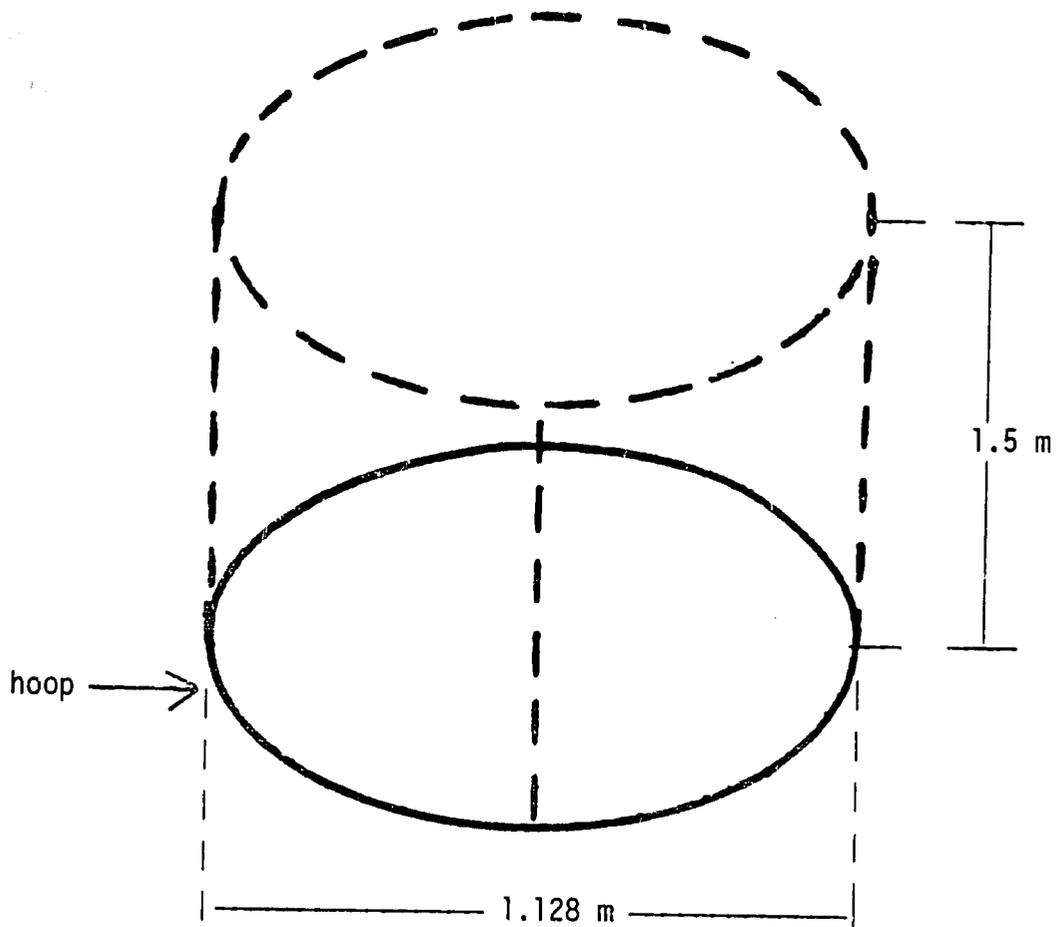
For clarification purposes concerning previous cultivated areas: fallows of four years and more identified in MLUC 5/6 were recorded as being MLUC 7, and fallows identified in MLUC 8/9 were recorded as being MLUC 8/9, but fallow.

Field identity of each LUC was determined by ocular reconnaissance and by using black and white aerial photos taken of the area in October 1980 at a scale of 1:25,000. MFP identified LUCs and demarcated sample plots on the B/W photos daily. Final analysis was made using the Gambian-German Land Use Classifications, as illustrated on the 525 GLUC maps and MFP Range Resource Inventory data.

Selected placement of one square meter sample plots was determined randomly by using the Land Rover odometer followed by stepping-off a multiple of 100 meters into the LUC. At the end of the predetermined distance, the person turns facing the direction he came from and throws the one square meter hoop over the shoulder. Where the hoop lies is where the biomass sample is taken. Exceptions to this practice occurred in inaccessible areas with no roads where predetermined transect lines were stepped off in straight lines, in multiples of 100 meters. At the end of the transect line the hoop was again thrown over the shoulder. Later modifications included placing of hoop at toe of foot at the end of the stepped-off transect.

The one square meter x 1.5 meter high sample plot, or hoop area, from which biomass data was collected is illustrated on page 5.

ILLUSTRATION: Biomass Measurement/Sample Plot



Oblique view of biomass measurement sample plot.

- Hoop area: 1 meter square
- Hoop radius: 0.564 meter
- Hoop diameter: 1.128 meters
- Hoop perimeter: 3.545 meters

MAP USER NOTES

Prepared By
Ed A. Riegelmann

Purpose

The purpose of mapping was to create a spatial inventory of natural and human resources of primary importance to the management and development of livestock populations in The Gambia.

Method

The methodological objective was to produce a series of district unit maps, each map areally including a single district. This objective was modified due to wide variance in the comparative size and shape of individual districts. The result was a series of nineteen maps covering fourteen districts. Exceptions to the district unit maps include the three maps that cover Fulladu East District and the two maps that cover Wuli District. Each of these maps consists of a single, named sub-district within their respective district.

Design

The map design is intended to satisfy the requirements for both a detailed field map and a thematic management map. The chosen scale of 1:25,000 is a compromise of the high level of detail required for field work and the generality preferred for management. Data representations are designed to facilitate quick location, simple identification, and accurate analysis.

Procedure

The mapping procedure was split into three phases, as follows: Phase 1 - The transfer of land use/vegetative type data for 246 Gambian-German Forestry Project Photomaps (1:10,000 scale) to 48 O.M.V.G. Orthophotomaps (1:25,000 scale) covering the MacCarthy Island Division and the Upper River Division of The Gambia. Phase 2 - The transfer of field collected range sample site locational data, stock route data, and stock watering accessway data from flightline panchromatic (black & white) aerial photographs (1:25,000 scale) to the 48 O.M.V.G. Orthophotomaps (1:25,000 scale) mentioned above. Phase 3 - The transfer of data collected on the 48 O.M.V.G. Orthophotomaps (1:25,000 scale), in final form, to the 19 District Range Resource Inventory Maps. This was accomplished with ink and dry transfer lettering on a 0.003 in. single side frosted mylar base.

Data

Land Use Classification Data - Land use information was derived from Gambian-German Forestry Project Maps (1:10,000). Gambian technicians photointerpreted the data from flightline panchromatic and color infrared aerial photography (1:25,000 scale) flown by Teledyne Geotronics in October-November, 1980. The data were verified by intermittent ground-truthing. Accuracy parameters are unknown. Time of data: Fall, 1980.

L.O.A. Range Demonstration Plots, L.O.A. Deferred Range Management Sites, and Range Seed Multiplication Plots - Their locations were plotted according to ground observation and measurement, and were verified by photointerpretation. Level of Accuracy is excellent. Time of data: Spring 1986.

Stock Routes - Stock routes are passageways to give animals access through cultivated fields. This information was obtained by field observation, plotted on prints of the Teledyne aerial photography (1:25,000 scale), and modified by photointerpretation. Level of accuracy is excellent. Level of completion is unknown. Time of data: 1982-1985.

Upland Stock Watering Sites - Upland livestock watering sites are simple, shallow wells developed for grazing animals in the upland tree and shrub savanna. These data were photointerpreted from O.M.V.G. 1:25,000 Orthophotomaps, dated 1983. Level of accuracy is good. Level of completion is unknown. Time of data: 1983. NOTE: This data type was designed to include former (dry) watering sites as well as present sites.

Developed Stock Watering Accessway to Waterways, and Undeveloped Stock Watering Accessway to Waterways - Livestock accessways to waterways are passageways down steep banks allowing animals to drink from the Gambia River and larger bolons (streams). Developed accessways are those which are reinforced with concrete to prevent erosion. This information was obtained by ground observation. Level of accuracy is excellent. Level of completion is unknown. Time of data: 1982-1985.

Major Highways and Minor Roads - Major highways include the North Bank Highway (from Banjul to Georgetown) and the South Bank Highway (from Banjul to Basse Santa Su). All other routes are classified as minor roads. The majority of routes classified as minor roads are simple sand traces created by cattle and human traffic. Route information was photointerpreted from O.M.V.G. 1:25,000 Orthophotomaps, dated 1983. Level of accuracy is good. Level of completion is excellent. Time of data: 1983.

International Boundary - International boundary information was transferred by UTM grid coordinates and feature recognition from Gambian-German Forestry Project Maps (1:10,000 scale) to O.M.V.G. Orthophotomaps. NOTE: Accurate international boundary information for The Gambia is not available due to a lack of survey monumentation along the Gambia-Senegal frontier. Level of accuracy is unknown. Level of completion is excellent. Time of data: 1983.

Divisional Boundary, District Boundary, Sub-District Boundary - Boundary information was transferred by UTM grid coordinates and feature recognition from D.O.S. 1:50,000 Topographic Maps to O.M.V.G. 1:25,000 Orthophotomaps. Level of accuracy is good. Level of completion is excellent. Time of data: 1983.

Range Vegetation Sample Site - The range vegetation sample sites are individually numbered, by district, corresponding with tabular data collected at each site in the field. Qualitative and quantitative data included in each sample site write-up is as follows:

- Write-up #
- Date of Sample
- Photo Reference # (flightline #'s of Teledyne prints)
- Technician
- Site Identification
- Land Use Classification
- Total District Land Area
- Total District Land Area Per Land Use Classification Unit

Sample Plot Size
Sample Height
Treatment
Soil Erosion Rating
Stock Water Source
Distance to Stock Water From Sample
Total Forage of Sample (air dried)
Kilograms of Forage Biomass/Hectare
Tons of Forage Biomass Produced/District/Land Use Classification Unit
Total Tons of Forage Biomass Produced/District
A detailed breakdown of the forbs, grasses, shrubs, and trees found in the sample plot including genus, species, local name, % plot composition, and weight (dry and green)

Sample site locations were plotted on prints of the Teledyne aerial photography (1:25,000 scale), and transferred to D.M.V.G. 1:25,000 Orthophotomaps by feature recognition. Level of accuracy is good. Level of completion is excellent. Time of data: 1982-1985.

Potential Map Use

The following are a number of potential analyses based on the data available in this map series:

- a specific land use or vegetation type category analysis
- community resource analysis
- locational analysis of cattle watering sites for improvement or replacement
- study of potential irrigated agricultural land
- socio-economic analysis at broad and specific community levels
- water resource analysis
- detailed analysis of vegetation associations
- analysis of the potential maintenance, protection, and development of cattle accessways and stock routes
- study of land use change due to cultural or environmental factors
- District management analyses for livestock, rangeland resources, agriculture, forestry, water resources, transportation, communication, and community development
- economic locational analyses

There are many more uses implied in the project reports which accompany this map series. The list of analyses above is in no way meant to be finite.

Limitations

All map products have their inherent limitations of detail and accuracy. The maps produced by this project are no exception.

Most information portrayed on maps has a time viability; that is, a period of time that the data is accurate. The time viability for this map series is approximately ten (10) years. This estimate is based on the observed rate of settlement and development in The Gambia.

Certain elements of the land use classification system employed in this study are very changeable. The classification categories 9 (land presently in agriculture) and 7 (land presently in fallow) change from season to season making classification difficult for any single time period. However, the rate of change or inversion of these classifications (9 to 7 or 7 to 9) is constant. This means that

overall area data for these land use categories remains accurate whereas local area data may fluctuate.

The land use classification information was derived from photointerpretation by Gambian technicians and field checking on a limited basis as described in the DATA section above. However, it is apparent upon close scrutiny of the land use classification data that each Gambian technician involved in analysis had his own perception of the described land use types. Their perceptual differences were limited to classification types that are highly similar in photo-signature qualities such as classes 6 and 7 and classes 4 and 5 and 4. This variation in perception resulted in degradation of the uniformity of the data only.

Upland livestock watering sites were determined using photointerpretive methods as described in the DATA section above. However, none of the watering site locations were field checked. This lack of ground truthing leaves the validity of this data in question. All other information in this map series has been adequately field checked and is valid.

Technical Specifications

Number of Maps: 19

Scale: 1:25,000, 1 centimeter = 250 meters, 1 inch = 2083.33 feet

Grid: U.T.M. Zone 28. Tickmarks and crosshairs at 5000 meter (5 kilometer) intervals

Projection: Universal Transverse Mercator

Spheroid: Clarke 1880

Meridian of Origin: 15 00' West of Greenwich

Latitude of Origin: Equator

Magnetic Variation as of January, 1986: Grid North is 11 39' East of Magnetic North. Annual change is 06' East.

FINDINGS BY DISTRICT AND/OR SUB-DISTRICT

MID - NIAMINA DANKUNKU

The map reference is NIAMINA DANKUNKU/NIAMINA WEST.

Range Resource Inventory sampling completed in October 1982.

Principal cultivated crops are millet and groundnuts.

Desirable biomass (also referred to as Code 1 BM) is that part of natural vegetation, the plant specie, eaten by livestock. In this district about one-half the total desirable biomass is produced in the Swamps (MLUC 10 and 11), an additional one-third is produced in the Tree and Shrub Savanna (MLUC 5/6). The remaining biomass is furnished from Upland Crop Areas (MLUC 8/9), primarily from crop residues left on the ground following harvest.

Biomass productivity (Code 1) for the 12,909 hectare district area is that 1.0 hectare produces enough food for one Unitaire Bovin Tropicale (UBT), or an average of 2,887 kilograms of desirable biomass per hectare of land area.

TABLE: Biomass Production

MLUC	AvComb. BM/HA.	Hectares	Total kgs.	AvCode 1 BM/HA.	Hectares	Total kgs.
1	0	491	NA	NA	491	NA
2	0	15	NA	0	15	NA
3	0	0	0	0	0	0
4	2,730	496	1,354,080	0	496	0
5/6	3,330	3,328	11,082,240	3,040	3,328	10,117,120
7	2,610	703	1,834,830	2,090	703	1,469,270
8/9	3,760	2,147	8,072,720	2,840	2,147	6,097,480
10	(4,470)	1,879	8,399,130	(3,540)	1,879	6,651,660
11	2,830	3,513	9,941,790	(3,749)	3,513	12,322,137
12	3,540	237	838,980	1,820	237	431,340
13	NA	NA	NA	NA	NA	NA
14	(3,760)	100	376,000	(2,840)	100	284,000
TOTALS		12,909	41,899,770		12,909	37,373,007

Key :

- MLUC : Mixed Farming Land Use Classification
- AvComb. BM/Ha. : Average Combined Biomass per Hectare
- kgs. : kilograms
- AvCode 1 BM/ha. : Average Code 1 Biomass per Hectare
- Combined Biomass : All years and seasons combined, all measured biomass, no grazing preference. (See Key: Appendix 26)
- Code 1 Biomass : Desirable Grazing Preference, plant preferred by ruminants

TABLE: Carrying Capacity, average number of hectares per UBT

=	$\frac{37,373,007 \text{ Kgs. Code 1 Biomass}}{12,909 \text{ total hectares}}$	=	2,887 Kgs. Code 1 biomass/hectare
=	$\frac{2,740 \text{ Kgs. Biomass/UBT (3\% ration)}}{2,887 \text{ Kgs. Code 1 biomass/hectare}}$	=	1.0 HECTARES/UBT

TABLE: Stocking Rate based on *1984 cattle census and estimates for sheep and goat population based on *1979 small ruminant census; both are for Niamina Dankunku District, and both are converted to Unitaire Bovin Tropicale (UBT)

739 Suckling Calves (23%) X 75 kgs., average unit weight	=	55,425 kgs.
996 Weaned Calves (31%) X 125 kgs., average unit weight	=	124,500 kgs.
1,478 Adults (46%) X 225 kgs., average unit weight	=	332,550 kgs.
4,095 Units Sheep and Goats X 41 kgs., est. av. unit weight	=	167,895 kgs.
Total		680,370 kgs.
$\frac{680,370 \text{ kgs. total body weight}}{250 \text{ kgs./UBT}}$	=	2,721 UBT

*Department of Animal Health and Production, MOAG

TABLE: Biomass Cover Type (only vegetal matter considered prior to 1985)

Bare ground	0%
Perennial grass	3%
Annual grass	35%
Sedges and Rushes	0%
Annual forbs	19%
Shrubs	3%
Trees	26%
Cultivated	<u>10%</u>
	97%

Livestock Migration

Migrating cattle and small ruminants move into the district starting in February and remain through most of June; length of stay depends on arrival of rains, sprouting of vegetation, and cultivation. Most migrant ruminants come from the east, probably Fulladu West District. Sometime in June the migration is reversed, transhumant ruminants return homeward where they remain confined to non-cropping Tree and Shrub Savannas (MLUC 5/6) during July to November period.

TABLE: Grazing Intensity, incidence of bush fire, and Cultivation (Oct.'82)

Ungrazed (0%)	55%
Lightly grazed (5-25%)	29%
Moderately grazed (25-50%)	6%
Heavily grazed (50-100%)	0%
Totally burned (75-100%)	0%
Moderately burned (25-75%)	0%
Lightly burned (5-25%)	0%
Cultivated or Cleared	10%
	<u>100%</u>

(Note: One choice per sample plot)

Conclusions

Resident flocks and herds normally experience adequate natural feed conditions from July through January. Competition for feed starts occurring in January with the reduction of choices for ranging ruminants and the eventual influx of migrant ruminants from other districts. As a result, resident animals may have to range farther from their home village as dry season progresses.

Livestock Water

Livestock water is adequate during and following rainy season. Natural depressions in the Tree and Shrub Savanna collect rainfall and water-rich vegetation minimize water intake. Long treks to more structured sources is minimized. Following the rainy season animals use swamps, river tributaries, and the Gambia River for water sources. However, as the dry season progresses and low river water, receding swamp waters, and tidal river conditions 1) increase water salinity, and 2) decrease fresh surface water availability, stockmen are forced to draw fresh water from wells for livestock. They frequently complain of this heavy task.

TABLE: Stock Watering Sources

Concrete Lined Wells	23%
Borehole w/handpump	3%
Borehole w/motor pump	3%
Gambia River and Tributaries	71%
	<u>100%</u>

At the time of the range inventory, late October 1982, seventy percent of livestock water was from river and swamp sources, and thirty percent was from wells. Ninety-five percent of all livestock water sources were within five kilometers of the write-up sample plot.

Salinity is present in The Gambia River and its tributaries; saline concentration is affected by tidal flow. Salt content of flood plains starts increasing west of Kuntaur where salt tolerant plant species start showing-up in RRI ocular analysis of sample plot areas. Indicator plants would be Avicennia africans (Black Mangrove), Rhizophora racemosa (Red Mangrove), and Phloxerus vermicularis. Ndama cattle have some tolerance for saline drinking water, and can be observed routinely drinking from the Atlantic Ocean. However, if animals are given a choice, fresh water is always consumed in

quantity, saline waters are consumed in minimum amounts. Usually intake decreases as salinity increases.

Soil Erosion

Forty-one percent of sample plots indicated moderate to advanced erosion tendencies, mostly resulting from insufficient rainfall soil penetration.

TABLE: Soil Erosion Rating (See Appendix 24.)

Nil	31%
Minor	25%
Moderate	22%
Advanced	19%
Severe	0%
Unknown	3%
	<u>100%</u>

Burning

No write-ups indicated burning damage from bush fires in October; however, severe burning of Tree and Shrub Savanna (MLUC 5/6) is recorded almost annually starting in November.

MID - NIAMINA WEST

The map reference is NIAMINA DANKUNKU/NIAMINA WEST.

Range Resource Inventory sampling completed in October 1982.

Principal cultivated crops are millet, groundnuts, with important amounts of maize being produced in later years (1984-1985).

Code 1 biomass produces an average of 2,603 kilograms per hectare, or 1.1 hectares produce enough food for one UBT. Fifty-two percent of biomass (19,469 tons) is produced in Tree and Shrub Savanna (MLUC 5/6) and Tree and Shrub Savanna with Previous Cultivation (MLUC 7), and twenty-six percent (9,665 tons) from Upland Crop (MLUC 8/9).

TABLE: Biomass Production

MLUC	AvComb. BM/HA.	Hectares	Total Kgms.	AvCode 1 BM/HA.	Hectares	Total Kgms.
1	0	69	NA	NA	69	0
2	0	7	NA	0	7	NA
3	0	0	0	0	0	0
4	4,020	181	727,620	3,590	181	649,790
5/6	3,440	6,071	20,884,240	2,810	6,071	17,059,510
7	6,630	934	6,192,420	2,580	934	2,409,720
8/9	5,600	2,172	12,162,200	4,450	2,172	9,665,400

10	(4,470)	1,361	6,083,670	(3,540)	1,361	4,817,940
11	810	3,246	2,629,260	630	3,246	2,044,980
12	(3,540)	319	1,129,260	(1,820)	319	580,580
13	NA	NA	NA	NA	NA	NA
14	(5,600)	80	448,000	(4,450)	80	356,000
TOTALS		14,440	50,257,670		14,440	37,583,920

Key :

- MLUC : Mixed Farming Land Use Classification
- AuComb. BM/Ha. : Average Combined Biomass per Hectare
- Kgms. : Kilograms
- AuCode 1 BM/Ha. : Average Code 1 Biomass per Hectare
- Combined Biomass : All years and seasons combined, all measured biomass, no grazing preference. (See Key: Appendix 26)
- Code 1 Biomass : Desirable Grazing Preference, plant preferred by ruminants

TABLE: Carrying Capacity, average number of hectares per UBT

$$= \frac{37,583,920 \text{ Kgms. Code 1 Biomass}}{14,440 \text{ total hectares}} = 2,603 \text{ Kgms. Code 1 biomass/hectare}$$

$$= \frac{2,740 \text{ Kgms. Biomass/UBT (3\% ration)}}{2,603 \text{ Kgms. Code 1 biomass/hectare}} = 1.1 \text{ HECTARES/UBT}$$

TABLE: Stocking Rate based on #1984 cattle census and estimates for sheep and goat population based on #1979 small ruminant census, both are for Niamina West District, and both are converted to Unitaire Bovin Tropicale (UBT)

971 Suckling Calves (23%) X 75 Kgms., average unit weight	=	72,825 Kgms.
1,309 Weaned Calves (31%) X 125 Kgms., average unit weight	=	163,625 Kgms.
1,943 Adults (46%) X 225 Kgms., average unit weight	=	437,175 Kgms.
5,118 Units Sheep and Goats X 41 Kgms., est. av. unit weight	=	209,838 Kgms.
Total		883,463 Kgms.

$$\frac{883,463 \text{ Kgms. total body weight}}{250 \text{ Kgms./UBT}} = 3,534 \text{ UBT}$$

*Department of Animal Health and Production, MOAG

TABLE: Biomass Cover Type (only vegetal matter considered prior to 1985)

Bare Ground	0%
Perennial Grass	10%
Annual Grass	42%
Sedges and Rushes	0%
Annual Forbs	11%
Shrubs	30%
Trees	14%
Cultivated	<u>3%</u>
	100%

Livestock Migration

Cattle and small ruminants migrate from within and from outside of the district throughout the year. Ruminants are confined to MLUC 5/6 and 7 during the rainy season (July through October).

TABLE: Grazing Intensity, Incidence of Bush Fire, and Cultivation (Oct.'82)

Ungrazed (0%)	25%
Lightly grazed (5-25%)	22%
Moderately grazed (25-50%)	25%
Heavily grazed (50-100%)	22%
Totally burned (75-100%)	0%
Moderately burned (25-75%)	6%
Lightly burned (5-25%)	0%
Cultivated or Cleared	<u>0%</u>
	100%

(Note: One choice per sample plot)

Conclusions

Competition for feed occurs starting in January with reduction of feed choices and with competition from migrating flocks and herds, and annual burning of entire Tree and Shrub Savanna (MLUC 5/6) and Tree and Shrub Savanna with Previous Cultivation (MLUC 7). For five years (1982-1986) almost the entire 7,005 hectares has been consumed by bush fire, usually occurring in the month of March.

Livestock Water

Water requirements are similar to Niambina Dankunku and Niambina East. At the time of the Range Inventory, late in October 1982, fifty-nine percent of livestock water requirements were from wells, forty-one percent from river and swamp sources. Ninety-two percent of all livestock water sources are within five kilometers of rangelands.

Salinity is present in The Gambia River and tributaries, levels being affected by tidal fluctuation. Salt content of flood plains starts increasing west of Kuntaur where salt tolerant plant species start showing up in RRI ocular analysis of sample plot areas. Indicator plants would be Avicennia africans (Black Mangrove), Rhizophora racemosa (Red Mangrove), and Philoxerus vermicularis. Livestock have some tolerance for saline drinking water, and cattle are routinely observed drinking from the Atlantic Ocean. If animals are given a choice, fresh water is always consumed in quantity, saline waters are consumed in minimum amounts. Cattle intake decreases as salinity increases.

Soil Erosion

Sixty-one percent of sample plots indicated moderate to advanced erosion tendencies, mostly resulting from insufficient rainfall soil penetration, because of lack of vegetal cover.

Burning

At the time of the Resource Inventory in October, only six percent of the plots sampled were moderately burned (50-75% of vegetal composition destroyed by fire).

MID - NIAMINA EAST

The map reference is NIAMINA EAST, PART 1 AND PART 2.

Range Resource Inventory sampling completed in November 1982.

Principal cultivated crops are millet and groundnuts.

Code 1 biomass produces an average of 3,140 kilograms of biomass per hectare, or .9 hectare produces enough food for one UBT. Fifty percent of biomass is produced in Uncultivated Swamps (MLUC 11), thirty-three percent is produced in the Tree and Shrub Savanna and T-S Savanna with Previous Cultivation (MLUC 5/6 and 7), and nine percent of biomass is produced in Upland Cultivated (MLUC 8/9).

TABLE: Biomass Production

MLUC	AuComb. BM/HA.	Hectares	Total Kqms.	AuCode 1 BM/HA.	Hectares	Total kqms.
1	0	6	0	0	6	0
2	0	5	0	0	5	0
3	(7,120)	420	2,990,400	(981)	420	412,020
4	(3,375)	292	985,500	(1,795)	292	524,140
5/6	2,410	16,712	40,275,920	1,810	16,712	30,248,720
7	3,030	3,756	11,380,680	1,590	3,756	5,972,040
8/9	3,020	7,348	22,190,960	1,770	7,348	13,005,960
10	(4,470)	1,441	6,441,270	(3,540)	1,441	5,101,140
11	8,370	7,507	62,833,590	8,370	7,507	62,833,590
12	(3,540)	42	148,680	(1,820)	42	76,440
13	NA	NA	NA	NA	NA	NA
14	(3,020)	234	706,680	(1,770)	234	414,180
TOTALS		37,763	147,953,680		37,763	118,588,230

Key :

MLUC	:	Mixed Farming Land Use Classification
AuComb. BM/Ha.	:	Average Combined Biomass per Hectare
Kqms.	:	kilograms
AuCode 1 BM/Ha.	:	Average Code 1 Biomass per Hectare
Combined Biomass	:	All years and seasons combined, all measured biomass, no grazing preference. (See Key: Appendix 26)
Code 1 Biomass	:	Desirable Grazing Preference, plant preferred by ruminants

TABLE: Carrying Capacity, average number of hectares per UBT

=	$\frac{118,588,230 \text{ Kqms. Code 1 Biomass}}{37,763 \text{ total hectares}}$	=	3,140 Kqms. Code 1 biomass/hectare
=	$\frac{2,740 \text{ Kqms Biomass/UBT (3\% ration)}}{3,140 \text{ Kqms. Code 1 biomass/hectare}}$	=	0.9 HECTARE/UBT

TABLE: Stocking Rate based on *1984 cattle census and estimates for sheep and goat population based on *1979 small ruminant census, both are for all of Niamina East District, and both are converted to Unitaire Bovin Tropicale (UBT)

1,874 Suckling Calves (23%) X 75 Kgs., average unit weight	=	140,550 Kgs.
2,525 Weaned Calves (31%) X 125 Kgs., average unit weight	=	315,625 Kgs.
3,747 Adults (46%) X 225 Kgs., average unit weight	=	843,075 Kgs.
10,237 Units Sheep and Goats X 41 Kgs., est. av. unit weight	=	419,717 Kgs.
Total		1,718,967 Kgs.

1,718,967 Kgs. total body weight = 6,876 UBT
250 Kgs./UBT

*Department of Animal Health and Production, MOAG

TABLE: Biomass Cover Type (only vegetal matter considered prior to 1985)

Bare Ground	0%
Perennial Grass	1%
Annual Grass	32%
Sedges and Rushes	2%
Annual Forbs	21%
Shrubs	21%
Trees	16%
Cultivated	<u>7%</u>
	100%

Livestock Migration

Migrating cattle and small ruminants move into the district starting in February and remain through end of dry season. Most migrating ruminants come from the east. Transhuming animals return home where they remain confined to non-cropping Tree and Shrub Savanna (MLUC 5/6) during July through November (cropping season).

TABLE: Grazing Intensity, incidence of bush fire, and cultivation (Nov. '82)

Ungrazed (0%)	7%
Lightly grazed (5-25%)	19%
Moderately grazed (25-50%)	30%
Heavily grazed (50-100%)	27%
Totally burned (75-100%)	7%
Moderately burned (25-75%)	5%
Lightly burned (5-25%)	0%
Cultivated and Cleared	<u>5%</u>
	100%

(Note: One choice per sample plot)

Conclusions

Resident flocks and herds normally experience adequate natural feed conditions during and immediately following the rainy season. Competition for feed starts occurring in January and February when Upland Crop (MLUC 8/9) areas are depleted and animals start using swamps and searching for any available forage and water. Animals have to range farther from their home village in search of forage and water as the dry season progresses.

Niamina East District, under normal non-drought conditions produces a surplus of Code 1 biomass beyond what resident animals consume. This surplus should be available to outside animals. Pending, of course, whether or not surplus feed has been destroyed by bush fires. Range resources were measured in November 1982 and already twenty-seven percent of sample plots were heavily grazed, and an additional thirty percent of samples indicated moderate grazed conditions.

Livestock Water

Migrating and resident herds are attracted to the abundance of river front, river tributaries, and swamps to the north of the district causing soil erosion in and out of the area by trailing livestock. Fifty-nine percent of the rangelands were within a one to five kilometer radius of all water sources. Forty-one percent of the rangelands were within one kilometer of all water sources.

TABLE: Stock Watering Sources

Concrete lined and Traditional Wells	29%
Gambia River and Tributaries	61%
Developed Collection Basins	exist
Multiple Sources	<u>10%</u>
	100%

Saline content of flood plains starts increasing west of Kuntaur where salt tolerant plant species start showing up in RRI ocular analysis of sample plot areas. Indicator plants would be Avicennia african (Black Mangrove), Rhizophora racemosa (Red Mangrove), and Philoxerus vermicularis. Salinity concentration is affected by tidal flow from the Atlantic Ocean. Livestock have some tolerance for saline drinking water, and cattle are routinely observed drinking from the Atlantic Ocean. If animals are given a choice, fresh water is always consumed in quantity, saline waters are consumed in minimum amounts. Cattle intake decreases as salinity increases.

Soil Erosion

Livestock trails can be observed through north and south directions into river and swamp watering sources, especially crossing the national highway into the swamplands bordering the Gambia River. Livestock trails can be observed throughout the district, general direction north/south, on the ground and from B/W aerial photography. (Teledyne, 1980)

Fifty-three percent of samples indicated moderate to advanced erosion. (RRI, Nov.'82)

Burning

Seven percent of samples were totally burned (75 -100% of biomass consumed by fire), and an additional five percent of samples were moderately burned (25 - 75% of biomass consumed).

TABLE: Soil Erosion Rating (Appendix 24)

Nil	3%
Minor	44%
Moderate	42%
Advanced	11%
Severe	0%
	<u>100%</u>

MID - FULLADU WEST

The map reference is FULLADU WEST, PART 1,2, AND 3.

Range Resource Inventory sampling completed in December, 1985.

The largest district in land area with 78,836 hectares, of which 26,100 hectares is classified as cultivated. The largest cultivated area in The Gambia. Though considered as one district, it is divided into Upper and Lower Fulladu West. The Lower lies west of the bolon running from Georgetown, Sankuli Kunda, YBK, and from the end of the bolon along an imaginary line to Galleh Manda. Upper Fulladu West is east of the bolon. Thirty-seven percent of all cattle in MacCarthy Island and twelve percent of cattle country-wide are found here. (Appendix 5)

Human population centers (MLUC 14) are evenly distributed throughout the district, with one percent of the total land surface classified as Town/Village. (GGFP, 1981-1983) Large towns such as Brikama Ba and Bansang, and large villages exist.

The land is under extreme pressure filling human food and living requirements for items such as wood for home cooking and construction. Additional requirements for sustaining ruminant animal population exceed the land's ability to sustain equilibrium, or supply. The supply is dwindling in attempts to meet demands.

Fifty percent of Upland Crop (MLUC 8/9) and Cultivated Swamp (MLUC 10) was in fallow, and the remaining fifty percent was in groundnuts (17%), millet (14%), rice (7%), sorghum (4%), cotton (2%), maize (1%), and intercropped (5%).

Code 1 biomass produces an average of 1,686 kilograms per hectare, or 1.6 hectares produce enough food for one UBT. Fifty percent of biomass (66,205 tons) is produced in Tree Shrub Savanna with and without Previous Cultivation (MLUC 5/6 and 7), thirty percent (40,918 tons) by Upland Crops (MLUC 8/9), and fifteen percent (22,748 tons) of ruminant feed by Swamps (MLUC 10 and 11).

TABLE: Biomass Production

MLUC	AvComb. BM/HA.	Hectares	Total kgs.	AvCode 1 BM/HA.	Hectares	Total kgs.
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	7,120	1,027	7,312,240	981	1,027	1,007,487
4	2,750	276	759,000	1,220	276	336,720
5/6	2,945	39,907	117,526,115	1,340	39,907	53,475,380
7	3,310	6,793	22,494,830	1,874	6,793	12,730,082
8/9	2,750	22,859	62,862,250	1,790	22,859	40,917,610
10	4,470	3,230	14,438,100	3,540	3,230	11,434,200
11	6,040	3,784	22,855,360	2,990	3,784	11,314,160
12	(3,540)	171	605,340	(1,820)	171	311,220
13	NA	NA	NA	NA	NA	NA
14	(2,750)	789	2,169,750	(1,790)	789	1,412,310
TOTALS		78,836	251,012,985		78,836	132,939,169

Key : (TABLE: Biomass Production)

MLUC	:	Mixed Farming Land Use Classification
AvComb. BM/Ha.	:	Average Combined Biomass per Hectare
Kgms.	:	kilograms
AvCode 1 BM/Ha.	:	Average Code 1 Biomass per Hectare
Combined Biomass	:	All years and reasons combined, all measured biomass, no grazing preference. (See Key: Appendix 26)
Code 1 Biomass	:	Desirable Grazing Preference, plant preferred by ruminants

TABLE: Carrying Capacity, average number of hectares per UBT

=	$\frac{132,939,169 \text{ kgs. Code 1 Biomass}}{78,836 \text{ total hectares}}$	=	1,686 kgs. Code 1 biomass/hectare
=	$\frac{2,740 \text{ kgs. Biomass/UBT (3\% ration)}}{1,686 \text{ kgs. Code 1 biomass/hectare}}$	=	1.6 HECTARES/UBT

TABLE: Stocking Rate based on *1984 cattle census and estimates for sheep and goat population based on *1979 small ruminant census, both are for all Fulladu West District, and both are converted to Unitaire Bovin Tropicale (UBT)

7,062 Suckling Calves (23%) X 75 Kgms., average unit weight	=	529,650 Kgms.
9,519 Weaned Calves (31%) X 125 Kgms., average unit weight	=	1,189,875 Kgms.
14,125 Adults (46%) X 225 Kgms., average unit weight	=	3,178,125 Kgms.
37,875 Units Sheep and Goats X 41 Kgms., est. av. unit weight	=	1,552,875 Kgms.
Total		6,450,525 Kgms.
$\frac{6,450,525 \text{ kgs. total body weight}}{250 \text{ Kgms./UBT}}$	=	25,802 UBT

*Department of Animal Health and Production, MOAG

TABLE: Biomass Cover Type

Bare Ground	2%
Perennial Grass	3%
Annual Grass	32%
Sedges and Rushes	0%
Annual Forbs	6%
Shrubs	13%
Trees	10%
Cultivated	<u>34%</u>
	100%

Livestock Migration

Cattle and small ruminants migrate out of the district starting in February-March towards the Niaminas or the Casamance of Senegal in search of dry season feed and water, returning in June or July to be confined to Tree and Shrub Savanna (MLUC 5/6) for the duration of the rainy season.

TABLE: Grazing Intensity, Incidence of Bush Fire, and Cultivation (Nov./Dec. 1985 sample plots)

Ungrazed (0%)	26%
Lightly grazed (5-25%)	16%
Moderately grazed (25-50%)	12%
Heavily grazed (50-100%)	6%
Totally burned (75-100%)	1%
Moderately burned (25-75%)	5%
Lightly burned (5-25%)	1%
Cultivated and Cleared	<u>33%</u>
	100%

(Note: One choice per sample plot)

Conclusions

Resident herds have adequate feed supplies during and just following the rainy season, but as soon as crop residues are eaten, around January, all animals move to Swamps (MLUC 10 and 11), or randomly move between Tree and Shrub Savannas (MLUC 5/6 and 7) and Upland Crops (MLUC 8/9) in search of biomass. Animals start showing emaciation around March when they start migrating out of the District.

Mortality rate is high for young animals during the last two months of the dry season, May and June. Inadequate food supply is the main reason for death.

Livestock Water

Watering of livestock is diversified depending on physical location. Swamps and the Gambia River are used for watering animals within five kilometers, and wells for those more distant. Small ruminants are not watered regularly during dry season.

TABLE: Stock Watering Sources

Traditional Wells	23%
Developed Collection Basins	1%
Natural Collection Basins	1%
Gambia River & Tributaries	21%
Multiple Sources	54%
	<u>100%</u>

Soil Erosion

Soil erosion ratings indicate minor overall erosion problems, although there are several severe cases of gully erosion and other water related erosion taking place. The sampling did not take place in these areas.

TABLE: Soil Erosion Rating (Appendix 24)

Nil	89%
Minor	7%
Moderate	2%
Advanced	0%
Severe	0%
	<u>100%</u>

Burning

Excessive bush fires destroy much of the biomass found in Gallery Forest (GLUC 3), Closed Woodlands (GLUC 4) and Tree and Shrub Savannas (MLUC 5/6 and 7) during January/February each year. BUSH FIRES ELIMINATE BOTH POTENTIAL WOOD GROWTH AND MUCH NEEDED RUMINANT SOURCES AND THEIR LONG TERM AVAILABILITY. This is a major problem in this district.

MID - MacCARTHY ISLAND

The map reference is FULLADU WEST, PART 2.

Range Resource Inventory sampling completed in January 1986.

Overstocked by human and livestock, this small 1,042 hectare island is unable to supply needed natural biomass to feed its animal population and fuel its home cooking fires. Typically an urban environment depending on exterior resources. By virtue of its surroundings, water is in overabundance.

Fifty percent of Cultivated Swamp (MLUC 10) was identified as being in fallow, and the remainder was in paddy rice.

Code 1 biomass produces an average of 425 kilograms biomass per hectare, or 6 hectares produces enough food for one UBT. FOR THE 198 RESIDENT CATTLE UBT (cattle population only) A MINIMUM OF 1,188 HECTARES WOULD BE REQUIRED TO FURNISH ADEQUATE FOOD REQUIREMENTS.

TABLE: Biomass Production

MLUC	AuComb. BM/HA.	Hectares	Total kgms.	AuCode 1 BM/HA.	Hectares	Total kgms.
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	(7,120)	45	320,400	(981)	45	44,145
4	0	0	0	0	0	0
5/6	1,400	556	778,400	158	556	87,848
7	0	0	0	0	0	0
8/9	(2,750)	11	30,250	(1,790)	11	19,690
10	875	277	242,375	502	277	139,054
11	1,184	85	100,640	360	85	30,600
12	0	0	0	0	0	0
13	NA	NA	NA	NA	NA	NA
14	(2,750)	68	187,000	(1,790)	68	121,720
TOTALS		1,042	1,659,065		1,042	443,057

Key : (TABLE: Biomass Production)

- MLUC : Mixed Farming Land Use Classification
- AuComb. BM/Ha. : Average Combined Biomass per Hectare
- kgms. : kilograms
- AuCode 1 BM/Ha. : Average Code 1 Biomass per Hectare
- Combined Biomass : All years and seasons combined, all measured biomass, no grazing preference. (See Key: Appendix 26)
- Code 1 Biomass : Desirable Grazing Preference, plant preferred by ruminants

TABLE: Carrying Capacity, average Number of Hectares per UBT

$$= \frac{443,057 \text{ kgms. Code 1 Biomass}}{1,042 \text{ total hectares}} = 425 \text{ kgms. Code 1 biomass/hectare}$$

$$= \frac{2,740 \text{ kgms. Biomass/UBT (3\% ration)}}{425 \text{ kgms. Code 1 biomass/hectare}} = 6 \text{ HECTARES/UBT}$$

TABLE: Stocking Rate based on *1984 cattle census and estimates for sheep and goat population based on *1979 small ruminant census, both are for MacCarthy Island District, and both are converted to Unitaire Bovin Tropicale (UBT)

71 Suckling Calves (23%) X 75 kgms., average unit weight	=	5,325 kgms
96 Weaned Calves (31%) X 125 kgms., average unit weight	=	12,000 kgms.
143 Adults (46%) X 225 kgms., average unit weight	=	32,175 kgms.
307 Units Sheep and Goats X 41 kgms., est. av. unit weight	=	12,587 kgms.
Total		62,087 kgms.

$$\frac{62,087 \text{ kgms. total body weight}}{250 \text{ kgms./UBT}} = 248 \text{ UBT}$$

*Department of Animal Health and Production, MOAG

TABLE: Biomass Cover Type

Bare Ground	0%
Perennial Grass	0%
Annual Grass	62%
Sedges and Rushes	0%
Annual Forbs	0%
Shrubs	0%
Trees	15%
Cultivated	<u>23%</u>
	100%

Livestock Migration

Ruminants migrate into Sami, Niani, and Fulladu West Districts in search of feed.

TABLE: Grazing Intensity, Incidence of Bush Fire, and Cultivation (Jan.'86 sample plots)

Ungrazed (0%)	0%
Lightly grazed (5-25%)	8%
Moderately grazed (25-50%)	31%
Heavily grazed (50-100%)	31%
Totally burned (75-100%)	0%
Moderately burned (25-75%)	8%
Lightly burned (5-25%)	0%
Cultivated and Cleared	<u>23%</u>
	101%

Conclusions

Rice straw is available for supplementing diets of resident calves and young heifers, but observations have shown that rice straw is burned following harvest.

Livestock Water

Water is not the limiting factor for livestock production. All range areas on the island are less than one kilometer from the Gambia River.

Soil Erosion

Soil erosion ratings indicate nil overall erosion problems.

MID - SAMI

The map reference is SAMI, PART 1 AND 2.

Range Resource Inventory sampling completed in November 1985.

Sami District LOA is divided into two parts: (1) Sami Nana, lower west portion of district, and (2) Sami Karantaba, upper east portion. This summary is presented for the whole district.

Boundaries to the east are very clearly identifiable by the Sami Bolon. The international boundary to the north with Senegal is not clear. The boundary to the west, with Niani District, is distinct only where the escarpment is present.

Sami is a surplus feed producing area.

Crop cover details indicate that Sami is diversified in types of crops grown. The lack of frequency percentage for a particular crop does not mean the crop is not grown, it simply means that crop was not recorded in any RRI sample plots. A total of 134 sample plots were taken in Sami District. Appendix 13.

TABLE: Cultivated Crop Cover

Fallow	58%
Millet	16%
Groundnuts	10%
Rice	8%
Sorghum	3%
Maize	3%
Intercropped	<u>2%</u>
	100%

Code 1 biomass produces an average of 2,307 kilograms per hectare, or 1.2 hectares produces enough feed for one UBT. The principle land-use classification is Tree and Shrub Savanna (MLUC 5/6) with 30,282 hectares and 6,068 hectares of Tree and Shrub Savanna with Previous Cultivation (MLUC 7). Combined they produce 83,712 tons of Code 1 biomass, or 74% of total.

TABLE: Biomass Production:

MLUC	Average Biomass/HA.	Hectares	Total kgms.	Average Code 1 Biomass/HA.	Hectares	Total kgms.
1	0	NA	NA	NA	NA	NA
2	0	NA	NA	0	NA	NA
3	3,360	858	2,882,880	2,220	858	1,904,760
4	4,535	157	711,995	2,220	157	348,540
5/6	3,525	30,282	106,744,050	2,220	30,282	67,226,040
7	4,590	6,068	27,852,120	2,635	6,068	15,989,180
8/9	3,845	9,333	35,885,385	2,235	9,333	20,859,255
10	2,240	859	1,924,160	1,825	859	1,567,675
11	3,870	1,530	5,921,100	3,585	1,530	5,485,050

12	(120)	71	8,520	(45)	71	3,195
13	NA	NA	NA	NA	NA	NA
14	(3,845)	225	865,125	(2,235)	225	502,875
TOTALS		49,373	182,795,335		49,373	113,886,570

Key :

MLUC	:	Mixed Farming Land Use Classification
AvComb. BM/Ha.	:	Average Combined Biomass per Hectare
Kgms.	:	Kilograms
AvCode 1 BM/Ha.	:	Average Code 1 Biomass per Hectare
Combined Biomass	:	All year and seasons combined, all measured biomass, no grazing preference. (See Key: Appendix 26)
Code 1 Biomass	:	Desirable Grazing Preference, plant preferred by ruminants

TABLE: Carrying Capacity, average Number of Hectares per UBT

=	$\frac{113,886,570 \text{ Kgms. Code 1 Biomass}}{49,373 \text{ total hectares}}$	=	2,307 Kgms. Code 1 biomass/hectare
=	$\frac{2,740 \text{ Kgms. Biomass/UBT (3\% ration)}}{2,307 \text{ Kgms. Code 1 biomass/hectare}}$	=	1.2 HECTARES/UBT

TABLE: Stocking Rate based on *1984 cattle census and estimates for sheep and goat population based on *1979 small ruminant census, both for Sami District, and both are converted to Unitaire Bovin Tropicale (UBT)

2,162 Suckling Calves (23%) X 75 Kgms., average unit weight	=	162,150 Kgms.
2,914 Weaned Calves (31%) X 125 Kgms.; average unit weight	=	364,250 Kgms.
4,324 Adults (46%) X 225 Kgms., average unit weight	=	972,900 Kgms.
11,260 Units Sheep and Goats X 41 Kgms., est. av. unit weight	=	461,660 Kgms.
Total		1,960,960 Kgms.

$\frac{1,960,960 \text{ Kgms. total body weight}}{250 \text{ Kgms./UBT}}$	=	7,844 UBT
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*Department of Animal Health and Production, MOAG

TABLE: Biomass Cover Type

Bare Ground	0%
Perennial Grasses	1%
Annual Grasses	23%
Sedges and Rushes	0%
Annual Forbs	9%
Shrubs	10%
Trees	32%
Cultivated and Cleared	25%
	100%

Livestock Migration

Sani District is a surplus biomass producing area, however, seventy-four percent of the landmass is Tree and Shrub Savannas (MLUC 5/6 and 7) and bush fires destroyed eighty percent of biomass by December 1985. Once the crop residues are consumed from Upland Crops (MLUC 8/9), usually by the end of December, and the Swamps (MLUC 10 and 11) are depleted by February or March, livestock owners have no choice but to move their animals west along the Swamplands in Niani and Nianija Districts in search of food. So in what appears to be a surplus biomass producing area, devastating bush fires have reduced biomass to ashes. Stockmen have no other option but to move their animals to other districts in search of food.

TABLE: Grazing Intensity, Incidence of Bush Fire, and Cultivation (Nov. 1985 sample plots)

Ungrazed (0%)	15%
Lightly grazed (5-25%)	17%
Moderately grazed (25-50%)	10%
Heavily grazed (50-100%)	10%
Totally burned (75-100%)	8%
Moderately burned (25-75%)	8%
Lightly burned (5-25%)	2%
Cultivated and Cleared	29%
	<u>99%</u>

Conclusions

Bush fires force resident herds to migrate following consumption of crop residues and swamplands. Migration is westerly into Miani and Nianija.

Livestock Water

Stock watering is diversified. Thirty-six and sixty-four percent of rangelands were found to be within one kilometer and within five kilometers respectively from primary water sources. Water sources are traditional and developed concrete lined wells, The Gambia River, its tributaries, and wet swamplands, and natural clay depressions in the Tree and Shrub Savannas (MLUC 5/6 and 7). Thirty-eight percent of rangelands were within five kilometers of multiple sources of livestock water.

TABLE: Stock Watering Sources

Concrete Lined and Traditional Wells	38%
Natural Collection Basins	2%
Gambia River & Tributaries	22%
Multiple Sources	38%
	<u>100%</u>

Soil Erosion

Soil erosion is showing signs of accelerating. The predominant Tree and Shrub Savanna (MLUC 5/6 and 7) sites cleared of vegetal cover by wild fires exposes lateritic rock and shallow soil to erosive action early in the rainfall season, resulting in concentrated runoff pouring from upland sites

across croplands to The Gambia River and its tributaries. The results are new gullies and the deepening of existing ones.

TABLE: Soil Erosion Rating (Appendix 24)

Nil	51%
Minor	28%
Moderate	17%
Advanced	4%
Severe	<u>9%</u>
	100%

Burning

Blame for early devastating bush fires that destroy Tree and Shrub Savannas is placed at the feet of the northern neighbors, the Senegalese. That is the response Gambian stockmen give.

MID - NIANI

The map reference is NIANI, PART 1 AND 2.

Range Resource Inventory (RRI) sampling completed in December 1985.

This district is one unit, and is analysed as one. International boundary with Senegal is vague, the eastern boundary line with Sami Nana is partially distinct where the escarpment is present, and to the west with Nianija it is not distinct, except with Upper Saloum where Nianimarou Bolon distinctfully separates the two districts.

Agricultural cropping is diversified, with thirty-nine percent of cultivatable land being fallow. Millet, groundnut, and rice are the principal crops.

TABLE: Cultivated Crop Cover

Fallow	39%
Millet	20%
Groundnut	19%
Rice	12%
Maize	5%
Cotton	2%
Intercropped	<u>3%</u>
	100%

Code 1 biomass produces an average 1,794 kilograms of biomass per hectare, or 1.5 hectares produces enough feed for one UBT. Once again the principal land use classification is the Tree and Shrub Savannas (MLUC 5/6 and 7), with 28,651 hectares, sixty-seven percent of the total, followed by 10,009 hectares of Upland Crops (MLUC 8/9), and 2,732 hectares of Swamp (MLUC 10 and 11).

TABLE: Biomass Production:

MLUC	AuComb. BM/HA.	Hectares	Total Kgms.	AuCode 1 BM/HA.	Hectares	Total Kgms.
1	0	NA	NA	NA	NA	NA
2	0	71	0	0	71	0
3	5,030	771	3,878,130	3,020	771	2,328,420
4	(4,535)	446	2,022,610	(2,220)	446	990,120
5/6	2,330	24,288	56,591,040	1,580	24,288	38,375,040
7	2,880	4,363	12,565,440	1,300	4,363	5,671,900
8/9	3,125	10,009	31,278,125	1,810	10,009	18,116,290
10	4,445	1,370	6,089,650	3,940	1,370	5,397,800
11	4,745	1,362	6,462,690	4,210	1,362	5,734,020
12	(120)	26	3,120	(45)	26	1,170
13	NA	NA	NA	NA	NA	NA
14	(3,125)	298	931,250	(1,810)	298	539,380
TOTALS		43,004	119,822,055		43,004	77,154,140

Key :

- MLUC : Mixed Farming Land Use Classification
- AuComb. BM/Ha. : Average Combined Biomass per Hectare
- Kgms. : Kilograms
- AuCode 1 BM/Ha. : Average Code 1 Biomass per Hectare
- Combined Biomass : All years and seasons combined, all measured biomass, no grazing preference. (See Key: Appendix 26)
- Code 1 Biomass : Desirable Grazing Preference, plant preferred by ruminants

TABLE: Carrying Capacity, average Number of Hectares per UBT

$$= \frac{77,154,140 \text{ Kgms. Code 1 Biomass}}{43,004 \text{ total hectares}} = 1,794 \text{ Kgms. Code 1 biomass/hectare}$$

$$= \frac{2,740 \text{ Kgms. Biomass/UBT (3\% ration)}}{1,794 \text{ Kgms. Code 1 biomass/hectare}} = 1.5 \text{ HECTARES/UBT}$$

TABLE: Stocking Rate based on *1984 cattle census and estimates for sheep and goat population based on *1979 small ruminant census, both for Miani District, and both are converted to Unitaire Bovin Tropicale (UBT)

2,097 Suckling Calves (23%) X 75 Kgms., average unit weight	=	157,275 Kgms.
2,827 Weaned Calves (31%) X 125 Kgms., average unit weight	=	353,375 Kgms.
4,194 Adults (46%) X 225 Kgms., average unit weight	=	943,650 Kgms.
11,260 Units Sheep and Goats X 41 Kgms., est. av. unit weight	=	461,660 Kgms.
Total		1,915,960 Kgms.

$$\frac{1,915,960 \text{ Kgms. total body weight}}{250 \text{ Kgms./UBT}} = 7,664 \text{ UBT}$$

*Department of Animal Health and Production, MOAG

TABLE: Biomass Cover Type

Bare Ground	0%
Perennial Grass	2%
Annual Grass	19%
Sedges and Rushes	1%
Annual Forbs	6%
Shrubs	10%
Trees	27%
Cultivated	<u>35%</u>
	100%

Livestock Migration

Niani is a surplus biomass producing district.

TABLE: Grazing Intensity, Incidence of Bush Fire, and Cultivation (Dec. '85 sample plots)

Ungrazed (0%)	7%
Lightly grazed (5-25%)	12%
Moderately grazed (25-50%)	12%
Heavily grazed (50-100%)	12%
Totally burned (75-100%)	12%
Moderately burned (25-75%)	8%
Lightly burned (5-25%)	1%
Cultivated and Cleared	<u>36%</u>
	100%

Conclusions

Bush fires in Tree and Shrub Savannas (MLUC 5/6 and 7) late in year limit options farmers may have for feeding livestock, and force animals into Swamps (MLUC 10 and 11) earlier than necessary. Fifty-seven percent of the district's ruminant feed is produced in MLUC 5/6 and 7. Adequate Upland Crop lands exist to furnish surplus crop residues following harvest, November through December. In January resident livestock start moving into Swamps.

This district is potentially a surplus livestock feed producing area. Annual bush fires and intermittent drought are two factors limiting that potential.

Livestock Water

Stock watering is preferably done in The Gambia River and Swamps; when not possible, the developed and traditional wells supply hand drawn water for stock. Thirty-three percent of water sources are within one kilometer of rangelands, sixty-six percent is within five kilometer distance from rangeland.

TABLE: Stock Watering Sources

Concrete Lined and Traditional Wells	20%
Gambia River & Tributaries	26%
Multiple Sources	<u>54%</u>
	100%

Soil Erosion

Some moderate soil erosion exists.

TABLE: Soil Erosion Rating (Appendix 24)

Nil	53%
Minor	40%
Moderate	7%
Advance	0%
Severe	0%
	<u>100%</u>

Burning

The burning of the Tree and Shrub Savanna limits the availability of mid-dry season livestock feed. Fifty-seven percent of the districts ruminant feed is produced here and eighty percent of that is burned up by wild fires.

MID - NIANIJA

The map reference is UPPER SALOUM, PART 2.

Range Resource Inventory sampling completed in December 1985.

Nianija District is unique in that it has no boundary with Senegal; its west, north, and south boundaries are distinct and are occupied by water for most of the year. The eastern boundary is shared with Niani District and is vague, not physically distinct at all. OF ALL THE DISTRICTS NIANIJA IS BEST SUITED FOR ESTABLISHING A PILOT LIVESTOCK AND RANGE MANAGEMENT UNIT ONLY FOR RESIDENT LIVESTOCK. Forty-four percent is in Tree and Shrub Savannas (MLUC 5/6 and 7), thirty-two percent of the land mass is in Swamps (MLUC 10 and 11), and twenty-two percent is in Upland Crops (MLUC 8/9), of which thirty-one percent is in fallow. Fifty-one percent of the Code 1 biomass is produced in MLUC 10 and 11 (Cultivated and Uncultivated Swamps).

Complementing the rather encouraging range potential is the diversified agriculture cropping practices. Of particular interest for livestock feed is groundnuts, maize, and rice straw. Rice is farmed in the swamps on small tracts of land, managed by women. Average size of tract is less than one half hectare (no physical measurements made, estimated size by observation). Rice straw is consumed in the swamp where it is grown, no effort to collect and store it for dry season use has been attempted at this time. Maize cropping was popular in 1985. Under the direction of MFP three villages collected, stored, and fed maize stover to cattle during the dry season of 1986. (Appendix 21)

TABLE: Cultivated Crop Cover

Fallow	31%
Groundnuts	26%
Millet	20%
Maize	17%
Sorghum	3%
Rice	<u>3%</u>
	100%

Thirty-eight percent Code 1 biomass is produced in MLUC 5/6 and 7 (Tree and Shrub Savannas). Only ten percent of total Code 1 biomass is produced in MLUC 8/9 (Upland Crops). An ideal combination of land-use classes for livestock production in the ecological setting of The Gambia, with its long dry season of 8-9 months, and rainy season of 3-4 months. The average productivity is excellent at 3,230 kilograms Code 1 biomass per hectare (.85 hectares per UBT).

TABLE: Biomass Production

MLUC	AvComb. BM/HA.	Hectares	Total kgms.	AvCode 1 BM/HA.	Hectares	Total kgms.
1	0	NA	NA	NA	NA	NA
2	0	0	0	0	0	0
3	2,560	56	143,360	790	56	44,240
4	(4,535)	45	204,075	(2,220)	45	99,900
5/6	5,500	4,167	22,918,500	3,645	4,167	15,188,715
7	2,410	1,777	4,282,570	855	1,777	1,519,335
8/9	2,035	2,978	6,060,230	1,440	2,978	4,288,320
10	11,900	789	9,389,100	11,895	789	9,385,155
11	5,825	3,467	20,195,275	3,725	3,467	12,914,575
12	198	118	23,364	10	118	1,180
13	NA	NA	NA	NA	NA	NA
14	(2,035)	94	191,290	(1,440)	94	135,360
TOTALS		13,491	63,407,764		13,491	43,576,780

Key :

- MLUC : Mixed Farming Land Use Classification
- AvComb. BM/Ha. : Average Combined Biomass per Hectare
- kgms. : kilograms
- AvCode 1 BM/Ha. : Average Code 1 Biomass per Hectare
- Combined Biomass : All year and season combined, all measured biomass, no grazing preference. (See Key: Appendix 26)
- Code 1 Biomass : Desirable Grazing Preference, plant preferred by ruminants

TABLE: Carrying Capacity, average Number of Hectares per UBT

$$= \frac{43,576,780 \text{ kgms. Code 1 Biomass}}{13,491 \text{ total hectares}} = 3,230 \text{ kgms. Code 1 biomass/hectare}$$

$$= \frac{2,740 \text{ kgms. Biomass/UBT (3\% ration)}}{3,230 \text{ kgms. Code 1 biomass/hectare}} = 0.85 \text{ HECTARE/UBT}$$

TABLE: Stocking Rate based on *1984 cattle census and estimates for sheep and goat population based on *1979 small ruminant census, both for Nianiya District, and both are converted to Unitaire Bovin Tropicale (UBT)

1,200 Suckling Calves (23%) X 75 Kgms., average unit weight	=	90,000 Kgms.
1,618 Weaned Calves (31%) X 125 Kgms., average unit weight	=	202,250 Kgms.
2,401 Adults (46%) X 225 Kgms., average unit weight	=	540,225 Kgms.
6,142 Units Sheep and Goats X 41 Kgms., est. av. unit weight	=	251,822 Kgms.
Total		1,084,297 Kgms.

1,084,297gms. total body weight = 4,337 UBT
250 Kgms./UBT

*Department of Animal Health and Production, MOAG

TABLE: Biomass Cover Type

Bare Ground	0%
Perennial Grass	8%
Annual Grass	9%
Sedges and Rushes	4%
Annual Forbs	8%
Shrubs	9%
Trees	17%
Cultivated	<u>45%</u>
	100%

Livestock Migration

Migrating livestock from neighboring Saloums and Niani, and as far away as Sami have been known to feed on Nianiya swamp lands during the dry season. Possibly animals from other areas to the west and north (Senegal) migrate here during the dry season.

TABLE: Grazing Intensity, Incidence of Bush Fire, and Cultivation (Dec. 1985 sample plots)

Ungrazed (0%)	2%
Lightly grazed (5-25%)	4%
Moderately grazed (25-50%)	9%
Heavily grazed (50-100%)	28%
Totally burned (75-100%)	2%
Moderately burned (25-75%)	9%
Lightly burned (5-25%)	0%
Cultivated and Cleared	<u>45%</u>
	99%

Conclusions

Resident livestock could under normal conditions flourish all year round on a seasonal combination of Tree and Shrub Savannas (MLUC 5/6 and 7), Upland Crop (MLUC 8/9) residues, and Swamplands (MLUC 10 and 11).

Livestock Water

Water conditions are more than adequate. Salinity is present in The Gambia River and flood plains of the river, but animals still use these waters routinely.

TABLE: Stock Watering Sources

Concrete Lined and Traditional Wells	8%
Gambia River & Tributaries	9%
Multiple Sources	<u>83%</u>
	100%

Soil Erosion

Soil erosion is accelerating from minor to more severe conditions primarily from heavy runoff from the Upland Tree and Shrub Savannas, resulting in gully washing. Primary cause of high runoff from the upland sites is the lack of vegetal cover and soil depth to cushion the rainfall and absorb it in adequate quantities before it has a chance to concentrate and run down hill, across loose soil into the swamp lands.

TABLE: Soil Erosion Rating (Appendix 24)

Nil	68%
Minor	25%
Moderate	6%
Advanced	0%
Severe	<u>0%</u>
	99%

Burning

The annual burning of Tree and Shrub Savannas (MLUC 5/6 and 7) and adjacent forest corridors (MLUC 3 and 4) in adjoining districts causes unnecessary destruction of huge quantities of useable biomass, resulting in overpopulation by migrating livestock in unburned, higher producing range areas such as swamp lands (MLUC 10 and 11). This migration pattern can occur early in the dry season, as early as December/January. More than likely local livestock will not start to use the swamp lands before February or March, depending on available options such as burning of local Tree and Shrub Savannas, crop residue availability, and stock water. When local animals get ready to use the already occupied MLUC 10 and 11, say by March first, not only is the biomass heavily grazed on their arrival, but alternative options are unavailable. The upland sites have either been burned or heavily used and farm crop residues have already been consumed. The result is mortality for the weaker livestock at some point before the new green growth is brought on by the rainy season.

MID - UPPER SALOUM

The map reference is UPPER SALOUM/LOWER SALOUM, AND UPPER SALOUM, PART 2/NIANIJA.

Range Resource Inventory (RRI) sampling completed in January 1986.

The eastern boundary with Nianija and Niani Districts is physically well defined. Nianimarou Bolon, a tributary of The Gambia River, is the eastern boundary. The international northern boundary with Senegal and the western boundary with Lower Saloum are both very vague, poorly identified.

Fifty-five percent (14,602 hectares) of total land area is Tree and Shrub Savanna (MLUC 5/6 and 7), thirty percent is under cultivation (MLUC 8/9 and 10), and fourteen percent is Uncultivated Swamps (MLUC 11). Twenty-eight percent of the cultivated area is left in fallow.

Balancing out a potentially good seasonal range picture is the diversification of agriculture cropping practices. Roughly thirty percent of cropping area is in fallow (1985). Most other crop cover is food grains; millet and groundnuts dominate, with maize then rice being the crops grown. Some cotton was also recorded. Maize cropping was popular in 1985. Large collections of maize stover were being stored for dry season animal feed in the northern sector of the district.

TABLE: Cultivated Crop Cover

Fallow	28%
Millet	36%
Groundnut	16%
Maize	10%
Rice	8%
Cotton	<u>2%</u>
	100%

Code 1 biomass productivity is just reversed from the above order. Forty-four percent (18,348 tons) is produced in Uncultivated Swamps, thirty-one percent (13,008 tons) is from cultivated areas, and twenty-four percent (10,071 tons) is produced in the Tree and Shrub Savannas. Average productivity is 1,575 kilograms Code 1 biomass per hectare or 1.8 hectares are required to feed one UBT. Overall a good range potential complemented very nicely by diversification in cropping. The strength is the dry season feeding potential, the weaknesses are uncontrolled number of migrating animals using area in dry season, and bush fires.

TABLE: Biomass Production

MLUC	AuComb. BM/HA.	Hectares	Total Kgms.	AuCode 1 BM/HA.	Hectares	Total Kgms.
1	0	25	NA	NA	25	NA
2	0	0	0	0	0	0
3	2,910	8	23,280	1,085	8	8,680
4	(4,535)	8	36,280	(2,220)	8	17,760
5/6	1,665	12,377	20,607,705	580	12,377	7,178,660
7	2,695	2,225	5,996,375	1,300	2,225	2,892,500

8/9	1,690	7,228	12,215,320	1,075	7,228	7,766,875
10	8,635	607	5,241,445	8,635	607	5,241,445
11	6,295	3,644	22,938,980	5,035	3,644	18,347,540
12	145	172	24,940	120	172	20,640
13	NA	NA	NA	NA	NA	NA
14	(1,690)	175	295,750	(1,075)	175	188,125
TOTALS		26,469	67,380,075		26,469	41,682,865

Key :

MLUC	:	Mixed Farming Land Use Classification
AvComb. BM/Ha.	:	Average Combined Biomass per Hectare
kgms.	:	kilograms
AvCode 1 BM/Ha.	:	Average Code 1 Biomass per Hectare
Combined Biomass	:	All year and season combined, all measured biomass, no grazing preference. (See Key: Appendix 26)
Code 1 Biomass	:	Desirable Grazing Preference, plant preferred by ruminants

TABLE: Carrying Capacity, average Number of Hectares per UBT

=	$\frac{41,682,865 \text{ kgms. Code 1 Biomass}}{26,469 \text{ total hectares}}$	=	1,575 kgms. Code 1 biomass/hectare
=	$\frac{2,740 \text{ kgms. Biomass/UBT (3\% ration)}}{1,575 \text{ kgms. Code 1 biomass/hectare}}$	=	1.8 HECTARES/UBT

TABLE: Stocking Rate based on *1984 cattle census and estimates for sheep and goat population based on *1979 small ruminant census, both are for Upper Saloum District, and both are converted to Unitaire Bovin Tropicale (UBT)

2,019 Suckling Calves (23%) X 75 kgms., average unit weight	=	151,425 kgms.
2,721 Weaned Calves (31%) X 125 kgms., average unit weight	=	340,125 kgms.
4,038 Adults (46%) X 225 kgms., average unit weight	=	908,550 kgms.
11,260 Units Sheep and Goats X 41 kgms., est. av. unit weight	=	461,660 kgms.
Total		1,861,760 kgms.

$$\frac{1,861,760 \text{ kgms. total body weight}}{250 \text{ kgms./UBT}} = 7,447 \text{ UBT}$$

*Department of Animal Health and Production, MOAG

TABLE: Biomass Cover Type

Bare Ground	1%
Perennial Grass	2%
Annual Grass	22%
Sedges and Rushes	2%
Annual Forbs	7%
Shrubs	15%
Trees	9%
Cultivated	41%
	99%

Livestock Migration

Dry season migration is primarily from Lower Saloum and Senegal.

TABLE: Grazing Intensity, Incidence of Bush Fire, and Cultivation (Jan. 1986 sample plots)

Ungrazed (0%)	1%
Lightly grazed (5-25%)	7%
Moderately grazed (25-50%)	22%
Heavily grazed (50-100%)	23%
Totally burned (75-100%)	0%
Moderately burned (25-75%)	2%
Lightly burned (5-25%)	1%
Cultivated and Cleared	<u>43%</u>
	99%

Conclusions

Upper Saloum is a marginal surplus biomass producing area particularly in the Swamp lands bordering The Gambia River. River flow levels vary from year to year affecting the biomass quantity produced. Actual biomass produced fluctuates from year to year. Normal rainfall upstream will fill the river tributaries and swamps and yield surplus biomass, subnormal upstream rainfall will deprive the tributary and swamp lands of water levels necessary to guarantee quantities of biomass and deprive access by livestock till water recedes. This district could be self sufficient in furnishing adequate biomass to sustain non-inflated, normal resident livestock populations, without migration.

Livestock Water

Salinity is present in The Gambia River and tributaries, such as the flood plains of the river, but animals use these sources routinely. Salt content of flood plains increases as river access is cut off and evaporation progresses into the drier season. Livestock intake of severely saline water decreases and gradual dehydration of animal occurs, death may result if sufficient fresher non-saline water is not found to meet individual animal's requirements. All sources of water were found to be five kilometers and less from RRI rangelands. Thirty percent of stock water was found to be one kilometer or less from rangelands.

TABLE: Stock Watering Sources

Traditional and Developed Wells	15%
Natural Collection Basins	31%
Gambia River	1%
Other Rivers and Tributaries	26%
Multiple Sources	<u>27%</u>
	100%

Ninety-three percent of all wells recorded were developed, were constructed with concrete lining of permanent nature.

Soil Erosion

The sampling technique indicate erosion to be mostly stable, observations have shown gully erosion is accelerating from the Upland Tree and Shrub Savannas across Upland Crop lands, into the Gallery Forest and Swamplands.

TABLE: Soil Erosion Rating (Appendix 24)

Nil	56%
Minor	29%
Moderate	13%
Advanced	0%
Severe	0%
	<u>98%</u>

Burning

The annual burning of Tree and Shrub Savannas (MLUC 5/5 and 7) and adjacent Forest Corridors (MLUC 3 and 4) within the district and in adjoining districts causes unnecessary destruction of huge quantities of useable biomass, resulting in overpopulation by migrating livestock into unburned, higher producing range areas such as Swamp Lands (MLUC 10 and 11), causing critical dry season livestock feed to be used up prematurely. This leaves poor feed condition for late in the dry season when feed shortages are critical.

MID - LOWER SALOUM

The map reference is LOWER SALOUM/UPPER SALOUM, PART 1.

Range Resource Inventory (RRI) sampling completed in January 1986.

Borders on the east with Upper Saloum, Senegal to the north, and by Upper Baddibu District in the North Bank Division to the west. Boundaries are not physically distinct.

Fifty-two percent (8,273 hectares) of total land mass is classified as Tree and Shrub Savanna (MLUC 5/6 and 7), thirty-three percent is Upland Crops (MLUC 8/9), and ten percent as Swamps (MLUC 10 and 11).

This district has distinct signs of resource stress. Only 743 kilograms Code 1 biomass is produced per hectare, or 3.7 hectares are required to produce enough biomass to feed one UBT. Flood plains of The Gambia River are saline, with saline deposits on soil surface, and plants are salt tolerant, lacking any sort of favorable grazing preference by livestock.

The agriculture sector, though diversified, also has indications of pressure cropping. Pressure cropping is where marginal lands are put into the cultivation system because of inadequate quantities of available arable lands. Tree and Shrub Savanna (MLUC 5/6 and 7) are being cultivated. Only twenty-one percent of cultivated lands (MLUC 8/9 and 10) are being rested in fallow (1985).

TABLE: Cultivated Crop Cover

Fallow	21%
Millet	32%
Groundnut	26%
Rice	18%
Intercrop	3%
	<u>100%</u>

Sixty-four percent (7,561 tons) of the total districts Code 1 biomass is produced in Tree and Shrub Savanna (MLUC 5/6 and 7), Twenty-one percent (2,502 tons) is produced in Upland Crops (MLUC 8/9) mostly in the form of crop residues, and fourteen percent (1,590 tons) produced in Cultivated Swamps (MLUC 10). No Code 1 biomass was produced in 865 hectares of Uncultivated Swamps (MLUC 11).

TABLE: Biomass Production

MLUC	AvComb. BM/HA.	Hectares	Total Kgms.	AvCode 1 BM/HA.	Hectares	Total Kgms.
1	0	26	NA	NA	26	NA
2	0	0	0	0	0	0
3	4,150	0	0	2,660	0	0
4	(4,535)	2	9,070	(2,220)	2	4,440
5/6	1,310	8,033	10,523,230	925	8,033	7,430,525
7	4,070	240	976,800	545	240	130,800
8/9	1,855	5,267	9,770,285	475	5,267	2,501,825
10	3,210	723	2,320,830	2,200	723	1,590,600
11	225	865	194,625	0	865	0
12	19	472	8,968	10	472	4,720
13	NA	NA	NA	NA	NA	NA
14	(1,855)	202	374,710	(475)	202	95,950
TOTALS		15,830	24,178,518		15,830	11,758,860

Key :

- MLUC : Mixed Farming Land Use Classification
- AvComb. BM/HA. : Average Combined Biomass per Hectare
- Kgms. : Kilograms
- AvCode 1 BM/HA. : Average Code 1 Biomass per Hectare
- Combined Biomass : All year and season combined, all measured biomass, no grazing preference. (See Key: Appendix 26)
- Code 1 Biomass : Desirable Grazing Preference, plant preferred by ruminants

TABLE: Carrying Capacity, average Number of Hectares per UBT

$$= \frac{11,758,860 \text{ Kgms. Code 1 Biomass}}{15,830 \text{ total hectares}} = 743 \text{ Kgms. Code 1 biomass/hectare}$$

$$= \frac{2,740 \text{ Kgms. Biomass/UBT (3\% ration)}}{743 \text{ Kgms. Code 1 biomass/hectare}} = 3.7 \text{ HECTARES/UBT}$$

TABLE: Stocking Rate based on *1984 cattle census and estimates for sheep and goat population based on *1979 small ruminant, both for Lower Saloum District, and both are converted to Unitaire Bovin Tropicale (UBT)

891 Suckling Calves (23%) X 75 Kgms., average unit weight	=	66,825 Kgms.
1,202 Weaned Calves (31%) X 125 Kgms., average unit weight	=	150,250 Kgms.
1,783 Adults (46%) X 225 Kgms., average unit weight	=	401,175 Kgms.
5,118 Units Sheep and Goats X 41 Kgms., est. av. unit weight	=	209,838 Kgms.
Total		828,088 Kgms.

828,088 Kgms. total body weight = 3,312 UBT
250 Kgms./UBT

*Department of Animal Health and Production, MOAG

TABLE: Biomass Cover Type

Bare Ground	2%
Perennial Grass	3%
Annual Grass	13%
Sedges and Rushes	2%
Annual Forbs	2%
Shrubs	21%
Trees	6%
Cultivated	<u>51%</u>
	100%

Livestock Migration

Cattle migrate from Lower Saloum into Upper Saloum and Upper Baddibu.

TABLE: Grazing Intensity, Incidence of Bush Fire, and Cultivation (Jan. 1986 sample plots)

Ungrazed (0%)	2%
Lightly grazed (5-25%)	10%
Moderately grazed (25-50%)	18%
Heavily grazed (50-100)	12%
Totally burned (75-100%)	2%
Moderately burned (25-75%)	5%
Lightly burned (5-25%)	0%
Cultivated and Cleared	<u>52%</u>
	101%

Conclusions

Good wet season range potential in the Tree and Shrub Savanna (MLUC 5/6 and 7), marginally good farm crop residue for post rainy season feed, and a deficit of dry season Swamp lands (MLUC 10 and 11). There is no choice but for cattle to migrate in search of dry season feed.

Salinity is present in The Gambia River and its tributaries, concentration of which is affected by tidal flow. Salt content of flood plains starts increasing west of Kuntaur where salt tolerant plant species start showing up in RRI ocular analysis of sample plot areas. Indicator plants would be Avicennia africans (Black Mangrove), Rhizophora racemosa (Red Mangrove), and Phloxerus vermicularis. Livestock have some tolerance for saline drinking water, and in The Gambia cattle are routinely observed drinking from the Atlantic Ocean. If animals are given a choice, fresh water is always consumed in quantity, saline waters are consumed in minimum amounts. Cattle intake decreases as salinity increases. All sources of water were found to be five kilometers and less from rangelands. Twenty-one percent of water was found to be one kilometer or less from rangelands.

TABLE: Stock Water Sources

Traditional and Developed Wells	33%
Natural Collection Basins	26%
Gambia River and Tributaries	21%
Multiple sources	<u>20%</u>
	100%

Eighty-five percent of all wells recorded were developed, ^{and} ~~were~~ constructed with concrete lining of permanent nature.

Soil Erosion

Gully erosion is accelerating from the Upland Tree and Shrub Savannas across Upland Crop lands, into the Gallery Forest and Swamplands.

TABLE: Soil Erosion Rating (Appendix 24)

Nil	49%
Minor	39%
Moderate	10%
Advanced	2%
Severe	<u>0%</u>
	100%

Burning

With fifty-two percent of all land mass classified as Tree and Shrub Savanna (MLUC 5/6 and 7) producing sixty-four percent of the districts Code 1 biomass, annual destruction by bush fire leaves, at best, thirty-six percent remaining biomass. Hardly enough to meet feed requirements for seven months.

URD - FULLADU EAST - JIMARA

The map reference is FULLADU EAST-JIMARA.

Range Resource Inventory (RRI) sampling completed in November 1984.

The Fulladu East District is administratively divided into three sub-districts: 1) Jimara; 2) Basse; and 3) Tumana. The three are also considered separate Livestock Owners Associations.

Jimara is located in the western third of the District with headquarters at Bakadaji. The 29,586 hectares (38% of District) borders on the west with MacCarthy Island Division and Fulladu West, on the east by Basse Sub-District, on the north by The Gambia River and the south by Senegal.

Fifty-eight percent (17,080 hectares) of total land area is Tree and Shrub Savanna (MLUC 5/6 and 7), twenty-eight percent (8,223 hectares) is classified as Upland Crops (MLUC 8/9), and eleven percent (3,382 hectares) is Swamp (MLUC 10 and 11). Only 360 hectares (MLUC 10) are cultivated. Twenty-nine percent (8,583 ha.) of total area is classified as Cultivated (MLUC 8/9 & 10).

Cropping is diversified and consists almost exclusively of human food crops. The sample technique did not give any indication of maize production, which does exist. (Unfortunately Jimara area is one of two areas in MacCarthy Island and Upper River Divisions where MFP Range Component did not work, thus limiting observations to Resource Inventory sampling.)

TABLE: Cultivated Crop Cover

Fallow	58%
Groundnut	11%
Rice	7%
Millet	5%
Cotton	4%
Sorghum	2%
Maize	0%
Intercropped	<u>13%</u>
	100%

Forty-five percent (22,084 tons) of the total sub-district Code 1 biomass is produced in Tree and Shrub Savanna (MLUC 5/6 and 7), thirty-six percent (17,671 tons) is produced in Upland Crops (MLUC 8/9), and seventeen percent (8,660 tons) is from Swamps (MLUC 10 and 11). Average biomass productivity is 1,675 kilograms Code 1 biomass per UBT, or 1.6 hectares is required to feed one UBT. The strength is in the wet season feeding potential (MLUC 5/6 and 7) and with the post-wet season use of grounded crop residues from Upland Cropping areas (MLUC 8/9), but there is an inadequate source of dry season feed furnished from Swamps (MLUC 10 and 11).

TABLE: Biomass Production

MLUC	AuComb. BM/HA.	Hectares	Total kgs.	AuCode 1 BM/HA.	Hectares	Total kgs.
1	0	NA	NA	NA	NA	NA
2	0	NA	NA	0	NA	NA
3	1,475	221	325,975	931	221	205,751
4	675	154	103,950	550	154	84,700
5/6	2,000	15,853	31,704,000	1,272	15,852	20,163,744
7	2,462	1,228	3,023,336	1,564	1,226	1,920,592
8/9	3,084	8,223	25,359,732	2,149	8,223	17,671,227
10	3,231	360	1,163,160	2,484	360	894,240
11	4,061	3,022	12,272,342	2,570	3,022	7,766,540
12	1,728	250	432,000	1,105	250	252,500
13	NA	NA	NA	NA	NA	NA
14	(3,084)	276	851,184	(2,149)	276	593,124
TOTALS		29,586	75,235,679		29,586	49,352,418

Key :

- MLUC : Mixed Farming Land Use Classification
- AuComb. BM/ha. : Average Combined Biomass per Hectare
- kgs. : Kilograms
- AuCode 1 BM/ha. : Average Code 1 Biomass per Hectare
- Combined Biomass : All years and seasons combined, all measured biomass, no grazing preference. (See Key: Appendix 26)
- Code 1 Biomass : Desirable Grazing Preference, plant preferred by ruminants

TABLE: Carrying Capacity, average Number of Hectares per UBT

$$= \frac{49,352,418 \text{ kgs. Code 1 Biomass}}{29,586 \text{ total hectares}} = 1,675 \text{ kgs. Code 1 biomass/hectare}$$

$$= \frac{2,740 \text{ kgs Biomass/UBT (3\% ration)}}{1,675 \text{ kgs. Code 1 biomass/hectare}} = 1.6 \text{ HECTARES/UBT}$$

TABLE: Stocking Rate based on *1984 cattle census and estimates for sheep and goat population based on *1979 small ruminant census, both are for all of Fulladu East, and both are converted to Unitaire Bovin Tropicale (UBT)

7,579 Suckling Calves (23%) X 75 kgs., average unit weight	=	568,425 kgs.
10,215 Weaned Calves (31%) X 125 kgs., average unit weight	=	1,276,875 kgs.
15,158 Adults (46%) X 225 kgs., average unit weight	=	3,410,550 kgs.
40,818 Units Sheep and Goats X 41 kgs., est. av. unit weight	=	1,673,538 kgs.
Total		6,929,388 kgs.

$$\frac{6,929,388 \text{ kgs. total body weight}}{250 \text{ kgs./UBT}} = 27,718 \text{ UBT} \times **38\% = 10,533 \text{ UBT}$$

*Department of Animal Health and Production, MOAG

**Proportion of surface area

TABLE: Biomass Cover Type (1984)

Bare Ground	0%
Perennial Grass	8%
Annual Grass	25%
Sedges and Rushes	1%
Annual Forbs	1%
Shrubs	13%
Trees	32%
Cultivated	<u>20%</u>
	100%

Livestock Migration

Generally there is little cattle migration from this sub-district. If, however, bush fires destroy the Tree and Shrub Savanna, animals migrate into adjacent Districts or Senegal for dry season feed.

TABLE: Grazing Intensity, Incidence of Bush Fire, and Cultivation (1983-1984 average)

Ungrazed (0%)	16%
Lightly grazed (5-25%)	37%
Moderately grazed (25-50%)	17%
Heavily grazed (50-100%)	10%
Totally burned (75-100%)	0%
Moderately burned (25-75%)	0%
Lightly burned (5-25%)	0%
Cultivated and Cleared	<u>20%</u>
	100%

(Note: One choice per sample plot)

Conclusions

It requires 16,853 hectares to feed the 10,533 UBT estimated to be the ruminant population. The Swamps (MLUC 10 & 11) fall short of providing six full months of dry season feed; ranging ruminants must again depend upon unburned biomass from upland sites during the critically dry part of the year. Adequate biomass is produced to sustain resident herds and flocks.

Livestock Water

Late in dry season ruminants must depend on river, tributaries, and shallow wells for watering.

TABLE: Stock Watering Sources

Traditional Wells	17%
Natural Collection Basins	16%
Gambia River	9%
Other Rivers	2%
Multiple Sources	<u>56%</u>
	100%

Soil Erosion

Soil erosion ratings indicate moderate erosion problems, with erosion trend moving towards advanced. A serious problem area.

TABLE: Soil Erosion Rating (Appendix 24)

Nil	38%
Minor	24%
Moderate	24%
Advanced	20%
Severe	2%
	<hr/>
	100%

Burning

Excessive annual bush fires destroy productivity of Gallery Forest (MLUC 3), Closed Woodlands (MLUC 4), and Tree and Shrub Savannas (MLUC 5/6 and 7).

URD - FULLADU EAST - BASSE

The map reference is FULLADU EAST - BASSE

Range Resource Inventory (RRI) sampling completed in November 1984. Collection was in November 1983 and 1984.

Basse is located in the middle third of the District with headquarters in Basse Santa Su. The 21,519 hectares (27% of District) is bordered to the west by Jimara and on the east by Tumana sub-districts, Fulladu East District, to the north by the Gambia River, and on the south by Senegal.

Fifty-seven percent (12,233 hectares) of total land area is Tree and Shrub Savanna (MLUC 5/6 and 7), thirty-three percent (7,040 hectares) Upland Crops (MLUC 8/9), and six percent (1,373 hectares) is Swamps (MLUC 10 and 11). A relatively large two percent (432 hectares) is classified as Town/Village (MLUC 14), indicating a relatively large and important human population. Sixty-eight percent of cultivated lands (MLUC 8/9 and 10) are left fallow.

Upland cropping, though diversified, has indications of pressure cropping. Pressure cropping is where marginal lands (MLUC 5/6) are put under cultivation because of inadequate quantities of arable land. The checkerboard pattern as seen in MFP RRI map is the result of pressure cropping, with the farmer searching out small pockets of soil, usually in MLUC 5/6 & 7, to plant crops (syn. cutting and slashing).

Maize did not appear in any resource samples as primary crop, but most maize is grown in the vicinity of Town/Villages (MLUC 14) where few RRI samples were taken. One non-food crop that shows up is cotton.

Land resource demands for small subsistence farms, firewood, and construction woods deplete land resources faster than they can be replenished.

TABLE: Cultivated Crop Cover

Fallow	68%
Groundnut	9%
Rice	7%
Millet	3%
Cotton	3%
Sorghum	1%
Intercropped	9%
	<u>100%</u>

Forty-five percent (16,506 tons) of the total sub-district Code 1 biomass is produced in Tree and Shrub Savannas (MLUC 5/6 and 7), forty-one percent (15,129 tons) in Upland Crop (MLUC 8/9), and ten percent (3,478 tons) is produced in Swamps (MLUC 10 and 11). Average biomass productivity is 1,695 kilograms Code 1 biomass per UBT, or 1.6 hectares is required to feed one UBT. The strength is in the wet season feeding potential (MLUC 5/6 and 7) and with post-wet season use of grounded crop residues from Upland Cropping areas (MLUC 8/9). Weakness is amount of swamp land and its low productivity. Inadequate dry season feed from Swamps.

TABLE: Biomass Production

MLUC	AuComb. BM/HA.	Hectares	Total Kgms.	AuCode 1 BM/HA.	Hectares	Total Kgms.
1	0	NA	NA	NA	NA	NA
2	0	NA	NA	0	NA	NA
3	1,475	175	258,125	931	175	162,925
4	675	12	8,100	550	12	6,600
5/6	2,000	8,995	17,990,000	1,272	8,995	11,441,640
7	2,462	3,238	7,971,956	1,564	3,238	5,064,232
8/9	3,084	7,040	21,711,360	2,149	7,040	15,128,960
10	3,231	592	1,912,752	2,484	592	1,470,528
11	4,061	781	3,171,641	2,570	781	2,007,170
12	1,728	254	438,912	1,010	254	256,540
13	NA	NA	NA	NA	NA	NA
14	(3,084)	432	1,332,288	(2,149)	432	928,368
TOTALS		21,519	54,795,134		21,519	36,466,963

Key :

- MLCU : Mixed Farming Land Use Classification
- AuComb. BM/HA. : Average Combined Biomass per Hectare
- kgms. : kilograms
- AuCode 1 Bi/HA. : Average Code 1 Biomass per hectare
- Combined Biomass : All year and season combined, all measured biomass, no grazing preference. (see Key: Appendix 26)
- Code 1 Biomass : Desirable Grazing Preference, plant preferred by ruminants

TABLE: Carrying Capacity, average Number of Hectares per UBT

=	<u>36,466,963Kms Code 1 Biomass</u>	=	1,695 Kms. Code 1 biomass/hectare
	21,519 total hectares		
=	<u>2,740 Kms Biomass/UBT (3% ration)</u>	=	1.6 HECTARES/UBT
	1,695 Kms Code 1 biomass/hectare		

TABLE: Stocking Rate based on *1984 cattle census and estimates for sheep and goat population based on *1979 small ruminant census, both for all of Fulladu East District, and both are converted to Unitaire Bovin Tropicale (UBT)

7,579 Suckling Calves (23%) X 75 Kms., average unit weight	=	568,425 Kms.
10,215 Weaned Calves (31%) X 125 Kms., average unit weight	=	1,276,875 Kms.
15,158 Adults (46%) X 225 Kms., average unit weight	=	3,410,550 Kms.
40,818 Units Sheep and Goats X 41 Kms., est. av. unit weight	=	1,673,538 Kms.
Total		6,929,388 Kms.

$$\frac{6,929,388 \text{ Kms. total body weight}}{250 \text{ Kms./UBT}} = 27,718 \text{ UBT} \times **27\% = 7,484 \text{ UBT}$$

*Department of Animal Health and Production, MOAG

**Proportion of Surface Area

TABLE: Biomass Cover Type

Bare Ground	0%
Perennial Grass	9%
Annual Grass	23%
Sedges and Rushes	1%
Annual Forbs	2%
Shrubs	16%
Trees	34%
Cultivated	14%
	<u>101%</u>

Livestock Migration

Cattle and small ruminants (7,484 UBT) require 1,000 hectares, producing 1,695 Kms Code 1 biomass per hectare, to sustain them for one month, or 12,000 hectares per year. The Swamps in Basse total 1,373 hectares, or one month's forage. Feed must either be found in the Tree and Shrub Savanna or Upland Crop to carry the UBT population through June, or animals must migrate to Senegal to the south.

TABLE: Grazing Intensity, Incidence of Bush Fire, and Cultivation (November '83 and '84)

Ungrazed (0%)	14%
Lightly grazed (5-25%)	38%
Moderately grazed (25-50%)	14%
Heavily grazed ((50-100%)	19%
Totally burned (75-100%)	1%
Moderately burned (25-75%)	1%
Lightly burned (5-25%)	0%
Cultivated and Cleared	<u>13%</u>
	100%

(Note: One choice per sample plot)

Conclusions

Surplus rainy season and post-rainy season range feed can provide the additional feed needed to fill dry season deficit, on the condition that the surplus Tree and Shrub Savanna (MLUC 5/6 and 7) is not destroyed by bush fires. Upland Crop areas are also in surplus and can assist in filling needs later in the dry season. Swamps (MLUC 10 and 11) provide roughly one month of dry season feed. One thousand hectares per month of rangeland is required to feed the estimated 7,484 ruminants. Swamps provide 1,373 hectares.

Livestock Water

TABLE: Stock Watering Sources

Concrete Lined & Traditional Wells	15%
Springs	1%
Natural Collection Basins	22%
Gambia River & Tributaries	13%
Multiple Sources	<u>49%</u>
	100%

Water for livestock use is diversified but subject to herd's or flock's physical location. The flowing springs and natural collection basins are either dry or very limited by March, forcing animals to migrate near to river sources, swamps, etc., or stockmen must lift water from wells.

TABLE: Distance of Rangelands to Water

Less than 1 Kilometer	51%
1 kilometer to 5 kilometers	48%
5 kilometers to 10 kilometers	<u>1%</u>
	100%

Soil Erosion

Soil erosion rating indicates moderate erosion with severity increasing.

TABLE: Soil Erosion Rating (Appendix 24)

Nil	24%
Minor	31%
Moderate	27%
Advanced	16%
Severe	2%
	<u>100%</u>

Burning

The sample plots were read in November 1983 and 1984, there was little burning recorded at that time in Basse sub-district. However, damage from almost annual burning or bush fires was evident by the relatively high severity of erosion and scarred trees and shrubs. A problem in this sub-district. BUSH FIRES ELIMINATE BOTH POTENTIAL WOOD GROWTH AND MUCH NEEDED RUMINANT FEED SOURCES AND THEIR LONG TERM AVAILABILITY.

URD - FULLADU EAST - TUMANA

The map reference is FULLADU EAST - TUMANA.

Range Resource Inventory (RRI) sampling completed in November 1983.

Tumana is the most eastern third sub-district of Fulladu East District with headquarters at Dingirin. The 27,690 hectares (represents 35% of District) borders on the west with Basse sub-district and to the east with Kantora District, the north by the Gambia River and the south by Senegal.

Fifty-nine percent (16,335 hectares) of total land area is Tree and Shrub Savanna (MLUC 5/6 and 7), twenty-eight percent (7,716 hectares) is classified as Upland Crop (MLUC 8/9), and ten percent (2,748 hectares) is Swamp (MLUC 10 and 11), of which 455 hectares is cultivated.

Thirty percent (8,171 hectares) of area is classified as cultivated (MLUC 8/9 and 10), but in 1983 a large proportion of land so classified was in fallow. Not the 68% as indicated in the Table, but a lesser amount. Other indications are that a reduced area of land was actually under cultivation in 1983, that is, lower than average for previous years. Twenty percent or less of cultivable lands (MLUC 8/9 and 10) were cultivated in 1983, with less than average amounts of harvested grains. This applies to other sub-district and Districts in URD for 1983.

TABLE: Cultivated Crop Cover (1983 & 1984)

Fallow	68%
Groundnut	9%
Rice	7%
Millet	3%
Cotton	3%
Sorghum	1%
Intercropped	9%
	<u>100%</u>

One hectare produces an average of 1,672 kilograms Code 1 biomass, or 1.7 hectares are required to produce enough food for one UBT. Forty-seven percent of total biomass is produced in Tree and Shrub Savannas, with and without previous cultivation (MLUC 5/6 and 7), thirty-six percent by Upland Crops (MLUC 8/9), and fifteen percent is produced in Swamps (MLUC 10 and 11).

TABLE: Biomass Production

MLUC	AvComb. BM/HA.	Hectares	Total kgms.	AvCode 1 BM/HA.	Hectares	Total kgms.
1	0	NA	NA	NA	NA	NA
2	0	NA	NA	0	NA	NA
3	1,475	372	548,700	931	372	346,332
4	675	22	14,850	550	22	12,100
5/6	2,000	13,714	27,428,000	1,272	13,714	17,444,208
7	2,462	2,621	6,452,902	1,564	2,621	4,099,244
8/9	3,084	7,716	23,796,144	2,149	7,716	16,581,684
10	3,231	455	1,470,105	2,484	455	1,130,220
11	4,061	2,293	9,311,873	2,570	2,293	5,893,010
12	1,728	249	430,272	1,010	249	251,490
13	NA	NA	NA	NA	NA	NA
14	(3,084)	248	764,832	(2,149)	248	532,952
TOTALS		27,690	70,217,678		27,690	46,291,240

Key :

- MLUC : Mixed Farming Land Use Classification
- AvComb. BM/ha. : Average Combined Biomass per Hectare
- kgms. : kilograms
- AvCode 1 BM/ha. : Average Code 1 Biomass per Hectare
- Combined Biomass : All year and season combined, all measured biomass, no grazing preference. (See Key: Appendix 26)
- Code 1 Biomass : Desirable Grazing Preference, plant preferred by ruminants

TABLE: Carrying Capacity, average Number of Hectares per UBT

$$= \frac{46,291,240 \text{ kgms. Code 1 Biomass}}{27,690 \text{ total hectares}} = 1,672 \text{ kgms. Code 1 biomass/hectare}$$

$$= \frac{2,740 \text{ kgms. Biomass/UBT (3\% ration)}}{1,627 \text{ kgms. Code 1 biomass/hectare}} = 1.7 \text{ HECTARES/UBT}$$

TABLE: Stocking Rate based on *1984 cattle census and estimates for sheep and goat population based on *1979 small ruminant census, both are for all of Fulladu East District, and both are converted to Unitaire Bovin Tropicale (UBT)

7,579 Suckling Calves (23%) X 75 kgms., average unit weight	=	568,425 kgms.
10,215 Weaned Calves (31%) X 125 kgms., average unit weight	=	1,276,875 kgms.
15,158 Adults (46%) X 225 kgms. average unit weight	=	3,410,550 kgms.
40,818 Units Sheep and Goats X 41 kgms., est. av. unit weight	=	1,673,538 kgms.
Total		6,929,388 kgms.

$$\frac{6,929,388 \text{ kgs. total body weight}}{250 \text{ kgs./UBT}} = 27,718 \text{ UBT} \times **35\% = 9,701 \text{ UBT}$$

*Department of Animal Health and Production, MOAG

**Proportion of Surface Area

TABLE: Biomass Cover Type

Bare Ground	0%
Perennial Grass	11%
Annual Grass	20%
Sedges and Rushes	0%
Annual Forbs	3%
Shrubs	25%
Trees	36%
Cultivated	5%
	<u>100%</u>

Livestock Migration

Most probably ruminants, cattle particularly, migrate southward in search of food and water. More than likely this starts occurring around March each year when local water holes dry up and feed is scarce.

TABLE: Grazing Intensity, Incidence of Bush Fire, and Cultivation

Ungrazed (0%)	11%
Lightly grazed (5-25%)	40%
Moderately grazed (25-50%)	11%
Heavily grazed (50-100%)	30%
Totally burned (75-100%)	1%
Moderately burned (25-75%)	3%
Lightly burned (5-25%)	0%
Cultivated and Cleared	4%
	<u>100%</u>

Conclusions

A total of 16,492 hectares is required to feed the estimated 9,701 UBT of ruminants year round (12 months). This means 1,374 hectares are required per month of grazing; converting that to twenty total months of range forage produced, hypothetically MLUC 5/6 and 7 (Rainy Season plus) could provide twelve months, MLUC 8/9 (Post-Rainy Season) could provide six months, and MLUC 10 and 11 (Dry Season) could provide two months of the total twenty.

There is eighteen months of biomass produced in MLUC 5/6, 7 and 8/9, all available from July through December (six months), a surplus. For the remaining six months (January through June), two months are produced. Redistribution of surplus amounts of biomass to supplement deficient drier months, January through June, is difficult because of volatile dry/windy conditions. After November, bush fires

consume as high as eighty percent of the remaining biomass. Other areas producing biomass become overgrazed by concentrated numbers of ruminants looking for food.

Livestock Water

This sub-district is rich in spring-fed river tributaries and marshes that flow north and south till March, and remain in pools till early rains.

Livestock numbers concentrate in and around those remaining pools (marshes), causing overgrazing in the vicinities.

TABLE: Stock Watering Sources

Concrete Line & Traditional Wells	12%
Springs	3%
Natural Collection Basins	28%
Gambia River & Tributaries	15%
Multiple Sources	<u>42%</u>
	100%

TABLE: Distance of Rangelands to Water

Less than 1 kilometer	39%
1 kilometer to 5 kilometers	58%
6 kilometers to 10 kilometers	<u>1%</u>
	100%

Soil Erosion

Soil erosion ratings indicate overall moderate erosion problems, with a degrading trend towards an advanced condition.

TABLE: Soil Erosion Rating (Appendix 24)

Nil	16%
Minor	40%
Moderate	30%
Advanced	11%
Severe	<u>1%</u>
	100%

URD - KANTORA

The map reference is KANTORA.

Range Resource Inventory (RRI) sampling completed in December 1983.

Kantora is the most eastern District on the south bank. Bordered to the west by Fulladu East District, also in Upper River Division, to the east and south is Senegal, and north the Gambia River. Total land area is 30,065 hectares.

Sixty-five percent (19,490 hectares) of total land area is Tree and Shrub Savanna (MLUC 5/6 and 7), twenty-nine percent (8,727 hectares) is under cultivation (MLUC 8/9 and 10), and three percent is Uncultivated Swamp (MLUC 11). Sixty-seven percent of cultivated area is left in fallow.

Arable land in Kantora is limited and most is under cultivation. Primary crops are groundnuts and millet, sorghum and rice, and increasingly important amounts of maize are being grown. Non-food crop cotton is also grown.

MFP and DAN&P concentrated efforts to educate villages on the use of crop residues for ruminant feed during final stages of the dry season, particularly the collection and storage of maize stover and rice straw (MFP Technical Report 14).

The agriculture sector is attempting to become more diversified by planting more cotton (second cash crop behind groundnuts).

Two-thirds of the land area (19,490 hectares) is classified as a non-arable Tree and Shrub Savanna (MLUC 5/6). Area is predominated by shallow soils over lateritic rock formations of unknown depth, and surface rock and gravel. Vegetatively able to sustain adequate plant cover for anti-erosion purposes and livestock grazing. The MLUC 5/6 and 7 are rangelands. There is twenty-two percent indication of previous cultivation, and in fact many small parcels of one-half to five hectares are being cultivated, with very marginal results. This is called pressure cropping. Pressure cropping is where non-arable, marginal lands usually grazed by livestock are put into the cultivation system because of inadequate quantities of available arable lands.

TABLE: Cultivated Crop Cover

Fallow	67%
Groundnut	22%
Millet	11%
Maize	0%
	<u>100%</u>

Code 1 biomass produces an average of 907 kilograms per hectare, or 3.0 hectares produces enough feed for one UBT. The principal Tree and Shrub Savannas (MLUC 5/6 and 7) produce sixty-six percent (17,941 tons) of total Code 1 biomass, MLUC 8/9 twenty-four percent (6,543 tons), and Swamps (MLUC 10 and 11) provide eight percent (2,226 tons).

Requires 27,060 hectares for 9,020 UBTs, and 30,065 hectares are available. Kantora is overstocked.

TABLE: Biomass Production

MLUC	AvComb. BM/HA.	Hectares	Total Kgms.	AvCode 1 BM/HA.	Hectares	Total Kgms.
1	0	NA	NA	NA	NA	NA
2	0	NA	NA	0	NA	NA
3	(2,290)	136	311,440	(1,642)	136	223,312
4	(675)	171	115,425	(550)	171	94,050
5/6	1,618	15,142	24,499,756	894	15,142	13,536,948
7	1,260	4,345	5,478,480	1,013	4,348	4,404,524
8/9	1,354	8,498	11,506,292	770	8,498	6,543,460
10	(3,109)	229	711,961	(2,362)	229	540,898
11	4,805	1,041	5,002,005	1,619	1,041	1,685,379
12	582	258	150,156	265	258	68,370
13	NA	NA	NA	NA	NA	NA
14	(1,354)	242	327,668	(770)	242	186,340
TOTALS	-	30,065	48,103,183	-	30,065	27,283,280

Key :

- MLUC : Mixed Farming Land Use Classification
- AvComb. BM/HA. : Average Combined Biomass per Hectare
- Kgms. : kilograms
- AvCode 1 BM/HA. : Average Code 1 Biomass per Hectare
- Combined Biomass : All year and season combined, all measured biomass, no grazing preference. (See Key: Appendix 26)
- Code 1 Biomass : Desirable Grazing Preference, Plant preferred by ruminants

TABLE: Carrying Capacity, average Number of Hectares per UBT

$$= \frac{27,283,280 \text{ Kgms. Code 1 Biomass}}{30,065 \text{ total hectares}} = 907 \text{ Kgms. Code 1 biomass/hectare}$$

$$= \frac{2,740 \text{ Kgms. Biomass/UBT (3\% ration)}}{907 \text{ Kgms. Code 1 biomass/hectare}} = 3.0 \text{ HECTARES/UBT}$$

TABLE: Stocking Rate based on *1984 cattle census and estimates for sheep and goat population based on *1979 small ruminant census, both for Kantora District, and both are converted to Unitaire Bovin Tropicale (UBT)

2,481 Suckling Calves (23%) X 75 Kgms., average unit weight	=	186,075 Kgms.
3,345 Weaned Calves (31%) X 125 Kgms., average unit weight	=	418,125 Kgms.
4,963 Adults (46%) X 225 Kgms., average unit weight	=	1,116,675 Kgms.
13,026 Units sheep and Goats X 41 Kgms., est. av. unit weight	=	534,066 Kgms.
Total		2,254,941 Kgms.

$$\frac{2,254,941 \text{ Kgms. total body weight}}{250 \text{ Kgms./UB}} = 9,020 \text{ UBT}$$

*Department of Animal Health and Production, MOAG

TABLE: Biomass Cover Type

Bare Ground	0%
Perennial Grass	9%
Annual Grass	21%
Sedges and Rushes	0%
Annual Forbs	0%
Shrubs	30%
Trees	21%
Cultivated	18%
	<u>100%</u>

Livestock Migration

Insufficient biomass produced to sustain ruminants for duration of dry season. Probable migration, March; destination, Senegal, south and east of Kantera.

TABLE: Grazing Intensity, Incidence of Bush Fires, and Cultivation (Oct/Nov 1983 sample plots)

Ungrazed (0%)	23%
Lightly grazed (5-25%)	29%
Moderately grazed (25-50%)	17%
Heavily grazed (50-100%)	11%
Totally burned (75-100%)	1%
Moderately burned (25-75%)	1%
Lightly burned (5-25%)	0%
Cultivated and Cleared	18%
	<u>100%</u>

Conclusions

Code 1 biomass requirements for the estimated 9,020 UBT are 27,060 hectares or 24,543 tons of biomass, leaving an estimated biomass surplus of 2,740 tons (3,005 hectares). This is under no-burn conditions. The margin of surplus is too small, and the surface area of Tree and Shrub Savanna too great, bush fire risk very high. The District is not self-sufficient for livestock feed.

Livestock Water

Several slipways to the Gambia River exist and recent developed wells with handpumps have been installed specifically for livestock watering.

TABLE: Stock Watering Sources

Concrete Lined Wells	3%
Traditional Wells	29%
Natural Collection Basins	11%
Gambia River & Tributaries	53%
Multiple Sources	4%
Boreholes w/handpump (1985)	exist
	<u>100%</u>

TABLE: Distance of Rangelands to Water

Less than 1 kilometer	41%
1 kilometer to 5 kilometers	58%
6 kilometers to 10 kilometers	1%
	<u>100%</u>

Soil Erosion

A degree of soil erosion is always present in MLUC 5/6 and 7, and where there is a predominantly Tree and Shrub Savanna, soil erosion can be expected. Erosion is moderate, but the trend is accelerating in severity. Destruction of soil surface vegetation adds to the acceleration of erosion due to early heavy rainfall, before new vegetal growth can cover the bare rocky Savanna upland sites. Water penetration is poor, causing downhill acceleration of runoff to cut into deeper arable soils. Concentrated water cutting gullies and moving soils into swamps and the Gambia River.

TABLE: Soil Erosion Rating (Appendix 24)

Nil	26%
Minor	30%
Moderate	23%
Advanced	15%
Severe	6%
	<u>100%</u>

Burning

Once again the sampling timing does not indicate the severity of bush fire and the resulting destruction of vegetal matter. Burning starts accelerating when dry winds and vegetation prevail, usually after January in URD. Burning is a problem.

URD - WULI - UPPER WULI

The map reference is UPPER WULI.

Range Resource Inventory (RRI) sampling completed in December 1982.

The north bank of Upper River Division and Sami District of MacCarthy Island Division, also north of the Gambia River, are the most isolated areas in terms of poor roads, no river crossing facilities, no inter-connecting vehicle road between north bank MID and URD, poor communications, and few services. Human populations are sparse, few small small villages, well dispersed.

Upper Wuli is situated in the extreme northeast corner of the country, bordered on the east and north by Senegal, west by Lower Wuli, and to the south by the Gambia River. Headquarters for both Upper and Lower Wuli has been at Sutuko in Upper Wuli. Town/Village (MLUC 14) is 172 hectares of land surface (.5% of total).

Agricultural cropping is becoming more diversified and productive on Upland Crop lands (MLUC 8/9). Marginal arable areas (MLUC 5/6 and 7) have also been put into the cropping rotation system by slashing and burning shrub and trees. All the tree arable lands are occupied.

Digitaria exilis ("Findo") is grown in bush fields, and is a sweet, very small grain, considered a delicacy in most of Africa. Though fields were frequently observed, they were always away from other cultivated grains, situated in fallow Upland Crop areas. Remaining straw is eaten by cattle, but in minimal amounts.

Note: A weakness in MFP (RRI) sampling has been detected. Sampling has not been successful in indicating incidence of crops near to human habitations or villages. By design, the methodology was to give information concerning rangelands. The bulk of samples have been taken away from human population centers; villages and cities (MLUC 14). Crops such as maize, root crops, and vegetables are poorly defined in this Summary. Solution is to take more samples nearer to human habitats.

Quantities of maize have been grown near to village compounds.

Maize farm crop residue is effective dry season livestock feed and MFP Range Unit has introduced residue feeding to most LOAs in MID and URD. (MFP Technical Report 14, 1986) Maize stover is more effectively fed late in the dry season (May and June).

Cotton has increased in importance appreciably over the last four years. Cotton is a cash crop, after groundnuts, and is being processed in a mill at Basse, MID.

TABLE: Cultivated Crop Cover

Fallow	84%
Millet	5%
Groundnut	4%
Rice	4%
"Findo" (<u>Digitaria exilis</u>)	3%
Cotton	exists
Maize	<u>exists</u>
	100%

Code 1 biomass produces an average of 1,409 kilograms per hectare, or 1.9 hectares produce enough food for one UBT. Fifty-six percent of biomass (20,790 tons) is produced in Tree and Shrub Savanna (MLUC 5/6 and 7), thirty-one percent (14,896 tons) in Upland Crops (MLUC 8/9), and eleven percent (5,523 tons) is produced in Swamps (MLUC 10 and 11); only 350 tons of biomass is produced in Cultivated Swamps (MLUC 10).

TABLE: Biomass Production

MLUC	AvComb. BM/HA.	Hectares	Total kgms.	AvCode 1 BM/HA.	Hectares	Total kgms.
1	0	NA	NA	NA	NA	NA
2	0	NA	NA	0	NA	NA
3	1,778	199	353,822	1,778	199	353,822
4	(675)	45	30,375	(550)	45	24,750

5/6	1,495	20,928	31,287,360	1,021	20,928	21,367,488
7	2,810	4,014	11,279,340	1,351	4,014	5,422,914
8/9	3,036	6,225	18,899,100	2,393	6,225	14,896,425
10	2,933	143	419,419	2,452	143	350,636
11	3,198	2,178	6,965,244	2,375	2,178	5,172,750
12	661	303	200,263	609	303	184,527
13	NA	NA	NA	NA	NA	NA
14	(3,036)	172	522,192	(2,393)	172	411,596
TOTALS		*34,207	69,957,135		*34,207	48,184,908

Key :

- MLUC : Mixed Farming Land Use Classification
 AvComb. BM/Ha. : Average Combined Biomass per Hectare
 Kgs. : kilograms
 AvCode 1 BM/Ha. : Average Code 1 Biomass per Hectare
 Combined Biomass : All year and season combined, all measured biomass, no grazing preference. (See Key: Appendix 26)
 Code 1 Biomass: Desirable grazing preference; plant preferred by ruminants

TABLE: Carrying Capacity, average Number of Hectares per UBT

$$= \frac{48,184,908 \text{ kgs. Code 1 Biomass}}{34,207 \text{ total hectares}} = 1,409 \text{ kgs. Code 1 biomass/ hectare}$$

$$= \frac{2,740 \text{ kgs. Biomass/UBT (3\% ration)}}{1,409 \text{ kgs. Code 1 biomass/hectare}} = 1.9 \text{ HECTARES/UBT}$$

TABLE: Stocking Rate based on **1984 cattle census and estimates for sheep and goat population based on *1979 small ruminant census; both are converted to Unitaire Bovin Tropicale (UBT)

4,079 Suckling Calves (23%) X 75 kgs., average unit weight	=	305,925 kgs.
5,498 Weaned Calves (31%) X 125 kgs., average unit weight	=	687,250 kgs.
8,158 Adults (46%) X 225 kgs., average unit weight	=	1,935,550 kgs.
21,714 Units Sheep and Goats X 41 kgs., est. av. unit weight	=	890,274 kgs.
Total		3,718,999 kgs.

$$\frac{3,718,999 \text{ kgs. total body weight}}{250 \text{ kgs./UBT}} = 14,876 \text{ UBT} \times \frac{48,184,908 \text{ kgs BM (U.Wuli)}}{82,781,127 \text{ total kgs BM (Wuli)}}$$

$$= 8,659 \text{ UBT (Upper Wuli)}$$

*Makama Sireh north hectares not included
 **Department of Animal Health and Production, MOAG

TABLE: Biomass Cover Type

Bare Ground	1%
Perennial Grass	5%
Annual Grass	29%
Sedges and Rushes	0%
Annual Forbs	4%
Shrubs	22%

Trees	31%
Cultivated	<u>8%</u>
	100%

Livestock Migration

Under normal climatic conditions, there is no need for livestock to migrate out of the sub-district. However, there may be back and forth into Senegal, and vice versa. Factors triggering migration are unavailability of livestock water and lack of biomass or feed. Resident cattle range into river and tributary areas in search of dry season feed. Those cattle remaining in Upland Crop, and Tree and Shrub Savanna for duration of dry season do become emaciated because of trailing distances in search of food and not getting required amounts of biomass nor water for maintenance of body weight. Energy levels decrease for livestock as the dry season continues. In May and June older, younger, and gestating animals frequently die of starvation.

TABLE: Grazing Intensity, Incidence of Bush Fire, and Cultivation (Nov/Dec 1982 sample plots)

Ungrazed (0%)	3%
Lightly grazed (5-25%)	38%
Moderately grazed (25-50%)	22%
Heavily grazed (50-100%)	24%
Totally burned (75-100%)	0%
Moderately burned (25-75%)	4%
Lightly burned (5-25%)	1%
Cultivated and Cleared	<u>8%</u>
	100%

(Note: One choice per sample plot)

Conclusions

A total of 16,452 hectares is required to feed the estimated 8,659 UBT, at a monthly rate of 1,371 hectares. Surplus Code 1 biomass remains in MLUC 3, 4, 5/6, and 7, and MLUC 8/9 following the normal season-of-use (see TABLE). Grazing livestock can continue to use upland sites such as MLUC 5/6 and 7, and MLUC 8/9 through the entire twelve months.

TABLE: Season of Use

MLUCs	Season	Use and Months	Requirements	Surplus
3,4,5/6,7	Wet	Range, July thru Oct (4)	5,484 ha.	+19,702 ha.
8/9,14	Post-Wet	Range, Nov and Dec (2)	2,742 ha.	+ 3,655 ha.
10,11,12	Dry	Range, Jan thru June (6)	8,226 ha.	- 5,602 ha.
3,4,5/6,7	Dry	Range, Jan thru June (-)	5,602 ha.	---
Feed Surplus				+17,755

$$8,659 \text{ UBT} \times 1,9 \text{ hectares/UBT} = 16,452 \text{ hectares}$$

$$16,452 \text{ ha.} - 12 \text{ months} = 1,371 \text{ hectares required per month to feed 8,659 UBT}$$

Livestock Water

Most livestock, at least those away from the Gambia River, are watered from deep (sixty feet) open wells that dry up daily once the storage capacity has been depleted. In the dry season wells are emptied by manually lifting water, or by using animal traction to lift rubber tire buckets to the surface where they are emptied into holding troughs. Wells are left to recharge by mid-afternoon.

Unless dug away and improved, banks of the Gambia River are too steep for descents and ascents by hungry, thirsty cows. Many fall into the river. Developing river drinking accessways at intermittent points, as close as one kilometer apart, would reduce the risk of animals falling in and drowning, and increase the availability of fresh water for livestock.

Several earthen water collection basins (ponds) in MLUC 5/6 and 7 collect and store rainwater up until December, depending on rains.

TABLE: Stock Watering Sources

Concrete Lined & Traditional Wells	55%
Borehole w/handpump	1%
Natural Collection Basins	6%
Gambia River & Tributaries	35%
Multiple Sources	3%
	<u>100%</u>

TABLE: Distance of Rangelands to Water

Less than 1 kilometer	38%
1 to 5 kilometers	57%
Over 6 kilometers	2%
	<u>97%</u>

Soil Erosion

The majority of land mass (MLUC 5/6 and 7) is in burned condition, with little vegetal ground cover and limited deep plant roots to cushion, catch, and hold the early heavy rains. Soil erosion in all of Wuli District is moderate, but the trend is toward severe soil erosion. Indiscriminate slashing and burning of vegetation on marginal lands (MLUC 5/6 and 7) for cultivation is contributing to the accelerated erosion trend. In some areas, erosion conditions are severe.

TABLE: Soil Erosion Rating (Appendix 24)

Nil	2%
Minor	39%
Moderate	40%
Advanced	11%
Severe	5%
	<hr/>
	97%

Burning

Fifty-six percent of the total biomass in this sub-district is produced in the most volatile area, Tree and Shrub Savanna, which is seventy-three percent of the land area (24,942 hectares). Predictable annual bush fires consume as high as eighty percent of remaining biomass, exposing shallow soils to erosion.

URD - WULI - LOWER WULI

The map reference is LOWER WULI.

Range Resource Inventory (RRI) sampling was completed in November 1982, with some additional samples taken on the southwest corner in November 1984.

Isolated on the north bank of URD, borders with Upper Wuli on the east, Senegal on the north, Sandu District to the west, and the Gambia River south. Communications and road systems are poor. Human population sparse and scattered.

Principal crops are millet, groundnuts, and rice. Wuli District also cultivates "Findo," a short grass, *Digitaria exilis*, that produces a sweet small grain which is cooked like coos, and considered a delicacy. The remaining straw is considered a usable crop residue, but animals would prefer other vegetation over it.

Maize is also grown near to village compounds, and not in bush fields.

Non edible secondary cash crop cotton is grown.

TABLE: Cultivated Crop Cover

Fallow	83%
Millet	6%
Groundnut	4%
Rice	4%
"Findo"	2%
Cotton	1%
Maize	<u>exists</u>
	100%

Code 1 biomass produces an average of 1,443 kilograms per hectare, or 1.9 hectares produces enough feed for one UBT. Seventy-one percent (16,988 hectares) of the total land mass is classified as Tree and Shrub Savanna (MLUC 5/6 and 7), it produces 18,385 tons of Code 1 biomass (53% of total). Twenty percent (4,732 hectares) is Upland Crop (MLUC 8/9) and it produces 11,324 tons of Code 1 biomass (33% of total). All Swamp lands (1,799 hectares), eight percent of total land area, produces 4,300 tons of Code 1 biomass (12% of total).

TABLE: Biomass Production

MLUC	AuComb. BM/HA.	Hectares	Total Kgs.	AuCode 1 BM/HA.	Hectares	Total Kgs.
1	0	NA	NA	NA	NA	NA
2	0	NA	NA	0	NA	NA
3	1,778	82	145,796	1,778	82	145,796
4	(675)	6	4,050	(550)	6	3,300
5/6	1,495	13,836	20,684,820	1,021	13,836	14,126,556
7	2,810	3,152	8,857,120	1,351	3,152	4,258,352
8/9	3,036	4,732	14,366,352	2,393	4,732	11,323,676
10	2,933	351	1,029,483	2,452	351	860,652
11	3,198	1,448	4,630,704	2,375	1,448	3,439,000
12	661	257	169,877	609	257	156,513
13	NA	NA	NA	NA	NA	NA
14	(3,036)	118	358,248	(2,393)	118	282,374
TOTALS		23,982	50,246,450		23,982	34,596,219

Key :

MLUC	:	Mixed Farming Land Use Classification
AuComb. BM/HA.	:	Average Combined Biomass per Hectare
Kgs.	:	kilograms
AuCode 1 BM/HA.	:	Average Code 1 Biomass per Hectare
Combined Biomass	:	All year and season combined, all measured biomass, no grazing preference. (See Key: Appendix 26)
Code 1 Biomass	:	Desirable Grazing Preference, plant preferred by ruminants

TABLE: Carrying Capacity, average Number of Hectares per UBT

=	<u>34,596,219 Kgs. Code 1 Biomass</u>	=	1,443 Kgs. Code 1 biomass/hectare
	23,982 hectares		
=	<u>2,740 Kgs. Biomass/UBT (3% ration)</u>	=	1.9 HECTARES/UBT
	1,443 Kgs. Code 1 biomass/hectare		

TABLE: Stocking Rate based on *1984 cattle census and estimates for sheep and goat population based on *1979 small ruminant census, both are converted to Unitaire Bovin Tropicale (UBT)

4,079 Suckling Calves (23%) X 75 kgs., average unit weight	=	305,925 Kgs.
5,498 Weaned Calves (31%) X 125 kgs., average unit weight	=	687,250 Kgs.
8,158 Adults (46%) X 225 kgs., average unit weight	=	1,835,550 Kgs.
21,714 Units Sheep and Goats X 41 kgs., est. av. unit weight	=	890,274 Kgs.
Total		3,718,999 Kgs.
<u>3,718,999 Kgs. total body weight</u>	=	14,876 UBT X <u>34,596,219 Kgs BM (L. Wuli)</u>
250 Kgs./UBT		82,781,127 total Kgs BM (Wuli)
	=	6,217 UBT

*Department of Animal Health and Production, MOAG

TABLE: Biomass Cover Type

Bare Ground	1%
Perennial Grass	7%
Annual Grass	29%
Sedges and Rushes	0%
Annual Forbs	4%
Shrubs	22%
Trees	29%
Cultivated	9%
	<u>101%</u>

Livestock Migration

Under normal climatic conditions, adequate forage is available to sustain livestock in residence. Cattle particularly may range into river and tributary areas during stages of the dry season, or they may enter Sandu District in search of forage. The options may present themselves, and stockmen may utilize whatever option necessary to assure survival of his herd.

TABLE: Grazing Intensity, Incidence of Bush Fire, and Cultivation (Nov 1982 and 1984)

Ungrazed (0%)	5%
Lightly grazed (5-25%)	36%
Moderately grazed (25-50%)	22%
Heavily grazed (50-100%)	25%
Totally burned (75-100%)	0%
Moderately burned (25-75%)	4%
Lightly burned (5-25%)	1%
Cultivated and Cleared	8%
	<hr/> 101%

(Note: One choice per sample plot)

Conclusions

A total of 11,812 hectares is required to feed the estimated 6,217 UBT at a monthly rate of 984 hectares. Surplus Code 1 biomass remains in MLUC 3, 4, 5/6, and 7, and MLUC 8/9 following the normal season-of-use (see TABLE). These surpluses can assist in filling later dry season needs.

TABLE: Season of Use

Monthly Feed Requirements on Surpluses, Probable Effects of Bush Fires, Resulting Surplus

MLUCs	Season	Use and Months	Requirements	Surplus
3,4,5/6,7	Rainy	Range, July thru Oct (4)	3,936 ha.	+13,052 ha.
8/9,14	Post-Rainy	Range, Nov and Dec (2)	1,968 ha.	+ 2,885 ha.
10,11,12	Dry	Range, Jan thru June (6)	5,904 ha.	- 3,849 ha.
3,4,5/6,7	Dry	Range, Jan thru June (-)	3,849 ha.	---
		Feed Surplus		+12,088

$$6,217 \text{ UBT} \times 1.9 \text{ ha./UBT} = 11,812 \text{ ha.} - 12 \text{ months}$$

$$= 984 \text{ hectares required per month to feed } 6,217 \text{ UBT}$$

$$* 13,052 \text{ ha.} \times 80\% \text{ burned} = 10,442 \text{ ha. burned}$$

Livestock Water

Several earthen water collection basins (ponds) have been identified in MLUC 5/6 and 7 that are used during the rainy season to collect and retain rainwater up until December, depending on rains.

TABLE: Stock Watering Sources

Concrete Lined Wells	13%
Traditional Wells	41%
Borehole w/handpump	1%
Natural Collection Basins	7%
Gambia River & Tributaries	34%
Multiple Sources	4%
	<u>100%</u>

TABLE: Distance of Rangelands to Water

Less than 1 kilometer	40%
1 kilometer to 5 kilometers	56%
More than 5 kilometers	2%
	<u>98%</u>

Soil Erosion

Soil erosion rating is moderate, with trend towards more severity.

TABLE: Soil Erosion Rating (Appendix 24)

Nil	4%
Minor	38%
Moderate	37%
Advanced	13%
Severe	6%
	<u>98%</u>

Burning

Burning is still a major factor controlling livestock movement during the dry season months. Tree and Shrub Savannas (MLUC 5/6 and 7), almost three-quarters of the total land area, annually burn between December and February, destroying tons of potential forage.

URD - Sandu

The map reference is SANDU.

Range Resource Inventory (RRI) sampling completed in December 1984.

The second District in the north bank of Upper River Division. Sandu borders on the east with Lower Wuli, to the north with Senegal, the west with Sani Bolon dividing URD from MID on the north bank and Sandu District from Sani District, and on the south with the Gambia River.

Fifty-four percent of Upland Crop (MLUC 8/9) and Cultivated Swamps (MLUC 10) are in fallow. Crop diversity is excellent. Again, sampling procedures indicated no maize, but samples are not normally

taken near to villages in any quantities. This is where maize would show up, near human compounds in villages, or nearby.

TABLE: Cultivated Crop Cover

Fallow	54%
Millet	16%
Groundnut	12%
Sorghum	6%
Rice	4%
Cotton	2%
Maize	exists
Intercrop	<u>6%</u>
	100%

Code 1 biomass produces an average of 1,115 kilograms of biomass per hectare, or 2.5 hectares produce enough food for one UBT. Fifty percent of biomass (18,208 tons) is produced in Tree and Shrub Savanna (MLUC 5/6 and 7), twenty-three percent (8,506 tons) is produced in Upland Crops (MLUC 8/9), and twenty-four percent (8,768 tons) of total biomass is produced in Swamps (MLUC 10 and 11).

TABLE: Biomass Production

MLUC	AuComb. BM/HA.	Hectares	Total kgms.	AuCode 1 BM/HA.	Hectares	Total kgms.
1	0	NA	NA	NA	NA	NA
2	0	NA	NA	0	NA	NA
3	3,250	372	1,209,000	2,130	372	792,360
4	(675)	6	4,050	(550)	6	3,300
5/6	1,498	18,968	28,414,064	775	18,968	14,700,200
7	1,516	4,435	6,723,460	791	4,435	3,508,085
8/9	2,011	6,020	12,106,220	1,413	6,020	8,506,260
10	3,034	179	543,086	1,755	179	314,145
11	4,409	2,430	10,713,870	3,479	2,430	8,453,970
12	776	306	237,456	524	306	160,344
13	NA	NA	NA	NA	NA	NA
14	(2,011)	171	343,881	(1,413)	171	241,623
TOTALS		32,887	60,295,087		32,887	36,680,287

Key :

MLUC	:	Mixed Farming Land Use Classification
AuComb. BM/HA.	:	Average Combined Biomass per Hectare
kgms.	:	Kilograms
AuCode 1 BM/HA.	:	Average Code 1 Biomass per Hectare
Combined Biomass	:	All year and season combined, all measured biomass, no grazing preference. (See Key: Appendix 26, p.)
Code 1 Biomass	:	Desirable Grazing Preference, plant preferred by ruminants

TABLE: Carrying Capacity, average Number of Hectares per UBT

$$= \frac{36,680,287 \text{ Kgms. Code 1 Biomass}}{32,887 \text{ tota. hectares}} = 1,115 \text{ Kgms. Code 1 biomass/hectare}$$

$$= \frac{2,740 \text{ Kgms. Biomass/UBT (3\% ration)}}{1,115 \text{ Kgms Code 1 biomass/hectare}} = 2.5 \text{ HECTARES/UBT}$$

TABLE: Stocking Rate based on *1984 cattle census and estimates for sheep and goat population based on *1979 small ruminant census, both for Sandu District, and both are converted to Unitaire Bovin Tropicale (UBT)

2,067 Suckling Calves (23%) X 75 Kgms., average unit weight	=	155,025 Kgms.
2,785 Weaned Calves (31%) X 125 Kgms., average unit weight	=	348,125 Kgms.
4,133 Adults (46%) X 225 Kgms., average unit weight	=	929,925 Kgms.
11,292 Units Sheep and Goats X 41 Kgms., est. av. unit weight	=	462,972 Kgms.
Total		1,896,047 Kgms.

$$\frac{1,896,047 \text{ Kgms. total body weight}}{250 \text{ Kgms./UBT}} = 7,584 \text{ UBT}$$

*Department of Animal Health and Production, MOAG

TABLE: Biomass Cover Type

Bare Ground	0%
Perennial Grass	13%
Annual Grass	29%
Sedges and Rushes	0%
Annual Forbs	2%
Shrubs	18%
Trees	17%
Cultivated	21%
	<u>100%</u>

Livestock Migration

There is movement within the district come drier months when livestock, particularly cattle, move closer to Sami bolon and river flood plains.

TABLE: Grazing Intensity, Incidence of Bush Fire, and Cultivation (Nov/Dec 1984 sample plots)

Ungrazed (0%)	6%
Lightly grazed (5-25%)	31%
Moderately grazed (25-50%)	18%
Heavily grazed (50-100%)	23%
Totally burned (75-100%)	0%
Moderately burned (25-75%)	0%
Lightly burned (5-25%)	0%
Cultivated and Cleared	<u>22%</u>
	100%

Conclusions

A total of 18,960 hectares is required to feed the estimated 7,584 UBT, a monthly rate of 1,580 hectares. Surplus biomass remains in MLUC 3, 4, 5/6, and 7, and 8/9 and 14. The Surplus assists with the shortfall from January through June.

Seasonally effective rangelands such as MLUC 3, 4, 5/6, and 7, and to a lesser degree 8/9, can be valuable range biomass sources throughout the year if not burned. Annual forage dries up and becomes less appetizing to livestock and more vulnerable to bush fire.

TABLE: Season of Use

MLUCs	Season	Use and Months	Requirements	Surplus
3,4,5/6,7	Wet	Range, July thru Oct (4)	6,320 ha.	+17,461 ha.
8/9,14	Post-Wet	Range, Nov and Dec (2)	3,160 ha.	+ 3,031 ha.
10,11,12	Dry	Range, Jan thru June (6)	9,480 ha.	- 6,565 ha.
3,4,5/6,7	Early Dry	Range, Jan thru June (-)	6,565 ha.	---
		Feed Surplus		+13,927

Livestock Water

There are few concrete lined wells in this district that are used to water livestock. There is incidence of small clay rain collection ponds in MLUC 5/6 and 7 that hold water till November/December.

TABLE: Stock Watering Sources

Traditional Wells	35%
Natural Collection Basins	7%
Gambia River & Tributaries	38%
Multiple Sources	20%
	<u>100%</u>

During the last couple of years river accessways for watering livestock have been constructed using local government support.

TABLE: Distance of Rangelands to Water

Less than 1 kilometer	49%
1 kilometer to 5 kilometers	51%
	<u>100%</u>

Soil Erosion

Indications are that soil erosion is minor with trend advancing downward. There are instances of severe soil erosion taking place.

TABLE: Soil Erosion Rating

Nil	33%
Minor	31%
Moderate	16%
Advanced	16%
Severe	4%
	<hr/>
	100%

Burning

No samples taken in November and December 1984 indicated recent (that year) burn. Bush fires do occur and, like other districts, usually in Tree and Shrub Savannas. Dry, dense understory vegetation combined with dry, windy conditions rapidly ignite and spread fire from carelessly unattended sources. In a few short hours thousands of hectares of MLUC 5/6 and 7 are destroyed.

RECOMMENDATIONS

Rangelands and Farm Crop Residues

There appears to be a high mortality rate in both suckling and weaned calves during the driest months. Also, a high mortality rate with crippled and older cattle. Mortality is attributed to malnutrition.

Stress the collection and storage of farm crop residues such as maize and sorghum stovers, groundnut hay, and rice straw for the feeding of calves and heifers during the months of April, May, and June. (MFP Technical Report 14)

Establish deferred grazing areas near to village, free of bush fire, save for use by young animals in the months of April, May, and June. (MFP Technical Report 14)

Culling

Encourage slaughter/consumption of old, non-productive animals, within herd structure (culling). Non-productive animals need to be eliminated from rangelands.

Livestock Owners Associations

Livestock Owners Associations can be instrumental in creating dialogue concerning range/livestock programs. Most effective programs cannot be carried out on a LOA level, they are too big, but

interest groups, or villages within an LOA structure would be interested in implementation. All livestock range programs should go through the LOA body.

It is suggested that all implementation be carried out on village group bases, with technical assistance provided through specific Ministry departments: DAH&P, et. al.

Livestock Watering

As identified on RRI Maps, there are several natural earthen reservoirs in MLUC 5/6 and 7 that act as rain catchment basins, and can retain livestock drinking water until December. They are earthen clay, and could probably be cleaned of silt or enlarged slightly to increase their storage capacity. This action would lengthen actual time spent on these isolated ranges. Located mostly in URD. (See RRI Maps, 1986)

Similarly, it is found that the Gambia River is not being fully utilized for livestock watering. From Kuntaur eastward, river water is ideal but mostly inaccessible because of steep banks. Grazing animals cannot descend to partake of water. Simple 4-5 meter wide cuts through the bank and a simple concrete ramp would provide an inexpensive water source when comparing concrete wells and their productivity. Such accessways should accommodate no more than 500-600 head to prevent deteriorating effects of large numbers of animals passing from rangelands to water. Accessways should be placed at two to three kilometer intervals along the Gambia River and some Tributaries. (See MFP RRI Maps, 1986, and MFP Technical Report 14)

Recommend exploiting river water for livestock use through simple paved accessways (above). However, for livestock beyond the five (5) kilometer distance from river, water, especially in dry season, is critical. Recommend strategic placement of concrete lined wells five kilometers distance from any point on the Gambia River; for livestock use. Do Not recommend that any well be equipped with motorized pump. The danger is too real in destroying the surrounding environment with enormous numbers of animals searching for water. Temporary relief from thirst is not worth long term damage to resources.

Burning

Dry, dense understory combined with dry, turbulent winds rapidly ignites a fire spark and spreads flames out of control, destroying thousands of hectares of woodlands and tree - shrub savanna. This annual destruction of grazable biomass and wood products is a senseless massacre of natural resources. Recommend strongly that the Ministry of Agriculture with Environment create a National Task Force to develop ways of combatting this destructive force that annually plagues the same lands. And, at the same time mediate with leaders in rural areas in search for a solution to this big problem. If the bush fire issue is left to rest without action, then forest and range resources will die.

Final Recommendation

The last recommendation is that similar Range Resource Inventories be completed for Western, North Bank, and Lower River Divisions, and that the updating be continuous and another major RRI effort in MID and URD be undertaken in 1994.

APPENDICES TO FINAL REPORT
RANGE RESOURCE INVENTORY
GAMBIAN MIXED FARMING AND RESOURCE MANAGEMENT PROJECT

PART II
RANGE RESOURCE INVENTORY
A SUMMARY

Copies of maps are available for cost of reproduction.
They may be obtained from the Office of International
Programs, Colorado State University, Fort Collins,
CO 80523. (303) 491-7223.

Appendix 1

LIVESTOCK OWNERS' ASSOCIATIONS
1980

Division	District LOA	President	H/Qtrs	Enrolled
Western	Foni Jarrol	Yusupha Sanyang	Kalaji	156
Western	Foni Bondali	Lamin Sanneh	Bondali	144
Western	Foni Kansala	Momodou Bojang	Bwian	201
Western	Foni Bintang Karanzi	Masire Badji	Sibanor	140
Western	Foni Brefet	Musa Kolley	Ndemhani Jolla	132
Western	Kombo East	Alhaji Kawsu Jabang	Pirang	107
Western	Kombo Central	Bolong Jarumneh	Brikama	111
Western	Kombo South	Malanding Demba	Sifo	168
Western	Konabo North	Alhaji Abdou Sisay	Sukuta	105
Western	Kombo St. Mary	Madi Joof	Bakoteh	110
North Bank	Lower Niuni	Alhaji Ousman Betay	Chanen	155
North Bank	Upper Niuni	Alhaji Sukum Bah	Lamin	143
North Bank	Jokadu	Alhaji Amadou Kebbeh	Munyangen	102
North Bank	Lower Badibu	Alhaji Kairaba Makalo	Saba	110
North Bank	Central Badibu	Biji Penda Jallow	Ker Katim Fulla	115
North Bank	Upper Badibu	Momodou Kumba Bah	Duta Bulu	130
North Bank	Upper Badibu	Jangarido Bah	Dibba-Kunda Fulla	121
Lower River	Kiang West	Momodou Ceessay	Keneba	70
Lower River	Kiang Central	Massaneh Konta	Kuinella	112
Lower River	Kiang East	Alhaji Saikou K. Sanneh	Kaiaf	106
Lower River	Jarra West	Alhaji F. Saidiba	Scma Madina	110
Lower River	Jarra Central	Alhaji B. Jallow	Madina	118
Lower River	Jarra East	Alhaji S. Sanneh	Bureng	103
MacCarthy Is.	Niamina Dankunku	Ello Jallow	D/kunku F/kunda	135
MacCarthy Is.	Niamina West	Samba Y. Bah	Piniai	122
MacCarthy Is.	Niamina East	Alhaji K. Suma	Sotokoi	104
MacCarthy Is.	Lower Fulladu West	Bori Dem	Fulla Bantang	* 205
MacCarthy Is.	Lower Fulladu West	Alhaji Faiai Baldeh	Sare Ngai	* -
MacCarthy Is.	Upper Fulladu West	Sara Baldeh	Sare S/Tako	155
MacCarthy Is.	Niani	Kolly Bah	Kuntaur	168
MacCarthy Is.	Nianija	Samba York	Sinchu Demba	110
MacCarthy Is.	Upper Saloun	Alhaji S. Leigh	Leba	120
MacCarthy Is.	MacCarthy Is.	Junkung Jobarteh	Georgetown	60
MacCarthy Is.	Lower Saloun	Yoro Sey	Gorekura Tokolor	109
MacCarthy Is.	Sami Nana	Nofonye Jallow	Jamely Babou	100
MacCarthy Is.	Karantaba	Ba Mandou Gano	Karantaba T/kunda	116
Upper River	Sandu	Mutaga Bah	Sare Mataga	118
Upper River	Kantora	Foday Jawo	Jawo Kunda	181
Upper River	Tumana	Demba Sumareh	Dingirin	145
Upper River	Jinara	Alhaji J. Dranneh	Bakadaji	145
Upper River	Basse	Alhaji M. Baldeh	Masajang kunda	181
Upper River	Upper Wuli	Amadou Jallow	Sare Bohun	115
Upper River	Lower Wuli	Demba Sowe	Sankabare	112

Appendix 2

PERFORMANCE RANKING OF LOAs

LOA	Div.	Year	Rating	Year	Rating	Year	Rating
Karantaba Tuculur	URD	1982	1	1983	11	1984	11
*Boiram	MID	1982	2	1983	1	1984	1
*Piniai	MID	1982	3	1983	2	1984	2
Kumbul	URD	1982	4	1983	8	1984	8
*Makama Sireh	URD	1982	5	1983	5	1984	5
Sabi	URD	1982	6	1983	14	1984	14
Sambatako	MID	1982	7	1983	17	1984	17
Njau	MID	1982	8	1983	6	1984	6
Jar Kunda	URD	1982	9	1983	12	1984	12
Diabugu	URD	1982	10	1983	13	1984	13
Charmen	MID	1982	11	1983	7	1984	7
Konko Duma	MID	1982	12	1983	18	1984	18
Sare Ngai	MID	1982	13	1983	9	1984	9
*Sukuta	MID	1982	14	1983	3	1984	3
Maunda Kunda	MID	1982	15	1983	15	1984	15
Balanghar	MID	1982	16	1983	16	1984	16
Kundam	URD	1982	17	1983	4	1984	4
Dankunku	MID	1982	18	1983	10	1984	10

* Deferred Range Management Areas

Appendix 3

COLLECTION OF RANGE INVENTORY DATA BY YEAR

Sample Yr.	District	Division	**Hectares	RI-Hectares	No. Writeups
1982	Niamina Dankunku	MI	13,030	12,909	27
1982	Niamina West	MI	14,310	14,440	36
1982	Niamina East	MI	31,690	37,763	91
1982	Wuli (Lower)	UR	53,730	23,982	99
1982	Wuli (Upper)	UR	-	34,207	105
1983	Kantora	UR	33,075	30,065	66
1983	F-East (Tumana)	UR	40,275	27,690	50
1983-'84	F-East (Basse)	UR	-	21,519	72
1984	F-East (Jimara)	UR	40,275	29,586	45
1984	Sandu	UR	32,985	32,887	101
*1985	Sami	MI	46,865	49,373	134
*1985	Fulladu West	MI	79,055	78,837	188
*1985	Fulladu West	MI	-	-	-
*1985	MacCarthy Island	MI	1,165	1,042	13
*1985	Niani	MI	42,455	43,004	105
*1985	Nianija	MI	12,010	13,491	53
*1985	Upper Saloum	MI	27,760	26,469	87
*1985	Lower Saloum	MI	16,985	15,830	61
	<u>18</u>	<u>2</u>	<u>**485,665</u>	<u>****493,194</u>	<u>1,333</u>

(***506,300)

- * Two Collection Teams
- ** Land Resource Study 22
- *** Gambian German Forestry Project
- **** MFP Range Resource Inventory, LUC hectares, excluding LUC 13
(Presently lacking surface hectares for upper-most part of Upper
Wuli, around Makama Sireh, to Senegalese border)

Appendix 4

PROPOSED LIVESTOCK ACCESSWAYS

- Upper River Division
- Sandu District (1983)
- Darsilani Tenda
 - Changally Lankadi (completed 1983)
 - Kossemar Tenda
 - Diabugu Tenda (completed 1984)
 - Banatenda
 - Alimaka
 - Sami Wharf Town
- Kantora District
- Garowal Tenda (accessible)
 - Koina Tenda
 - Sami Tenda
 - Keneba Tenda (Rock concrete apron)
 - Fania Tenda
 - Baraji Kunda (MFP, 1986)
- Wuli District
- Koina Tenda
 - Kenniba
 - Madina Yero east
 - Fatoto (accessible)
 - Madina Yero west
 - Sutukoba south-east (MFP, 1986)
 - Perai Tenda
 - Fatta Tenda (Badja Kunda south)
 - Kusi south-east
 - Limbambula Bamo east
 - Limbambula Yamadu east
 - Dumboto (north Basse ferry)

Appendix 5

TABLE: CATTLE NUMBERS 1974, 1978, AND 1984 BY DIVISION AND DISTRICT

<u>Division</u>	<u>District</u>	<u>1974</u>	<u>'78-'79</u>	<u>'83-'84</u>	<u>'78-'84 Change</u>
Western	Foni Jarrol	-	2,477	2,393	(-) 84
"	Foni Bondali	-	2,517	1,849	(-) 668
"	Foni Kansala	-	3,263	3,500	(+) 237
"	Foni Bintang Karari	-	5,392	5,744	(+) 352
"	Foni Brefet	-	3,830	4,553	(+) 723
"	Kombo East	-	5,460	5,997	(+) 537
"	Kombo Central	-	5,204	4,593	(-) 611
"	Kombo South	-	7,973	6,526	(-) 1,447
"	Kombo North	-	5,674	3,708	(-) 1,966
"	Kombo St. Mary	-	1,569	2,408	(+) 839
"	TOTAL	57,035	43,359	41,271	(-) 2,088
Lower River	Kiang West	-	3,420	2,361	(-) 1,059
"	Kiang Central	-	3,427	3,733	(+) 306
"	Kiang East	-	1,767	2,291	(+) 524
"	Jarra West	-	4,600	4,114	(-) 486
"	Jarra Central	-	2,921	3,624	(+) 703
"	Jarra East	-	9,309	5,155	(-) 4,154
"	TOTAL	20,920	25,444	21,278	(-) 4,166
North Bank	Lower Niuni	-	12,672	9,816	(-) 2,856
"	Upper Niuni	-	5,291	4,663	(-) 628
"	Jokadu	-	6,811	6,268	(-) 543
"	Lower Badibu	-	2,929	1,874	(-) 1,055
"	Central Badibu	-	4,248	4,854	(+) 606
"	Upper Badibu	-	13,781	11,857	(-) 1,924
"	TOTAL	45,640	45,732	39,332	(-) 6,400
MacCarthy Is.	Niamina Dankunku	-	3,048	3,213	(+) 165
"	Niamina West	-	5,348	4,223	(-) 1,125
"	Niamina East	-	7,395	8,146	(+) 751
"	Fulladu West	-	40,298	30,706	(-) 9,592
"	MacCarthy Is.	-	642	310	(-) 332
"	Sani	-	13,882	9,400	(-) 4,482
"	Niani	-	11,490	9,118	(-) 2,372
"	Nianija	-	5,107	5,219	(+) 112
"	Upper Saloum	-	9,020	8,778	(-) 242
"	Lower Saloum	-	5,510	3,876	(-) 1,634
"	TOTAL	81,740	101,740	82,989	(-)18,751

Appendix 5 continued

Upper River	Fulladu East	-	39,520	32,953	(-) 6,567
"	" Kantora	-	12,753	10,789	(-) 1,964
"	" Wuli	-	21,979	17,734	(-) 4,245
"	" Sandu	-	13,045	8,985	(-) 4,060
"	" TOTAL		65,755	87,297	(-)16,836
	COUNTRY TOTAL		271,090	303,572	255,331 (-)48,241

1978/79 and 1983/84 cattle population figures come from the Bureau of Statistics, DAH&P.

1974 figures were estimates found in Land Resource Study No. 22.

Appendix 6

RANGE SEED MULTIPLICATION PLOTS
Seed & Hay Production
'84-'85 and '85-'86

<u>Yr.</u>	<u>Div.</u>	<u>Plot</u>	<u>Genus</u>	<u>Ha.</u>	<u>Urea Kg.</u>	<u>Comp Kg.</u>	<u>Sd. Kg.</u>	<u>Hay Kg./ha.</u>
'84/'85	MID	YBK	<u>An. gay. bisq.</u>	.96	none	none	148	1,600
'84/'85	MID	YBK	<u>Cen. cil.</u>	.79	none	none	23	1,600
'84/'85	MID	YBK	<u>Pan. max.</u>	.15	none	none	22	1,500
'84/'85	MID	YBK	<u>Stylo. ham.</u>	.25	none	none	5	none
'84/'85	MID	YBK	<u>Stylo. scab.</u>	.10	none	none	none	none
'84/'85	MID	YBK	<u>Leuc. leu.</u>	.12	none	none	10	none
'85/'86	MID	YBK	<u>And. gay. bisq.</u>	2.0	none	none	197	2,000
'85/'86	MID	YBK	<u>Cen. cil.</u>	2.5	25kg/ha	25kg/ha	45	2,000
'85/'86	MID	YBK	<u>Pan. max.</u>	.45	none	none	34	no cut
'85/'86	MID	YBK	<u>Stylo. ham.</u>	.50	none	none	5	none
'85/'86	MID	YBK	<u>Stylo. scab.</u>	.05	none	none	none	none
'85/'86	MID	YBK	<u>Leuc. leu.</u>	.12	none	none	20	none
'84/'85	URD	G.K.	<u>And. gay. bisq.</u>	.56	none	none	83	2,000
'84/'85	URD	G.K.	<u>Cen. cil.</u>	.32	none	none	11	350
'84/'85	URD	G.K.	<u>Pan. max.</u>	.17	none	none	32	750
'84/'85	URD	G.K.	<u>Stylo. scab.</u>	.05	none	none	2	none
'85/'86	URD	G.K.	<u>And. gay. bisq.</u>	.60	none	none	109	2,900
'85/'86	URD	G.K.	<u>Cen. cil.</u>	.50	none	23kg/ha	31	1,600
'85/'86	URD	G.K.	<u>Pan. max.</u>	none	none	none	none	none
'85/'86	URD	G.K.	<u>Stylo. scab.</u>	none	none	none	none	none

Key: Yr. (year)
Div. (Division)
Ha. (Hectares)
Kg. (kilograms)
Comp. Kg. (Compound fertilizer 15-15-15, kilograms)
Sd.Kg. (seed produced in kilograms)
Hay Kg./ha. (hay produced in kilograms per hectare)

Appendix 7

RANGE MANAGEMENT (DAH&P), AND FORAGE COMPONENT PERSONNEL (DA)

<u>Name</u>	<u>Position</u>	<u>Posting</u>	<u>Div.</u>	<u>LOA</u>	<u>Site</u>
<u>DAH&P</u>					
Alieu Joof	Range Officer	Abuko	MI/UR	18	ALL
Omar Njai	Range Officer	Abuko	MI/UR	18	ALL
Karano Bojang	Junior Range	UNSO	MI	Dankunku	-
Seedy Fatty	PA/LI	Charren	MI	Kaur,Njau,Charm.	Bal.,Njau,Charm.
Momodou Fofana	PA/LI	YBK	MI	Kuntaur	Sukuta/YBK
Lamin Jallow	PA/LA	Well/Dank.	MI	D/kunku,Pin.,Kud.	Dank.,Pin.,Maoun/K.
Omar Janneh	PA/LI	Basse	UR	Tumana,Basse	Kundan,G.K.,Sabi
Momodou Jobe	PA/LI	Fatoto	UR	Up. Wuli,Kant.	Makana, Kumbul
Demba Manneh	PA/LI	Bansang	MI	Sami/Sanbatako	Kar.Tuc.,K.D.,S/T.
Malang Sanneh	PA/LI	G/Town	MI	S/Ngai,F/Bant.	S/Ngai,Boiran
Vacant	PA/LA	Diabugu	UR	Sandu/Jar Kund.	Sandu/Lower Wuli
Lang Jarneh	Stockman	YBK	MI	none	Seed Multiplication
Soto Bojang	Stockman	YBK	MI	none	Seed Multiplication
Sossi Buraso	Stockman	YBK	MI	none	Seed Multiplication
Sulayman Faal	Stockman	YBK	MI	none	Seed Multiplication
Malang Ceesay	Stockman	YBK	MI	none	Seed Multiplication
Samuel Gomez	Stockman	YBK	MI	none	Seed Multiplication
Lamin Darboe	Stockman	YBK	MI	none	Seed Multiplication
Gallo Bah	Stockman	YBK	MI	none	Seed Multiplication
Vacant	Stockman	YBK	MI	none	Seed Multiplication
Vacant	Stockman	YBK	MI	none	Seed Multiplication
Vacant	Stockman	YBK	MI	none	Seed Multiplication
Vacant	Stockman	YBK	MI	none	Seed Multiplication
Vacant	Stockman	YBK	MI	none	Seed Multiplication
Vacant	Stockman	YBK	MI	none	Seed Multiplication
Abdoulie N'Goum	Stockman	Giroba K.	UR	none	Seed Multiplication
Vacant	Stockman	Giroba K.	UR	none	Seed Multiplication
Bobo Suso	Driver	Abuko	MI/UR	all	all
<u>D/AGRICULTURE</u>					
Bambo Ceesay	Ag. Officer	Abuko	ALL	ALL	Crp. Res.
Lamin Jobe	Ag. Assistant	Brik. Ba.	MI	Fulladu West	Crp. Res.
Sheik Omar Faye	Ag. Assistant	Sapu	MI	Fulladu West	Crp. Res.
Momodou Sabally	Ag. Demonstr.	Boiran	MI	Fulladu West	Boiran
Sait Swere	Ag. Demonstr.	Boiran	MI	Fulladu West	Boiran

Appendix 8

SUMMARY OF WORKSHOPS AND FIELD TRAINING SESSIONS

<u>Training</u>	<u>Date</u>	<u>Activities</u>
Workshop	15-16 Jan. '82	-Fencing techniques -9 participants
Field	4 Feb. '82	-Fencing plot at Dankunku LOA -25 participants
Field	Feb./Mar. '82	-Fencing training, each PA on first LOA Plot -21 sessions conducted
Workshop	14-16 Apr. '82	-Coordinated technical workshop co-sponsored by DAH&P projects; Animal Health Care, and MFP -59 participants
Field	11-12 May '82	-Seedbed preparation and seeding procedure -Plot design -9 participants
Workshop	20-24 Sep. '82	-Critiqued '81-'82 workplan -Discussed '82-'83 workplan -DAH&P projects update -GGFP Land-Use Classification -Field trip to Kabakor -Map reading and use of compass -Basic principles of range management -Biomass sampling technique -Herbarium plant material collection techniques -14 participants
LOA Demo.	21 Feb. '83	-35 key LOA members participate in a cattle feeding demonstration at Yundum (Forage component, MFP)
Workshop	19-23 Dec. '83	-Tour of YBK Seed Multiplication Plot -Tour of Boiran LOA Deferred Range Area and Crop Residue Feeding -Tour of Sukuta LOA Range Management Demonstration Plot -Basic principles of range management -Socio-Economic component, MFP -Forage Agronomy component, MFP -Maize Agronomy component, MFP -Introduction of crop residues in feeding livestock -Review of LOA participation -23 participants

LOA Demo.	May '84	<ul style="list-style-type: none"> -Members visit Giroba Kunda and YBK Seed Multiplication and hay production Plots -Members visit cattle feeding at Boiram
Field	15-16 May '84	<ul style="list-style-type: none"> -Held at YBK Seed Multiplication Plot and Boiram crop residue feeding site -Seeding and root transplanting, rainy season activities -Seed multiplication programs at YBK and Giroba Kunda -Weighed and measured heifers at Boiram, and weighed day's crop residue
Workshop	10-15 Sep. '84	<ul style="list-style-type: none"> -7 participants -Participants from DAN&P and DA in attendance, first time -The Use of Crop Residues in the Deferred Feeding of Cattle was theme of workshop -Update on DAN&P and MFP programs -Dry season crop residue feeding -EAU, Extension Methodology -Basic principles of range management -Basic principles of economics
Field	Oct.-Jan. '82-'86	<ul style="list-style-type: none"> -23 extension workers participated -Range Resource Inventory data collection -Plant collection and identification -Map reading and interpretation -7 Pasture Assistants

Appendix 9

TABLE: SEEDING OF RANGE MANAGEMENT DEMONSTRATION PLOTS

<u>LOA Plot</u>	<u>Andro.</u> <u>gayanus</u>	<u>Cenchrus</u> <u>ciliaris</u>	<u>Stylo.</u> <u>hanata</u>	<u>Stylo.</u> <u>quianen.</u>	<u>Stylo.</u> <u>scabra</u>
*Kumbul (Dantora-URD)	-	X	X	X	X
**Makana Sireh (U-Wuli-URD)	X	X	X	-	X
Jar Kunda (L-Wuli-URD)	X	X	X	-	X
*Kundan (Full. East-URD)	X	X	X	X	X
*Sabi (Full. East-URD)	-	X	X	X	X
Diabugu (Sandu-URD)	-	X	-	-	X
*Karantaba Tuc. (Sami-MID)	X	X	X	-	X
*Sarabatako (Full. West-MID)	X	X	X	-	X
*Sare Ngai (Full. West-MID)	X	X	X	X	X
**Boiram (Full. West-MID)	-	-	-	-	-
Maounda Kunda (Niam. E.-MID)	-	X	X	X	-
Balanghar (L. Saloum-MID)	X	X	-	-	X
*Charmen (Nianija-MID)	X	X	X	-	X
Njau (Upper Saloum-MID)	X	X	X	-	X
Dankunku (Niam. Dank. -MID)	-	X	X	X	X
Konko Duma (Sami-MID)	X	X	X	-	X
**Sukuta (Niani-MID)	X	X	-	X	X
**Piniai (Niamina W.-MID)	X	X	X	-	-

* Excellent results

** Expanded to Deferred Range Sites of 10 or more hectares

Appendix IV

TABLE: ROOT TRANSPLANTING OF ANDROPOGON GYANUS VAR. BISQUAMULATUS (GAMBA GRASS) AND PANICUM MAXIMUM (GUINEA GRASS)

<u>Date</u>	<u>Site</u>	<u>Division</u>	<u>Source</u>	<u>Hectares</u>
1983	Kabokorr (LMB)	Western	Yundum	4.2
1983	YBK	MI	Yundum	.6
1983	Boiram	MI	Yundum	1.5
1983	Piniai	MI	Yundum	.2
1983	Sukuta	MI	Yundum	.3
1983	Njau	MI	Yundum	.1
1983	Karantaba Tuculur	MI	Yundum	.1
1983	Kundaa	UR	Yundum	.1
1983	Giroba Kunda	UR	Yundum	.3
1984	Jar Kunda	UR	Giroba Kunda	.3
1984	Kumbul	UR	Giroba Kunda	.3
1984	Kabokorr (LMB)	W	Yundum	1.0
1984	ITC Sene-Gambia	W	Yundum	1.0
1984	Sukuta	MI	YBK	.5
1984	Piniai	MI	YBK	.5
1984	Boiram	MI	YBK	.3
1985	Boiram	MI	YBK	.5
1985	Piniai	MI	YBK	.7
1985	Sukuta	MI	YBK	.2
1985	ITC Sololo	MI	Giroba Kunda/YBK	1.0
3 years	13 different sites	3	3	13.7

Appendix 11

DEFERRED RANGE MANAGEMENT SITES

<u>Community</u>	<u>LGA</u>	<u>Div.</u>	<u>Ha.</u>	<u>Treatment</u>
Boiran/Njoben	F.B.	MI	10.00	-fenced March 1983, one parcel -Aug. 1983, '84, & '85 root transplanted <u>Andro. gay.</u> <u>bisq.</u> , approx. 1.5 hectare -20 heifers, 90 days, Feb.- April 1984 -12 heifers, 77 days, April- June 1985 -18 heifers, 1 bull, approx. 75 days, April-June 1986
Piniai	N.W.	MI	15.25	-fenced March 1984, three parcels -seeding (Appendix 9) -Aug. 1984 and 1985 root transplanted <u>Andro. gay.</u> <u>bisq.</u> , approx. 1.9 hectare -23 heifers, 0 days, 1985 -bush fire 10 March, 1985 destroyed all biomass -burned wooden fence posts replaced May 1985 -19 heifers, 1 bull, approx. 60 days, May-June 1986
Sukuta	Niani	MI	13.27	-fenced September 1984 -seeding (Appendix 9) -Aug. 1984 and 1985 root transplanted <u>Andro. gay</u> <u>bisq.</u> , approx. 1 hectare -26 heifers, 58 days, May-June 1985
Makana Sireh	L. Wuli	UR	10.00	-fenced May 1984, 2 parcels -seeding (Appendix 9) -28 heifers, 78 days, April-July 1985 -28 heifers, 1 bull, 61 days, May-June 1986

Appendix 12

LIVESTOCKMEN INSTRUMENTAL IN IMPLEMENTING RANGE RELATED ACTIVITIES

Alh. Manga Baldeh	Pres. LOA	Basse
Malang Manneh	-	Kundam/Badeni(Tumana)
Lamin Jawala	-	Kundam/Badeni(Tumana)
Alh. Nene Sillah	-	Sabi(Basse)
Alh. Tankora Sillah	-	Sabi(Basse)
Baba Sillah	-	Sabi(Basse)
Foday Kebba Jatta	Seyfo	Wuli
Foday DinDing Jatta	-	Sutukoba(Wuli)
Njau Jabang	-	Sutukoba(Wuli)
Suwaray Jatta	-	Sutukoba(Wuli)
Alh. Tora Jatta	-	Sutukoba(Wuli)
Suwarayba Jari	-	Sutukoba(Wuli)
Seko Darbo	-	Brifu(Wuli)
Alk. Saikou Kammateh	-	Makana Sireh(Wuli)
Suwadu Bah	-	Koli Kunda(Wuli)
Yarray Wally	-	Willingara(Wuli)
Dinding Kuntu Saigy	-	Tabading(Wuli)
Babading Saigy	-	Tabading(Wuli)
Alh. Jarra Saho	-	Kunjur Tabokoto(Wuli)
Alh. Kebelly Baragi	-	Baragi Kunda(Kantora)
Alh. Monodou Tonkara	-	Suduwol(Kantora)
Fodayba Sanyang	-	Kantel Kunda(Kantora)
Da Foday Kumanneh	-	Koina(Kantora)
Alh. Jahara Jabi	-	Koina(Kantora)
Kumo Touray	-	Geda(Kantora)
Alh. Foday Baldeh	-	Kumbul(Kantora)
Alh. Bakumba Bachelly	-	Garawal(Kantora)
Sada Sanyang	-	Kusunuh(Kantora)
Alh. Falai Baldeh	Pres. LOA	Sare Ngai
Alh. Ousman Boye	V-Pres. LOA	Boiran
Alh. Chendu Boy	-	Boiran
Alh. Abdou Howa	-	Boiran
Alh. Abdou Fatim Boy	-	Boiran
Alh. Ousman Boy	-	Boiran
Alh. Omar Boy	-	Boiran
Alh. Mod Satu Jobe	-	Njoben
Kebba Ceesay	-	Njoben
Mod Ceesay	-	Njoben
Hamadi Sy	-	Fass
Alh. E. Boye	-	Fass
Hadan Sy	-	Fass
Nignsiy Ndubeh Boy	-	Fass
Alieu Boy	-	Fass

Alh. Ebrima Boye	-	Allulai
A:n. Ebou Yama Boye	-	Allulai
Mod Yasin Boye	-	Allulai
Maley Boy	-	Allulai
Alh. Malek Basin Boye	-	Allulai
Alikali	-	Fut Sare Buti
Alet Mballo	-	Fut Sare Buti
Samba Mballo	-	Fut Sare Buti
Alh. Badjo Bah	Seyfo	Piniai(Nia. West)
Sambaye1 Bah	Pres. LOA	Piniai(Nia. West)
Tamba Chate	-	Piniai(Nia. West)
Denba Bah	-	Dalaba(Nia. West)
Amadou Jobe	-	Dalaba(Nia. West)
Janbo Bah	-	Dalaba(Nia. West)
Denba Bah	-	Dalaba(Nia. West)
Lonkar Bah	-	Bah Kunda(Nia. West)
Denba Jallow	-	Bah Kunda(Nia. West)
S. Musa Bah	-	Bah Kunda(Nia. West)
Hamat Bah	-	Bah Kunda(Nia. West)
Yorro Jallow	-	Wellingara(Nia. Dank.)
Babukar Touray	Seyfo	Kaur (Lower Saloum)
Musa Cham	Seyfo	Charmen(Nianija)
Samba York	Pres. LOA	Sinchu Demba (Nianija)
Dikorr Jawo	A'kalo	Fulla Kunda(Nicni)
Alh. Burena Ceessay	Comm. LOA	Sukuta (Niani)
(The Late) Pa Maodu Kano	Pres. LOA	Karantaba Tuc.(Sami)
Dawada Jobe	V.P. LOA	Karantaba Wolof(Sami)
Alh. Samba Leigh	Pres. LOA	Lebba(Upper Saloum)
-	Seyfo	Njau(Upper Saloum)

Appendix 13

SUGGESTED LOA BY-LAWS

Dated: 1977/1978

1. Meetings

a. There should be a Committee meeting once a month. A General meeting of card holding members should take place every three to six months at the discretion of the Committee.

An emergency meeting can be arranged if it is felt desirable. In addition, there should be an Annual General Meeting.

b. The Committee member should keep a Register whereby a check can be made on members that have attended or absented themselves from meetings.

c. Where a Committee member through ill health or otherwise is unable to attend a Committee meeting, he should delegate a member to attend.

2. Committee Decisions

Committee must have at least a two-thirds majority before any decision is agreed upon.

3. Subscriptions

a. This has to be decided by the Committee. However, an annual fee of D5.00 (five dalasis) is recommended for every card holding member.

b. Members should be punctual in the payments of subscriptions. It is suggested that subscriptions be paid between the months of January and March. Failure to pay within this period means the member's name will be crossed off the register. He/She discontinues to be a member for that year running.

4. Financial Expenditures

The Committee should decide how the money should be utilized. The cashier must have the approval of the Committee before releasing out any money.

5. Care of Money

a. There should be some form of a deposit system. This is either through a bank/Post Office or in the care of the district commissioner.

b. The auditor should make a monthly check on the deposit book and the cash in hand.

c. The cashier should account for all the expenditures at monthly meetings.

6. Duration of Office - Re-election

a. We recommend a term of office for a minimum period of two years. But where a Committee has proved inefficient, an Annual General Meeting can dissolve the Committee and a new committee be voted for.

b. Only card holding members (i.e. those who were members at least a month before election day) will have the right to vote for committee members.

7. Discipline

The committee has the right to take any disciplinary action against a committee member who has failed to attend three consecutive committee meetings without adequate reasons and without delegating another member.

Appendix 14

TABLE: LAND USE CLASSIFICATION

1. Mangrove A: Mangroves more than 7 m tall, mainly Rhizophora.
2. Mangrove B: Mangroves less than 7 m tall, mainly Avicennia.
3. Gallery Forest: Forests bordering water courses, tree heights above 7 m.
4. Closed Woodland: Forests on freely drained soils w/tree cover.
5. Open Woodland: Forests on freely drained soils w/10-50% cover.
6. Tree and Shrub Savanna: Tree and shrub vegetation on freely drained soils w/less than 10% tree cover or tree heights less than 11 m.
7. Tree and Shrub Savanna w/Previous Cultivation: Fallowed for at least 4 years at time of sampling.
8. Wooded Upland Crops: Cultivated land on freely drained soil with at least 10% tree cover.
9. Upland Crops w/Isolated or No Trees: Cultivated land on freely drained soils w/relatively few or no trees.
10. Swamps, Cultivated: Mainly rice cultivation; near water courses.
11. Swamps, Uncultivated: Areas near water courses with vegetation cover, but not cultivated.
12. Barren Flats: Saline soils near water courses w/no vegetation cover.
13. Water Surface
14. Town Village

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Appendix 15

RANGE MANAGEMENT UNIT, OFFICE AND EQUIPMENT INVENTORY

<u>Quantity</u>	<u>Item</u>
2	4 drawer filing cabinet, color black
2	3 drawer filing cabinet, color grey
1	2 drawer filing cabinet, color black
1	4 drawer filing cabinet, color brown
1	Steel storage cabinet, two door, locking
2	Plastic paper trays
1	Herbarium table, large size
1	Herbarium table, small size
2	Chairs, cushioned, color black
1	Chair, swing type, color black
1	Microscope
1	Map cabinet, wooden, 5 drawer
1	Map cabinet, steel, 5 drawer
1	Typewriter, Facit office, manual
1	Stapler
1	Two hole paper punch
1	Scale, dial type, to 200 kilograms
2	Scales, dial type, to 100 kilograms
2	Scales, spring type, Pesola, 1000 grams
2	Scales, spring type, Pesola, 500 grams
8	Scales, spring type, Pesola, 100 grams
1	Scale, spring type, 10 kilogram
1	Measuring tape, 35 meters
1	Measuring tape, 50 meters
2	Biomass sampling hoops, 2 meter square
6	Shears, biomass sampling
2	Compasses, pocket size
1	Planimeter
1	Leroy lettering set
1	Leroy pen set
2	Aerial photo cases, leather, belt type
2	Field cases, small leather, belt type
3	Clipboards, aluminum, covered
3	Rapidograph pen cleaning bottles
5	Scales, ruler type, multiple scales
4	Rulers, see through metric
1	Survey pins, set
1	Labels, expendable packet
2	Counters, hand
3	Stereoscopes, pocket type
7	Templates, mapping
3	Plant presses
1	Farm level, survey

3	Sighting poles, survey
1	Level rod, survey
1	Tripod, farm level, survey
2 rolls	Map backing cloth, iron on type
5	Jerry cans, steel, 20 liter
1	Tent, 4 man, cotton
1	Tent, 2 man, cotton
4	Camp Beds
2	Sleeping bags
1	Fireplace grid, camping
1	Dish set, camping
2	Coolers
6	Broadcast seeders
2	Creosote, 55 gallon barrels
3	2,4-D, 40 gallon barrels
12	Tree/Shrub injectors, for 2,4-D
4	Wheel barrows
20	Pickaxes
20	Shovels
8	Fence pliers
8	Fence post drivers (2 in store)
2	Handyman jacks
41	Sickles
5	Handles, extra
2665	Fence posts, steel
15	Woven wire, fencing, maintenance
9	Fencing clips, 10 X 100 = 9000
1	Fencing clips, 8 X 100 = 800
1.5 boxes	U-Nails, fencing maintenance

(Inventory completed 1 May, 1986)

Appendix 16

TABLE: ALLOCATION OF HEIFERS FOR DRY SEASON FEEDING PROGRAM AT BOIRAM, 1983

<u>Village</u>	<u>##Labor Furnished (17/05 to 10/09)</u>	<u># Allocation</u>
Boiram	126 man days	11 heifers
** Fass	16 man days	3 heifers
***Sare Buti	13 man days	2 heifers
Njoben	10 man days	2 heifers
***Allulai	6 man days	1 heifer
* Tabanding	6 man days	1 heifer
Baya Fulla	2 man days	0 heifer
	<hr/> 179 man days	<hr/> 20 heifers

- * was not interested in contributing animals, but was interested in labor contribution
- ** complained early about no maize program, never contributed their animals
- *** do not wish to contribute animals, labor problems
- # allocation includes identical number of heifers for control group, heifer number is 20
- ## labor furnished to complete the fencing of deferred range site, 10 hectares

Appendix 17

PARTICIPANTS BOIRAM FEEDING PROGRAM, HEIFER STARTING WEIGHTS AND GIRTH MEASUREMENTS,
14/12/1983

E. tag	Owner	Village	Orange/Fed		Yellow/Control	
			Kgms.	cm.	Kgms.	cm.
1	Alh. Ousman Boye	B	100	109	129	119
2	Alh. Ousman Boye	B	130	122	130	119
3	Sambala Damballe	N	75	102	95	106
4	Alh. Abdou Fatim	B	122	122	135	120
5	Mot Yai Boye	B	80	104	70	99
6	Alh. Ouar Boye	B	75	100	70	99
7	Alh. A. Hawa Boye	B	135	122	115	115
8	Alh. A. Hawa Boye	B	95	108	90	107
9	Alh. Chendu Boye	B	60	110	60	103
10	Alh. B. Jimbi Boye	B	125	120	115	121
11	Alh. Babou Boye	B	85	104	115	117
12	Kebba Sise	N	85	100	125	120
13	Alieu Jobe	N	100	105	95	106
14	Alh. Mot Jobe	N	135	120	135	124
15	Alh. Mot Jobe	N	105	116	120	118
16	Alh. Baloon Boye	B	70	100	70	100
17	Alh. Abdou Hawa	B	70	94	115	115
18	Alh. Ousman Boye	B	140	126	150	122
19	Alh. Waggeh Gassama	B	140	125	150	122
20	Alh. Fatim Boye	B	150	123	130	125

Key: E. tag (ear tag number)
 Orange/Fed (Orange ear tagged heifers are fed)
 Yellow/Control (Yellow ear tagged heifers are in control group)
 B (Boiram village)
 N (Njoben village)
 Kgms. (kilograms)
 cm. (centimeters)

Appendix 18

TABLE: TREATMENT FOR THE 20 HEIFERS IN THE FED GROUP, BOIRAM FEEDING PROGRAM, 1984

Dates	Days	Treatment	Qty./Koms.	% Utilized
28/12 - 25/01	28	**Maize stover	220 daily	40
25/01 - 22/02	28	**Sorghum stover	220 daily	40
22/02 - 18/04	56	Deferred Range Site	90 daily	100
18/04 - 16/05	28	# Sorghum stover, plus rice straw	220 daily *40 daily	40 60
16/05 - 13/06	28	##Panicum maximum hay, plus rice straw, plus groundnut hay	*90 daily *40 daily *40 daily	95 95 95
13/06 - 27/06	14	Groundnut hay, plus rice straw	*90 daily *40 daily	95 60
28/12 -27/06	182	-	-	-

* estimates

** mainly leaf material eaten by animals, little stalk consumed

sorghum stover gradually used up and the rice straw became the principle feed at an estimated 90 kilograms/day

combination of the two feeds were fed first, then rice straw, then groundnut hay

Appendix 19

STATUS: DEFERRED RANGE SITES, PRODUCED AND RESIDUAL BIOMASS AND STOCKING RATES FOR 1984 AND 1985

Site	Ha.	V. Type MLUC	#Biomass kgm/ha.	S.R. '84 * UBT	& '85 * UBT	Time days	Req. kgms.	+Res. k/ha.
M/Sireh	10	7	2,810	-	12	78	7,020	1,650
Boiran	10	7	1,500	8	-	56	3,360	948
Boiran	10	7	1,600	-	6	77	3,465	1,138
Sukuta	13.27	3 & 7	4,733	-	12	58	5,150	1,965
Piniai	15.25	7/9	4,450	-	0	0	0	4,450**

* UBT (Unitaire Bovine Tropicale) = 250 kilogram bovin, live weight, range ration is 3% body weight, or daily ration of seven and one half kilograms/day/UBT

** Site totally burned by bush fire 10 March, 1985

RRI combination production biomass from Grazing Preference codes 0, 1, and 2 (see Appendix 26, p. xxxiv for more detail)

+ Residual biomass mostly consisted of dry tree leaves that had fallen from above 1.5 meter height

Key

MLUC	:	MFP Land-Use Classification
GLUC	:	Gambia Land-Use Classification
S.R.	:	Stocking Rate
Biomass kilograms/hectare:	:	Code 1, desirable plants
Sukuta	:	LUC 7, 2.37 hectares # 3,125 kgms./ha.
	:	LUC 3, 11.0 hectares # 5,028 kgms./ha.
RRI	:	MFP Range Resource Inventory 1982 - 1986
Res. k./ha.	:	Residual kilograms per hectare (measured)

Appendix 20

SUMMARY: DRY SEASON SUPPLEMENTAL VILLAGE FEEDING PROGRAM - 1985

Village	Dis.	Fence m x m	Pltforms no.	Storage/kgms. D.M.				feeding	
				M.S.	Mil.S.	R.S.	Gn.H.	Heif./#	Time
K/Tab.	U/Wuli	25x25	1	1,700	-	-	*2,800	12	4w
Well/M.	U/Wuli	25x25	1	3,380	-	-	-	8	4w
Koli/K.	U/Wuli	24x25	1	3,000	887	-	-	9	4w
Sutuko.	U/Wuli	15x25	1	3,985	-	1,544	-	25	4w
Sutuko.	U/Wuli	20x20	1	1,566	-	374	-	25	4w
Sare/K.	U/Wuli	-	-	-	-	-	-	-	-
Suduwoi	Kantora	20x20	2	2,200	-	-	-	24	6w
Kusunuh	Kantora	20x20	2	3,853	-	-	-	24	8w
Garowol	Kantora	40x40	7	**1,436	-	-	-	-	-
Bar/K.	Kantora	15x15	1	1,194	-	140	-	12	4w
Kuzbul	Kantora	25x25	-	-	-	-	-	-	-
Sare N.	full/4	25x25	-	-	-	-	-	-	-
9		254x265	-	22,314	887	2,058	*2,800	139	-

* Groundnut hay fed independently

** Animals broke down fence and ate all stover

Time is in weeks (w)

M.S.(maize stover)

Mil.S.(Millet stover)

R.S.(Rice straw)

Gn.H.(Groundnut hay)

Appendix 21

SUMMARY: DRY SEASON SUPPLEMENTAL VILLAGE FEEDING PROGRAM - 1986

Village	Dis.	Fence Platforms m x m	Platforms no.	Storage/Kgms. D.M.				Feeding	
				M.S.	Mil.S.	R.S.	Gn.H.	Heif/	Time
K/Tabor.	U/Wuli	25x25	3	1,950	-	-	#2,885	NI	NI
Well/Man.	U/Wuli	25x25	2	565	-	-	-	NI	NI
Koli/Kun.	U/Wuli	25x25	3	565	65	-	-	NI	NI
Sutukoba	U/Wuli	15x25	0	6,545	-	-	-	NI	NI
Sutukoba	U/Wuli	20x20	1	* 300	-	-	-	NI	NI
Brifu	U/Wuli	40x40	5	8,052	-	-	-	NI	NI
Sare Kobo	U/Wuli	-	-	-	-	-	-	-	-
Tanbading	U/Wuli	30x25	-	4,000	-	-	-	NI	NI
Koina	Kantora	30x35	4	12,000	-	-	-	NI	NI
Koina	Kantora	20x25	2	-	-	1,200	-	NI	NI
Suduwol	Kantora	35x30	4	3,200	-	-	-	NI	NI
Kusunuh	Kantora	35x30	2	4,000	-	-	-	NI	NI
Garowol	Kantora	40x40	7	1,500	yes	-	-	NI	NI
Baraji/K.	Kantora	15x15	3	5,100	-	450	-	NI	NI
Geda	Kantora	25x25	2	4,000	-	-	-	NI	NI
Kantel/K.	Kantora	30x35	2	4,500	-	-	-	NI	NI
Kumbul	Kantora	-	-	-	-	-	-	-	-
Kundan	Full./E.	25x25	2	2,567	-	-	-	NI	NI
Sabi	Full./E.	-	-	-	-	-	-	NI	NI
K/Duma	Sani	22x22	-	500	-	-	-	NI	NI
Fass	Full./W.	22x22	-	2,000	-	-	-	NI	NI
Njoben	Full./W.	22x22	2	1,500	-	-	-	NI	NI
Allulai	Full./W.	22x22	-	1,200	-	-	-	NI	NI
F.Sare/B.	Full./W.	22x22	-	800	-	-	-	NI	NI
Sare N.	Full./W.	22x22	-	750	-	-	-	NI	NI
Fuila/K.	Niani	22x22	-	1,400	-	-	-	NI	NI
Dalaha	Niam./W.	24x25	1	1,850	-	-	-	NI	NI
Bah/Kun.	Niam./W.	24x24	2	3,923	-	-	-	NI	NI
Bakadagy	Nianiija	22x22	4	**6,000	-	-	-	NI	NI
Welling.	Nianiija	22x22	2	700	-	-	-	NI	NI
Buduk	Nianiija	22x22	4	850	-	-	-	NI	NI
28		713x714	-	80,337	65	1,650	#2,885	NI	NI

Groundnut hay fed independently

* Remainder of maize stover, cattle were eating

** Bakadagy, Nianiija, was last observed storing maize stover, no final measurement taken, tons of stover stacked in fields

NI (No information)

M.S. (Maize stover)

Mil.S. (Millet stover)

R.S. (Rice Straw)

Gn.H. (Groundnut Hay)

Appendix 22

PARTITION OF ANNUAL WORK PLAN - RANGE COMPONENT

- October through January - Range Resource Inventory
 - Field Mapping
 - LOA Meetings
 - Constructing Fire Lanes
 - Collecting and Storing Crop Residues
 - Collecting Range Seeds
 - Plant Collection
 - Plant Identification
- February through June
 - Cutting and Storage Grass Hay
 - Implementing Feeding Programs
 - Implementing Deferred Range Programs
 - Seed bed preparation
 - Reseeding
 - LOA Meetings
 - Plant Identification
 - June, 2,4-D Root Injection-Shrub Control
- July through September
 - Reseeding
 - Root Transplanting
 - Weeding of Seeded Areas
 - Seed Collection
 - Plant Collection
 - Plant Identification
 - Field Storage Maize Stover

Appendix 23

TABLE: AVERAGE HERD SIZE FOR DISTRICTS IN MID AND URD

<u>District</u>	<u>Div.</u>	<u>Yr.</u>	<u>Herds</u>	<u>Numbers</u>	<u>Average</u>
Niamina Dank.	MI	'82	NI	-	-
Niamina West	MI	'82	NI	-	-
Niamina East	MI	'82	NI	-	-
Fulladu West	MI	'85	38	2,347	62
Sani	MI	'85	22	989	45
Niani	MI	'85	23	1,340	58
Nianiya	MI	'85	8	350	44
Upper Saloum	MI	'85	39	1,660	42
Lower Saloum	MI	'85	14	635	45
-	MI	-	153	7,891	52
Upper Wuli	UR	'82	26	1,340	52
Lower Wuli	UR	'82	31	1,510	49
Sandu	UR	'84	53	2,330	44
Fulladu East	UR	'83-'84	14	730	52
Kantcra	UR	'83	16	835	52
-	UR	-	140	6,745	48

**FORAGE BIOMASS PRODUCTION
RANGE RESOURCE INVENTORY
P. ta Sheet Coding**

<u>Item</u>	<u>Subject / Description</u>
1	WRITEUP NUMBER: District (see Item 5), Sample No. (1-999)
2	DATE OF SAMPLE: Day, Month, Year
3	PHOTO REFERENCE NO: 0001-2132; Oct. 1980; 1:25,000; MINAG/USAID; B/W and IR images.
4	TECHNICIAN'S INITIALS
5	SITE IDENTIFICATION: Division, District
	<u>Division</u>
	1. Upper River (UR)
	2. MacCarthy Island (MI)
	3. Lower River (LR)
	4. North Bank (NB)
	5. Western (W)
	<u>District</u>
	URD (1)
	11. Fulladu East (FUE)
	12. Kantora (KAN)
	13. Wuli (WUL)
	14. Sandu (SAN)
	MID (2)
	20. MacCarthy Island (MCI)
	21. Niamina Dankunku (NID)
	22. Niamina West (NIW)
	23. Niamina East (NIE)
	24. Fulladu West (FUW)
	25. Sami (SAM)
	26. Niani (NIA)
	27. Nianija (NIJ)
	28. Upper Saloum (USA)
	29. Lower Saloum
	LRD (3)
	31. Kiang West (KIW)
	32. Kiang Central (KIC)
	33. Kiang East (KIE)
	34. Jarra West (JAW)
	35. Jarra Central (JAC)
	36. Jarra East (JAE)
	NBD (4)
	41. Upper Baddibu (UBA)
	42. Central Baddibu (CBA)
	43. Lower Baddibu (LBA)
	44. Jokadu (JOK)
	45. Upper Niuni (UNI)
	46. Lower Niuni (LNI)
	WD (5)
	50. Kombo St. Mary (KSM)
	51. Kombo North (KON)
	52. Kombo South (KOS)
	53. Kombo Central (KOC)
	54. Kombo East (KOE)
	55. Foni Brefet (FBR)
	56. Foni Bintang Karenai (FBK)
	57. Foni Kansala (FKA)
	58. Foni Bondali (FBO)
	59. Foni Jarrol (FJA)

Item
6

Subject / Description

LAND USE CLASSIFICATION: 1 - 14

1. Mangrove A: Mangroves more than 7 m tall, mainly Rhizophora.
2. Mangrove B: Mangroves less than 7 m tall, mainly Avicennia.
3. Gallery Forest: Forests bordering water courses, tree heights above 7 m.
4. Closed Woodland: Forests on freely drained soils w/tree cover (canopy density) of 50% or more.
5. Open Woodland: Forests on freely drained soils w/10-50% tree cover.
6. Tree and Shrub Savanna: Tree and shrub vegetation on freely drained soils w/less than 10% tree cover or tree heights less than 11 m.
7. Tree and Shrub Savanna w/Previous Cultivation: Fallowed for at least 4 years at time of sampling.
8. Wooded Upland Crops: Cultivated land on freely drained soil with at least 10% tree cover.
9. Upland Crops w/Isolated or No Trees: Cultivated land on freely drained soils w/relatively few or no trees.
10. Swamps, Cultivated: Mainly rice cultivation; near water courses.
11. Swamps, Uncultivated: Areas near water courses with vegetation cover, but not cultivated.
12. Barren Flats: Saline soils near water courses w/no vegetation cover.
13. Water Surface
14. Town Village

- 7 TOTAL DISTRICT LAND AREA: In 100 hectare units.
8 TOTAL DISTRICT LAND AREA PER LAND USE CLASSIFICATION UNIT: in 100 ha. units.
9 SAMPLE PLOT SIZE: Standard; 1 sq. meter (1m²).
10 SAMPLE HEIGHT: Up to 1.5m above soil surface.
11 TREATMENT: T1, T2, T3

T1	T2	T3
0. Ungrazed	0. Bare	0. Fallow
1. Lightly Grazed	1. Perennial Grass	1. Groundnut
2. Moderately Grazed	2. Annual Grass	2. Sorghum
3. Heavily Grazed	3. Sedge/Rush	3. Millet
4. Total Burn	4. Annual Forb	4. Maize
5. Moderate Burn	5. -----	5. Cowpeas
6. Light Burn	6. Shrub	6. Rice
7. Cleared/Cult.	7. Tree	7. Lateritic Gravel
	8. Cultivated	8. Swamp Fringe
		9. Finde
		10. Never Cultivated
		11. Cotton
		12. Intercropped

Item
12

Subject / Description

SOIL EROSION RATING: 0 - 4

0. Severity Nil:

Plant and litter cover adequate for soil protection, rock and pavement where present, normal and in place. Gullies, if present, completely stabilized and healed.

1. Minor Severity:

Isolated bare soil openings characterize this stage. Erosion confined more or less to the individual bare soil openings.

2. Moderate Severity:

Bare soil openings larger and frequently joined together. Indicators may include one or more of the following:

- a) soil hummocking due to lowing of soil surface in the bare areas,
- b) pedestalling of plants,
- c) erosion pavement evident in gravelly soils,
- d) rills conspicuous after storms,
- e) gullies occasional and moderately active (cutting after heavy storm),
- f) sheet erosion has removed less than half and upper horizon of soil,
- g) some noticeable alluvial deposition.

3. Advanced Severity:

Soil movement advanced and bare ground dominates the site. Indicators are:

- a) soil loss heavy and continuing with subsoil exposed in places, at least half the upper horizon having been lost,
- b) where soils are gravelly, heavy erosion pavement occurs,
- c) gullies frequent and active,
- d) plants pedestalled or partially buried due to dislodging and redeposition of the soil,
- e) wind scouring on exposed sites,
- f) exposure of roots of shrubs and root crown.

4. Severe:

Soil movement severe with most of area bare and uninfluenced by vegetation or litter.

Indicators are:

- a) sub-soil mostly exposed,
- b) heavy pavement on gravelly soils,
- c) gullies frequent and deep and actively cutting with each storm,
- d) large soil deposits.

13

STOCK WATER SOURCE: 1 - 10

1. Developed Well (DW)
2. Bore Hole w/Hand Pump (BH)
3. Bore Hole w/Motorized Pump (BM)
4. Traditional Well - unlined (TW)
5. Spring (SP)
6. Developed Reservoir (DR)
7. Natural Collection Basin (NB)

- 8. The Gambia River (GR)
- 9. Other Rivers (OR)
- 10. Multiple Sources (MS)

<u>Item</u>	<u>Subject / Description</u>
14	DISTANCE TO STOCK WATER FROM SAMPLE: 0 - 3 0. less than 1 km 1. 1 - 5 km 2. 5 - 10 km 3. 10 km or more
15	<u>GENUS</u> : first two letters of genus name.
16	<u>SPECIE</u> : first two letters of specie name.
17	(Clarification): third letter of specie name or first letter of sub-specie name.
18	PLANT IDENTIFICATION CODE (SEE APPENDIX 26)
19	PERCENT OF PLOT COMPOSITION: Trace (T) to 100%; T assigned a value of 2%; otherwise to nearest 5%.
20	SAMPLE WEIGHT (GREEN): weight at clipping; 100 g units.
21	DRY MATYER CODE (SEE APPENDICES 26 AND 27)
22	TOTAL WEIGHT (DRY): green weight x % dry matter; 1 g units,
23	TOTAL FORAGE (AIR DRIED) OF SAMPLE: 100 g units.
24	KILOGRAMS OF FORAGE BIOMASS/HA: 100 kg units.
25	TONS OF FORAGE BIOMASS PRODUCED/DISTRICT/LAND USE CLASSIFICATION UNIT: value in Item 8 x value Item 22, converted to tons.
26	TOTAL TONS OF FORAGE BIOMASS PRODUCED/DISTRICT: sum of production figures of all land use classification units in the district.

Appendix 25

RANGE RESOURCE INVENTORY / DATA COLLECTION SHEET 1

1...WRITEUP NUMBER				
2...DATE OF SAMPLE				
3...AERIAL PHOTO REFERENCE NO.				
4...TECHNICIANS INITIALS				
5...SITE IDENTIFICATION			X	
<hr/>				
6...LAND USE CLASSIFICATION				
7...TOTAL DISTRICT LAND AREA				In 100 hectare units
8...TOTAL DISTRICT LAND AREA/ LAND USE CLASSIFICATION UNIT				In 100 hectare units
<hr/>				
9...SAMPLE PLOT SIZE		Standard; one square meter (1m ²)		
10...SAMPLE HEIGHT		Standard; up to one and one half meter above ground		
11...TREATMENT			T1	
			T2	
			T3	
12...SOIL EROSION RATING				
13...STOCK WATER SOURCE				
14...DISTANCE TO STOCK WATER FROM SAMPLE PLOT				
<hr/>				

NOTES:

RANGE INVENTORY PLANT LIST

Key:

-
- FWTA No. - Flora of West Tropical Africa reference identification number
 00/nn/nn....Family
 nn/00/nn....Genus
 nn/nn/00....specie
- *FWTA No. - Indicates plant specimen found in Range Unit Herbarium, Abuko
- ID - Identification Code
column 1 2 3
- 0 n n.....Crops
 1 n n.....Grasses/Grass-like
 3 n n.....Forbs
 4 n n.....Forbs
 5 n n.....Sub-shrubs
 6 n n.....Variable habit
 7 n n.....Shrubs/small trees/woody climber
 9 n n.....Trees
 n 0 0.....Family unknown
 n 5 n.....Suffrutex or parasite
 n 9 9.....Family unknown
- GP - Grazing Preference Code
 0.....Preference unknown
 1.....Desirable
 2.....Undesirable
- DM - Dry Matter Code
 1 through 34 (see Appendix 27)
- SpOc - Specie Occurrence in Land-Use Class

Genus	Species	FWTA No.	ID			GP	DM	SpOc																				
			1	2	3			1	2	3	4	5/6	7	8/9	10	11	12	13	14									
CROPS																												
Agave	sisalana	192/(1)/(1)	0	0	1	2	24	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	X	
"Sisal"		192/(1)/(1)	0	0	1	2	24	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X
Arachis	hypogea	91/66	0	0	2	1	3	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
"Groundnuts"		91/66	0	0	2	1	3	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Avigna	ungulata	91/52	0	0	3	1	21	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X
"Cowpeas"		91/52	0	0	3	1	21	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X
"Cotton"		77/11	0	0	4	1	18	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Gossypium	sp.	77/11	0	0	4	1	18	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Hibiscus	sabdariffa	77/10/19	0	0	5	0	21	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X
"Sorrel"		77/10/19	0	0	5	0	21	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X
"Calabash"		59/2	0	0	6	1	21	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X
Lagenaria	siceraria	59/2	0	0	6	1	21	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X
"Manioc"		86/53/5	0	0	7	0	33	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X
Manihot	esculentia	86/53/5	0	0	7	0	33	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X
Oryza	sativa	202/9/1	0	0	8	1	2	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
"Rice"		202/9/1	0	0	8	1	2	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
Pennisetum	americanum	202/101/19	0	0	9	1	8	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X
"Millet"		202/101/19	0	0	9	1	1	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X
Phaseolus	sp.	91/52	0	1	0	1	21	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X
"Beans"		91/52	0	1	0	1	21	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X
Saccharum	officinarum	202/104/2	0	1	1	1	10	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X
"Sugarcane"		202/104/2	0	1	1	1	10	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X
"Sorghum"		202/106/3	0	1	2	1	1	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Sorghum	bicolor	202/106/3	0	1	2	1	1	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Zea	mays	202/146	0	1	3	1	1	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X
"Maize"		202/146	0	1	3	1	1	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X
"Banana"		178/(1)/(1)	0	1	4	0	33	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	X
Musa	sp.	178/(1)/(1)	0	1	4	0	33	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	X

GRASSES/GRASS-LIKE

Unknown	grass	202/	1	0	0	0	9	-	-	-	X	X	X	X	X	X	X	X	X	-	-	-	-	-	-	-	-	-
Andropogon	sp.	202/124	1	0	1	1	10	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Andropogonae	sp.	202/	1	0	2	1	8	-	-	-	X	X	X	X	X	X	X	X	X	-	-	-	-	-	-	-	-	-
Brach./Pasp	sp.	202/	1	0	3	1	6	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Brachiaria	sp.	202/88	1	0	4	1	6	-	-	-	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyperus	sp.	202/1	1	0	5	0	13	X	X	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-
Eragrostis	sp.	202/37	1	0	6	1	6	-	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-
Junc-/Cyperac	sp.	- - -	1	0	7	0	15	X	X	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	X
Loudetia	sp.	202/67	1	0	8	0	8	-	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-
Oryza	sp.	202/9	1	0	9	1	11	-	-	-	-	-	-	-	X	X	X	-	-	-	-	-	-	-	-	-	-	-

Genus	Species	FWTA No.	ID			GP	DM	SpOc													
			1	2	3			1	2	3	4	5/6	7	8/9	10	11	12	13	14		
Panicum	sp.	202/75	1	1	0	1	6	-	-	-	X	X	X	-	-	-	-	-	-		
Pennisetum	sp.	202/101	1	1	1	1	8	-	-	-	-	-	X	X	-	-	X	-	-		
Schizachyrium	sp.	202/122	1	1	2	2	9	-	-	-	-	X	X	-	-	-	-	-	-		
Sporobolus	sp.	202/59	1	1	3	1	9	-	-	-	-	-	X	-	-	-	-	-	-		
Andropogon	gayanus v.g.	*202/124/29a	1	1	4	1	10	-	-	-	-	-	X	X	-	-	X	-	X		
Andropogon	gay. v.squ.	*202/124/29c	1	1	5	1	10	-	-	X	X	X	X	X	-	-	X	-	X		
Andropogon	gay. v.bis.	*202/124/29d	1	1	6	1	10	-	-	-	-	X	X	X	-	-	-	-	X		
Andropogon	pseudapricus	*202/124/15	1	1	7	2	8	-	-	X	X	X	X	X	-	-	-	-	X		
Brachiaria	villosa	*202/88/4	1	1	8	1	6	-	-	-	-	X	X	-	-	-	-	-	-		
Brachiaria	distichophylla	202/88/14	1	1	9	1	6	-	-	-	-	X	X	X	-	-	-	-	-		
Bulbostylis	coleotricha	*201/10/13	1	2	0	0	10	-	-	-	-	-	-	X	-	-	-	-	-		
Cenchrus	biflorus	*202/102/1	1	2	1	1	8	-	-	-	-	X	X	X	-	-	X	-	X		
Chloris	pilosa	*202/51/3	1	2	2	1	8	-	-	-	X	X	X	X	-	-	-	-	X		
Ctenium	elegans	*204/49/1	1	2	3	2	9	-	-	-	X	X	X	-	-	-	-	-	-		
Cyperus	articulatus	201/1/7	1	2	4	0	13	-	-	-	-	-	-	-	X	X	-	-	-		
Leptochloa	caerulescens	202/47	1	2	5	2	8	-	-	-	-	-	-	-	X	X	-	-	-		
Cyperus	amabilis	201/1/50	1	2	6	0	13	-	-	-	-	-	-	X	-	-	-	-	-		
Cyperus	iria	201/1/28	1	2	7	0	13	-	-	-	-	-	-	-	X	X	-	-	-		
Cyperus	difformis	201/1/41	1	2	8	0	13	-	-	-	-	-	-	-	X	X	-	-	-		
Dactyloctenium	aegypticum	*202/41	1	2	9	1	6	-	-	-	-	-	X	X	-	-	-	-	X		
Digitaria	ciliaris	*202/94/15	1	3	0	1	6	-	-	-	-	X	X	X	-	-	-	-	X		
Diheteropogon	hagerupii	*202/125/2	1	3	1	1	6	-	-	-	X	X	X	-	-	-	-	-	-		
Echinochloa	colona	*202/85/4	1	3	2	1	10	-	-	-	-	-	-	-	X	X	-	-	-		
Eleusine	indica	*202/43/1	1	3	3	1	9	-	-	-	-	-	-	X	X	-	-	-	X		
Elionurus	elegans	*202/136/2	1	3	4	0	7	-	-	-	-	X	X	-	-	-	-	-	-		
Eragrostis	turgida	*202/37/9	1	3	5	1	6	-	-	-	-	-	X	-	X	X	X	-	-		
Eragrostis	tremula	*202/37/32	1	3	6	1	6	-	-	-	-	-	X	X	-	-	-	-	-		
Eragrostis	ciliaris	*202/37/1	1	3	7	1	6	-	-	-	-	-	X	X	-	-	-	-	-		
Eragrostis	tenella	*202/37/4	1	3	8	1	6	-	-	-	-	-	X	X	-	-	-	-	-		
Eragrostis	lingulata	*202/37/34	1	3	9	2	6	-	-	-	-	X	X	-	-	-	-	-	-		
Hackelochloa	granularis	*202/138	1	4	0	1	10	-	-	-	-	-	-	X	-	-	-	-	-		
Isachaeum	rugosum	*202/119/2	1	4	1	1	10	-	-	-	-	-	-	-	X	X	-	-	-		
Kyllinga	squamulata	201/6/2	1	4	2	0	13	-	-	-	-	-	-	-	X	X	-	-	-		
Kyllinga	(appendiculata)	201/6/(17)	1	4	3	0	13	-	-	-	-	-	-	-	X	X	-	-	-		
Loudetia	togoensis	*202/67/1	1	4	4	2	4	-	-	-	-	X	-	-	-	-	-	-	-		
Mariscus	alternifolius	201/2/13	1	4	5	0	13	-	-	-	-	X	X	-	-	-	-	-	-		
Mariscus	squamosus	201/2/1	1	4	6	0	13	-	-	-	-	X	X	-	-	-	-	-	-		
Oryza	barthii	*202/9/6	1	4	7	1	11	-	-	-	-	-	-	-	X	X	-	-	-		
Oryza	longistaninata	*202/9/2	1	4	8	1	11	-	-	-	-	-	-	-	X	X	-	-	-		
Oxytenanthera	abyssinica	*202/3	1	4	9	1	14	-	-	-	-	X	-	-	-	-	-	-	-		
Panicum	anabaptistum	*202/75/20	1	6	0	1	6	-	-	-	-	X	X	-	-	-	-	-	-		
Paspalum	orbiculare	*202/90/7	1	6	1	1	9	-	-	-	-	-	X	-	-	-	-	-	-		
Paspalum	scrobiculatum	202/90/7	1	6	1	1	9	-	-	-	-	-	-	-	X	X	-	-	-		
Pennisetum	pedicellatum	*202/101/3	1	6	3	1	8	-	-	X	X	X	X	X	X	X	X	X	-		

Genus	Species	FWTA No.	ID			GP	DM	SpOc																		
			1	2	3			1	2	3	4	5/6	7	8/9	10	11	12	13	14							
Pennisetum	hordeoides	*202/101/7	1	6	4	1	8	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pycerus	(flavescens)	201/5/(28)	1	6	5	1	7	-	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-
Rottboellia	exaltata	*202/141	1	6	6	1	12	-	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-
Schizachyrium	brevifolium	*202/122/2	1	6	7	2	7	-	-	-	X	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-
Setaria	palide-fusca	202/72/2	1	6	8	1	6	-	-	X	X	X	X	X	X	X	X	X	X	X	X	-	X	-	X	-
Setaria	gracilipes	202/72/8	1	6	9	0	11	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
"Jajeo"		202/72/8	1	6	9	0	11	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Setaria	barbata	*202/72/9	1	7	0	0	11	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	X
Setaria	anceps	*202/72/4	1	7	1	1	11	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-
Sporobolus	pyramidalis	*202/59/18	1	7	2	1	9	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-
Vetevaria	nigritana	*202/109/2	1	7	3	2	12	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-
Setaria	sp.	202/72	1	7	5	1	6	-	-	-	X	X	X	X	X	X	X	X	X	X	-	-	-	-	-	-
Oryzaceae	sp.	202/	1	7	6	0	11	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-
Microchloa	indica	202/57/1	1	7	7	1	7	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Eragrostis	atrovirens	202/37/21	1	7	8	1	12	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-
Echinochloa	pyramidalis	202/85/2	1	7	9	1	10	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-
Echinochloa	stagnina	202/85/3	1	8	0	1	10	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-
Panicum	repens	*202/75/40	1	8	1	1	10	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-
Schizachyrium	sanguineum	202/122/11	1	8	2	2	9	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-
Paspalum	vaginatum	*202/90/4	1	8	4	1	10	-	-	-	-	-	-	-	X	X	X	-	-	-	-	-	-	-	-	-
Diplachne	fusca	*202/48	1	8	5	2	4	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-
Aristida	sieberiana	*202/31/12	1	8	6	2	4	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-
"Findo" (M)		202/94/20	1	8	7	1	7	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-
Digitaria	exilis	202/94/20	1	8	7	1	7	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-
Cenchrus	ciliaris	202/102/5	1	8	8	1	8	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-
Chasmopodium	caudatum	202/143	1	8	9	1	10	-	-	-	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Phragmites	karka	202/25	1	9	0	1	15	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-
Typha	australis	188/	1	9	1	0	15	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-
Tripogon	minimus	202/39/2	1	9	2	1	7	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Paspalidium	geminatum	202/86	1	9	3	0	13	X	X	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-
Schoenfeldia	gracilis	*202/54	1	9	4	1	7	-	-	-	-	X	X	X	-	-	-	-	-	-	-	-	-	-	X	-
Vossia	cuspidata	*202/132	1	9	5	1	10	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-
Oropetium	aristatum	*202/58/2	1	9	6	0	7	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cymbopogon	gigantea	202/123/1	1	9	7	2	10	-	-	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
Anadelphia	afzeliana	202/131/6	1	9	8	1	10	-	-	X	X	X	X	-	X	X	-	-	-	-	-	-	-	-	-	-

FORBS

Unknown	forb	- - -	3	0	0	0	20	-	-	-	-	-	-	X	X	X	-	-	-	-	-	-	-	-	-	-
Achyranthes	sp.	37/10	3	0	1	0	17	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
"Sudulo"		91/78	3	0	2	1	18	-	-	-	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Alysicarpus	sp.	91/78	3	0	2	1	18	-	-	-	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Boerhavia	sp.	47/3	3	0	3	2	17	-	-	-	X	X	X	-	X	X	-	-	-	-	-	-	-	-	-	-
Cassia	sp.	89/12	3	0	4	0	24	-	-	-	-	-	X	X	X	-	-	-	-	-	-	-	-	-	-	-

Genus	Species	FWTA No.	ID			GP	DM	SpOc													
			1	2	3			1	2	3	4	5/6	7	8/9	10	11	12	13	14		
Hygrophila	senegalensis	*159/1/9	3	4	8	0	20	-	-	-	-	-	-	-	-	X	X	-	-	-	
Hyptis	suaveolens	*162/21/3	3	4	9	2	24	-	-	X	X	X	X	X	X	X	X	X	-	X	
Hyptis	spicigera	162/21/1	3	6	0	2	24	-	-	X	X	-	-	-	-	-	-	-	-	-	
Indigofera	hirsuta	* 91/26/2	3	6	1	0	17	-	-	-	-	X	X	-	X	X	X	-	-	-	
Ipomoea	eriocarpa	*152/16/25	3	6	2	1	21	-	-	-	X	-	X	X	-	-	-	-	-	-	
Ipomoea	vagens	*152/16/20	3	6	3	1	21	-	-	-	X	X	X	X	-	-	-	-	-	-	
Ipomoea	pileata	*152/16/9	3	6	4	1	21	-	-	-	X	X	X	-	-	-	-	-	-	-	
Ipomoea	heterotricha	*152/16/6	3	6	5	1	21	-	-	-	X	X	X	X	-	-	-	-	-	-	
Justicia	insularis	*159/43/2	3	6	6	1	17	-	-	-	X	X	X	-	-	-	-	-	-	-	
Leucas	martinicensis	*162/27/1	3	6	7	2	20	-	-	-	X	X	X	-	-	-	-	-	-	-	
Luffa	aegyptiaca	59/5/2	3	6	8	0	21	-	-	-	-	-	-	X	-	-	-	-	-	X	
Melliniella	micrantha	* 91/79	3	6	9	1	17	-	-	X	X	-	-	-	-	-	-	-	-	-	
Melothria	maderaspatana	* 59/10/5	3	7	0	2	21	-	-	-	-	-	-	X	X	-	-	-	-	-	
Merrimia	pinnata	*152/11/1	3	7	1	1	21	-	-	-	X	X	X	X	-	-	-	-	-	-	
Merrimia	kentrocaulos	*152/11/7	3	7	2	1	21	-	-	-	X	X	X	X	-	-	-	-	-	-	
Mitracarpus	villosus	*137/88/(1)	3	7	4	1	17	-	-	-	-	-	-	X	-	-	-	-	-	-	
Mitracarpus	scaber	*137/88	3	7	5	1	17	-	-	-	-	-	-	X	-	-	-	-	-	-	
Monochoria	brevipetiolata	184/1	3	7	6	2	22	-	-	-	-	-	-	-	X	X	-	-	-	-	
Nicotiana	tabacum	*151/2/1	3	7	7	2	20	-	-	-	-	-	-	X	-	-	-	-	-	-	
Ocimum	canum	*162/1/6	3	7	8	2	18	-	-	-	-	-	-	X	-	-	-	-	-	X	
Pandaka	heudelotii	* 37/9/2	3	7	9	1	16	-	-	-	-	X	-	-	-	-	-	-	-	-	
Passiflora	foetida	* 58/1	3	8	0	2	21	-	-	-	-	-	-	-	X	X	X	-	-	-	
Philoxerus	vermicularis	* 37/12	3	8	1	0	21	X	X	-	-	-	-	-	X	X	-	-	-	-	
"Singindo" (M)		* 37/12	3	8	1	0	21	X	X	-	-	-	-	-	X	X	-	-	-	-	
Phyllanthus	amarus	* 86/16/11	3	8	2	1	19	-	-	-	-	-	-	X	-	-	-	-	-	-	
Physalis	micrantha	*151/6/1	3	8	3	0	17	-	-	-	-	-	-	-	X	X	-	-	-	-	
Physalis	angulata	*151/6/2	3	8	4	0	17	-	-	-	-	-	-	-	X	X	-	-	-	-	
Polycarpaea	tenuifolia	* 29/8/3	3	8	5	2	26	-	-	X	X	-	-	-	-	-	-	-	-	-	
Polycarpaea	corymbosa	* 29/8/6	3	8	6	2	26	-	-	-	-	X	X	-	-	-	-	-	-	-	
"Tomato"		151/8/(1)	3	8	7	2	17	-	-	-	-	-	-	X	X	-	-	-	-	X	
Solanum	lycopersicum	151/8/(1)	3	8	7	2	17	-	-	-	-	-	-	X	X	-	-	-	-	X	
Sphenoclea	zeylanica	*145/1	3	8	8	0	17	-	-	-	-	-	-	X	X	-	-	-	-	-	
Spilanthes	uliginosa	*139/9/2	3	8	9	0	18	-	-	-	-	-	-	X	X	-	-	-	-	-	
Striga	hermontheca	153/30/13	3	9	0	2	18	-	-	-	-	-	-	X	-	-	-	-	-	-	
Striga	aspera	*153/30/11	3	9	1	2	18	-	-	-	-	-	-	X	-	-	-	-	-	-	
Tribulus	terrestris	* 85/2	3	9	2	0	16	-	-	-	X	X	X	X	-	-	-	-	-	-	
Tridax	procumbens	*139/3	3	9	3	2	17	-	-	-	-	-	-	X	-	-	-	-	-	-	
Vernonia	sp.	139/62	3	9	4	2	28	-	-	X	X	-	-	X	-	-	-	-	-	-	
Vicoa	leptoclada	*139/44	3	9	5	0	17	-	-	-	-	-	-	X	-	-	-	-	-	-	
Zornia	glochidiata	* 91/66/1	3	9	6	2	16	-	-	-	-	X	X	X	-	-	-	-	-	-	
"Kunturo" (M)		137/87	3	9	7	1	23	-	-	X	X	X	X	X	X	X	X	-	-	X	
Borreria	sp.	137/87	3	9	7	1	23	-	-	X	X	X	X	X	X	X	X	-	-	X	
Nymphaea	micrantha	11/-/1	3	9	8	6	15	-	-	-	-	-	-	-	X	X	-	-	-	-	
Unknown	forb 2	- - -	3	9	9	0	20	-	-	X	X	-	X	X	-	-	-	-	-	-	
Unknown	forb 3	- - -	4	0	0	0	20	-	-	X	X	-	X	X	-	-	-	-	-	-	

Genus	Species	FWTA No.	ID			GP	DM	SpOc													
			1	2	3			1	2	3	4	5/6	7	8/9	10	11	12	13	14		
Bacopa	decumbens	153/14/5	4	0	1	0	17	-	-	-	-	-	-	-	-	X	X	-	-	-	
"Water Lily"		11/-/4	4	0	2	0	17	X	X	-	-	-	-	-	-	X	X	-	-	-	
Nymphaea	lotus	11/-/4	4	0	2	0	17	X	X	-	-	-	-	-	-	X	X	-	-	-	
Blepharis	sp.	159/20	4	0	3	2	17	-	-	-	-	X	X	-	-	-	-	-	-	-	
Cassia	nigricans	* 89/12/3	4	0	4	1	24	-	-	-	-	X	X	-	-	-	-	-	-	-	
Borreria	verticillata	137/87/9	4	0	5	0	20	-	-	-	-	X	X	X	-	-	-	-	-	-	
Merrimia	trident. v.ag.	152/11/2a	4	0	6	1	21	-	-	-	-	-	-	-	-	X	X	-	-	-	
"Julung Dingo"		- - -	4	0	7	1	21	-	-	-	X	X	X	X	-	-	-	-	-	X	
Corchorus	olitorius	74/6/5	4	0	8	0	17	-	-	-	-	-	-	X	X	-	-	-	-	-	
Tephrosia	pedicellata	91/23/5	4	2	1	1	18	-	-	-	X	X	X	X	-	-	-	-	-	-	
Unknown	forb 4	- - -	4	9	9	0	20	-	-	-	-	-	X	X	X	X	X	-	-	-	

SUB-SHRUBS

Unknown	sub-shrub	- - -	5	0	0	0	29	-	-	-	-	X	X	-	-	-	-	-	-	-
Asparagus	sp.	182/2	5	0	1	2	25	-	-	-	-	X	X	-	-	-	-	-	-	-
Euphorbia	sp.	86/64	5	0	2	2	17	-	-	-	-	-	-	X	-	-	-	-	-	-
Sesbania	sp.	91/24	5	0	3	0	24	-	-	-	-	-	-	X	-	-	-	-	-	-
Sida	sp.	77/3	5	0	4	1	17	-	-	-	-	-	X	X	X	-	-	-	-	X
Stylosanthes	sp.	91/65	5	0	5	1	17	-	-	X	X	X	X	X	-	-	-	-	-	-
Achyranthes	aspera	37/10/3	5	0	6	0	17	-	-	X	X	-	-	-	-	-	-	-	-	-
Asparagus	flagellaris	182/2/6	5	0	7	2	25	-	-	-	-	X	-	-	-	-	-	-	-	-
Cassia	absus	* 89/12/15	5	0	8	0	24	-	-	-	-	-	X	X	X	X	X	-	-	X
Cassia	tora	89/12/19	5	0	9	0	25	-	-	X	X	X	X	X	X	X	X	-	-	X
Indigofera	colutea	* 91/26/47	5	1	0	0	17	-	-	-	X	X	-	-	-	-	-	-	-	-
Indigofera	stenophylla	* 91/26/32	5	1	1	0	17	-	-	-	X	X	-	-	-	-	-	-	-	-
Indigofera	pulchra	* 91/26/18	5	1	2	1	17	-	-	-	X	X	-	-	-	-	-	-	-	-
Indigofera	pricureana	* 91/26/31	5	1	3	0	17	-	-	-	X	X	-	-	-	-	-	-	-	-
Ipomoea	aquatica	152/16/18	5	1	4	1	23	-	-	-	-	-	-	-	X	X	-	-	-	-
Lippia	chevalieri	160/6/3	5	1	5	2	26	-	-	-	X	X	X	-	-	-	-	-	-	-
Oxystelma	bornouense	*136/6	5	1	6	1	21	-	-	X	X	-	-	-	-	-	-	-	-	-
Sida	alba	77/3/5	5	1	7	1	17	-	-	-	-	-	X	X	-	-	-	-	-	-
Sida	acuta	* 77/3/9	5	1	8	1	17	-	-	-	-	-	X	X	-	-	-	-	-	-
Stylosanthes	mucronata	* 91/65/2	5	1	9	1	17	-	-	X	X	-	-	-	-	-	-	-	-	-
Stylosanthes	hamata	91/65/(1)	5	2	0	1	17	-	-	-	-	-	X	X	-	-	-	-	-	-
Tephrosia	pedicellata	* 91/23/5	5	2	1	1	18	-	-	-	X	X	X	X	-	-	-	-	-	-
Triumfetta	rhomboidea	74/7/5	5	2	2	2	24	-	-	X	X	-	-	-	-	-	-	-	-	-
"Dagilo"		77/4	5	2	3	2	18	-	-	X	X	X	X	X	X	X	X	X	-	X
Urena	lobata	* 77/4	5	2	3	2	18	-	-	X	X	X	X	X	X	X	X	X	-	X
Waltheria	indica	* 75/11/2	5	2	4	2	24	-	-	X	X	X	X	-	-	-	-	-	-	-
Cassia	occidentalis	89/12/21	5	2	5	0	24	-	-	-	-	-	X	X	-	-	-	-	-	X
"Tribo" (N)		* 52/-/1	5	5	1	2	16	-	-	-	X	X	X	-	-	-	-	-	-	-
Cochlospermum	tinctorum	* 52/-/1	5	5	1	2	16	-	-	-	X	X	X	-	-	-	-	-	-	-
Datura	innoxia	*151/1/3	5	5	2	2	27	-	-	-	-	X	X	-	-	-	-	-	-	-

Genus	Species	FWTA No.	ID			GP	DM	SpOc																	
			1	2	3			4	5/6	7	8/9	10	11	12	13	14									
Englerina	lecardii	*109/3/1	5	5	3	2	29	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-
Icacina	senegalensis	102/6/1	5	5	4	2	27	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-

SHRUBS, SMALL TREES, WOODY CLIMBERS

Unknown	shrub	- - -	7	0	0	0	29	-	-	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-
Acacia	sp.	90/20	7	0	1	0	30	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-
Cassia	sp.	89/12	7	0	2	0	24	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-
Combretaceae	sp.	69/	7	0	3	0	32	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-
Combretum	sp.	69/2	7	0	4	1	32	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-
Abrus	prectorius	* 91/64/1	7	0	5	2	29	-	-	X	X	-	-	-	-	-	-	-	-	X	-	-	-	-	-
Acacia	macrostachya	* 90/20/7	7	0	6	1	28	-	-	-	-	X	X	-	-	-	-	-	-	X	-	-	-	-	-
Annona	senegalensis	* 4/22/3	7	0	7	0	33	-	-	-	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-
Annona	glabra	* 4/22/4	7	0	8	0	33	-	-	-	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-
Baissea	multiflora	*134/35/7	7	0	9	1	29	-	-	-	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-
Balanites	aegyptiaca	85/6/2	7	1	0	1	30	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bauhinia	rufescens	* 89/1	7	1	1	1	30	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-
Caesalpinia	pulcherrima	* 89/52/(1)	7	1	2	0	28	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Calotropis	procera	*136/10	7	1	3	2	27	-	-	-	-	-	X	X	X	X	-	-	-	-	-	-	-	-	-
Capparis	tomentosa	* 17/4/8	7	1	4	1	30	-	-	X	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
Cassia	minosoides	* 89/12/5	7	1	5	1	24	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	X	-
Cassia	alata	* 89/12/10	7	1	7	0	24	-	-	X	X	-	-	-	X	X	-	-	-	-	-	-	-	-	-
Combretum	micranthum	69/2/16	7	1	8	0	32	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-
Dialium	guineense	* 89/10/2	7	1	9	0	29	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dichrostachys	glomerata	* 90/14	7	2	0	1	30	-	-	-	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-
Drepanocarpus	lunatus	* 91/14	7	2	1	0	30	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ectadiopsis	oblongifolia	*135/8	7	2	2	0	28	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Gardenia	erubescens	*137/18/7	7	2	4	2	30	-	-	-	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-
Grewia	flavescens	* 74/2/15	7	2	5	0	29	-	-	X	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-
Grewia	carpinifolia	* 74/2/14	7	2	6	0	29	-	-	X	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-
Guiera	senegalensis	* 69/5	7	2	7	1	28	-	-	-	-	-	X	X	-	-	-	-	-	X	-	-	-	-	-
Heeria	insignis	*121/13/2	7	2	8	2	30	-	-	-	-	X	X	X	-	-	-	-	-	-	-	-	-	-	-
Hymenocardia	acida	* 86/14/3	7	2	9	2	29	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Lanea	velutina	121/9/5	7	3	0	0	7	-	-	X	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-
Lanea	acida	121/9/7	7	3	1	0	7	-	-	X	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-
Lantana	camara	*160/4/1	7	3	2	0	30	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-
Leptadenia	hastata	*136/29/2	7	3	3	1	30	-	-	X	X	X	X	X	X	-	X	-	X	-	-	-	-	-	-
Mimosa	pigra	* 90/18/2	7	3	4	1	30	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-
Mitragyna	inermis	*137/43/1	7	3	5	2	31	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-
Naucllea	latifolia	*137/46/1	7	3	6	2	30	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ocimum	gratissimum	*162/1/3	7	3	7	2	18	-	-	X	X	-	X	-	-	-	-	-	-	-	-	-	-	X	-
Parinari	macrophylla	* 87/7/8	7	3	8	0	29	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	X
Pavetta	corymbosa	*137/29/2	7	3	9	0	33	-	-	-	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-

Genus	Species	FWTA No.	ID			GP	DM	SpOc													
			1	2	3			1	2	3	4	5/6	7	8/9	10	11	12	13	14		
Piliostigma	thonningii	* 89/2/2	7	4	0	0	30	-	-	X	X	X	X	X	X	-	-	-	-	-	X
Sclerocarya	birrea	121/7	7	4	1	0	30	-	-	-	-	X	X	X	-	-	-	-	-	-	-
Securidaca	longepeduncul.	* 22/3/2	7	4	2	2	33	-	-	-	X	X	X	X	-	-	-	-	-	-	-
Sesbania	sudanica	* 91/24/(1)	7	4	3	0	24	-	-	-	-	-	X	X	-	-	-	-	-	-	-
Strychnos	spinosa	*132/2/1	7	4	4	0	28	-	-	-	-	X	X	-	-	-	-	-	-	-	-
Terminalia	macroptera	* 69/6/4	7	4	5	0	33	-	-	X	X	X	X	X	-	-	-	-	-	-	-
Ziziphus	mucronata	*112/1/4	7	4	6	2	30	-	-	X	X	X	X	X	-	-	-	-	-	-	-
Ziziphus	mauritanica	*112/1/2	7	4	7	1	30	-	-	X	X	X	X	X	-	-	-	-	-	-	-
Lanea	sp.	121/9	7	4	9	0	7	-	-	X	X	X	X	X	-	-	-	-	-	-	-
Grewia	sp.	74/2	7	6	0	0	29	-	-	X	X	-	X	-	-	-	-	-	-	-	-
Combretum	glutinosum	69/2/9	7	6	1	1	29	-	-	X	X	X	X	-	-	-	-	-	-	-	-
"Yiri Kundango" (M)		139/62/19	7	6	2	2	28	-	-	-	-	-	-	-	X	X	X	X	-	-	-
Vernonia	colorata	139/62/19	7	6	2	2	28	-	-	-	-	-	-	-	X	X	X	X	-	-	-
Avicennia	africans	161/	7	6	3	0	33	X	X	-	-	-	-	-	X	X	X	X	-	-	-
"Mangrove" (black)		161/	7	6	3	0	33	X	X	-	-	-	-	-	X	X	X	X	-	-	-
"Jubukungo" (M)		161/	7	6	3	0	33	X	X	-	-	-	-	-	X	X	X	X	-	-	-
Rhizophora	racemosa	70/4/3	7	6	4	0	33	X	X	-	-	-	-	-	-	-	-	-	-	-	-
"Mangrove" (red)		70/4/3	7	6	4	0	33	X	X	-	-	-	-	-	-	-	-	-	-	-	-
"Mankwo" (M)		70/4/3	7	6	4	0	33	X	X	-	-	-	-	-	-	-	-	-	-	-	-
Combretum	fuscum	69/2/27	7	6	5	0	32	-	-	X	X	-	-	-	-	-	-	-	-	-	-
Vitex	doniana	*160/10/6	7	6	6	2	28	-	-	-	X	X	X	X	-	-	-	-	-	-	-
Chrysobalanus	orbicularis	87/5/1	7	6	7	0	30	-	-	X	X	-	-	-	-	-	-	-	-	-	-
"Voratch" (M)		87/5/1	7	6	7	0	30	-	-	X	X	-	-	-	-	-	-	-	-	-	-
Desmodium	velutinum	91/75/3	7	6	8	0	30	-	-	X	X	X	-	-	-	-	-	-	-	-	-

TREES

Unknown	tree	- - -	9	0	0	0	31	-	-	X	X	-	-	-	-	-	-	-	-	-	-
Acacia	sp.	90/20	9	0	1	0	30	-	-	-	-	-	-	-	X	X	-	-	-	-	-
Combretum	sp.	69/2	9	0	2	0	32	-	-	-	-	X	X	-	-	-	-	-	-	-	-
Ficus	sp.	202/6	9	0	3	0	29	-	-	-	-	-	-	X	-	-	-	-	-	-	-
Sterculia	sp.	75/14	9	0	4	0	25	-	-	-	X	X	X	-	-	-	-	-	-	-	-
Acacia	nilotica	* 90/20/12	9	0	5	1	30	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Acacia	polyacantha	* 90/20/5	9	0	6	1	30	-	-	X	-	-	-	-	X	X	X	-	-	-	-
Acacia	albida	* 90/20/6	9	0	7	1	30	-	-	-	-	-	X	X	-	-	-	-	-	-	-
Acacia	sieberiana	* 90/20/10	9	0	8	1	30	-	-	X	-	X	X	-	X	X	X	-	-	-	-
Albizia	adanthifolia	* 90/21/8	9	1	0	0	30	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Anogeissus	leiocarpus	* 69/8	9	1	1	0	33	-	-	X	X	X	-	X	-	-	-	-	-	-	X
"Neem"		118/12	9	1	2	0	33	-	-	X	X	X	X	X	-	-	-	-	-	-	X
Azadirachta	indica(Neem)	118/12	9	1	2	0	33	-	-	X	X	X	X	X	-	-	-	-	-	-	X
"Kaltupa" (W)		76/2/1	9	1	3	0	25	-	-	-	-	X	X	X	-	-	-	-	-	-	X
Bombax	buonopozense	76/2/1	9	1	3	0	25	-	-	-	-	X	X	X	-	-	-	-	-	-	X
Bombax	costatum	96/2/2	9	1	4	0	25	-	-	-	-	X	X	-	-	-	-	-	-	-	-

Genus	Species	FWTA No.	ID			GP	DM	SpOc													
			1	2	3			1	2	3	4	5/6	7	8/9	10	11	12	13	14		
Borassus	aethiopum	193/10	9	1	5	0	33	-	-	X	X	-	-	X	X	X	-	-	X		
Cassia	sieberiana	* 89/12/8	9	1	6	1	24	-	-	-	X	X	X	X	-	-	-	-	X		
Ceiba	pentandra	76/3	9	1	7	0	32	-	-	-	-	-	-	X	-	-	-	-	X		
Cola	cordifolia	75/15/42	9	1	8	0	33	-	-	-	-	-	-	X	-	-	-	-	X		
Adansonia	digitata	76/1	9	1	9	0	32	-	-	-	X	X	X	X	-	-	-	-	X		
Cordyla	pinnata	89/6/1	9	2	1	0	32	-	-	-	X	X	X	X	-	-	-	-	X		
Detarium	microcarpum	* 89/19/1	9	2	2	0	29	-	-	X	X	-	-	-	-	-	-	-	-		
Detarium	senegalensis	* 89/19/2	9	2	3	0	29	-	-	X	X	-	-	-	-	-	-	-	-		
Diospyros	mespiliformis	*127/-/21	9	2	4	1	33	-	-	X	X	-	X	X	-	-	-	-	X		
Elaeis	guinensis	193/3	9	2	5	0	33	-	-	-	-	-	-	-	X	X	-	-	-		
Entada	africana	* 90/9/4	9	2	6	0	32	-	-	-	X	X	X	X	-	-	-	-	X		
Erythrina	senegalensis	* 91/43/3	9	2	7	0	29	-	-	-	-	X	X	-	-	-	-	-	-		
Gmelina	arborea	160/(1)/(1)	9	2	8	1	33	-	-	-	-	-	-	X	-	-	-	-	X		
Hannoa	undulata	*115/4/3	9	2	9	0	29	-	-	-	-	X	X	-	-	-	-	-	-		
Khaya	senegalensis	116/1/1	9	3	0	0	29	-	-	X	X	-	-	X	-	-	-	-	X		
Magifera	indica	121/1	9	3	1	0	29	-	-	-	-	-	-	X	X	X	-	-	X		
"Mango"		121/1	9	3	1	0	29	-	-	-	-	-	-	X	X	X	-	-	X		
Moringa	oleifera	18/	9	3	2	0	33	-	-	-	-	-	-	X	-	-	-	-	-		
Newbouldia	laevis	*157/6	9	3	3	0	29	-	-	-	X	-	X	-	-	-	-	-	-		
Parkia	biglobosa	90/2/1	9	3	4	0	33	-	-	X	X	-	-	X	-	-	-	-	X		
Peltophorum	pterocarpum	* 89/(1)/(1)	9	3	5	0	33	-	-	X	X	-	-	-	X	X	-	-	-		
Piliostigma	reticulatum	* 89/2/1	9	3	6	0	30	-	-	X	X	-	X	X	-	-	-	-	X		
Prosopis	africana	* 90/11	9	3	7	0	30	-	-	X	X	X	X	X	-	-	-	-	-		
Psidium	guajava	* 66/(1)/(1)	9	3	8	0	29	-	-	X	X	-	-	-	-	-	-	-	-		
Pterocarpus	lucens	* 91/12/1	9	3	9	0	31	-	-	-	-	X	X	-	-	-	-	-	-		
Sterculia	setigera	75/14/1	9	4	0	0	25	-	-	-	X	X	X	-	-	-	-	-	-		
Tamarindus	indica	* 89/46	9	4	1	0	30	-	-	-	-	-	-	-	X	X	X	-	-		
Terminalia	avicennoides	* 69/6/10	9	4	2	0	33	-	-	X	X	X	X	X	-	-	-	-	X		
Celtis	integrifolia	95/1/3	9	4	4	0	33	-	-	X	X	X	-	-	-	-	-	-	-		
"Buleyi" (F)		95/1/3	9	4	4	0	33	-	-	X	X	X	-	-	-	-	-	-	-		
"Kamanyango" (M)		95/1/3	9	4	4	0	33	-	-	X	X	X	-	-	-	-	-	-	-		
Hyphaene	thebaica	193/11	9	4	5	0	33	-	-	X	X	-	X	X	X	X	X	-	X		
"Dune Palm"		193/11	9	4	5	0	33	-	-	X	X	-	X	X	X	X	X	-	X		
Citrus	spp.	144/(1)/(1)	9	4	6	0	30	-	-	-	-	-	-	X	-	-	X	-	X		
Erythrophleum	guineense	* 89/57/1	9	4	7	0	33	-	-	X	X	-	-	-	-	-	-	-	-		
Pterocarpus	erinaceus	91/12/5	9	4	9	0	33	-	-	X	X	X	X	X	-	-	-	-	X		
Daniellia	oliveri	89/26/1	9	5	0	0	33	-	-	X	X	X	X	X	-	-	-	-	-		
Phoenix	reclinata	193/12/2	9	6	0	0	33	-	-	-	-	-	-	-	X	X	-	-	-		
Spondias	rombin	121/4/1	9	6	1	0	30	-	-	X	X	-	-	-	-	-	-	-	-		
Tapinanthus	bangwensis	109/6/4	9	6	2	0	30	-	-	X	X	-	-	-	-	-	-	-	-		

<u>Genus</u>	<u>Species</u>	<u>Fl/TA No.</u>	<u>ID</u>			<u>GP</u>	<u>DM</u>	<u>SpOc</u>													
			<u>1</u>	<u>2</u>	<u>3</u>			<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5/6</u>	<u>7</u>	<u>8/9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>		
MISCELLANEOUS																					
Litter	--	- - -	6	0	0	0	5	-	-	X	X	X	X	X	X	X	-	-			
Acacia	sp.	90/20	6	0	1	0	30	-	-	-	-	-	-	-	X	X	X	-	-		
Achyranthes	sp.	37/10	6	0	2	0	17	-	-	X	X	-	-	-	-	-	-	-	-		
Baissea	sp.	134/35	6	0	3	1	29	-	-	-	-	X	X	-	-	-	-	-	-		
Cassia	sp.	89/12	6	0	4	0	24	-	-	-	-	-	X	X	-	-	-	-	-		
Clerodendrum	sp.	160/9	6	0	5	0	28	-	-	-	X	X	X	-	-	-	-	-	-		
Combretaceae	sp.	69/	6	0	6	0	32	-	-	-	-	X	X	X	-	-	-	-	-		
Combretum	sp.	69/2	6	0	7	1	32	-	-	-	-	X	X	X	-	-	-	-	-		
Compositae	sp.	37/	6	0	8	0	19	-	-	-	-	-	-	X	X	X	-	-	-		
Euphorbia	sp.	86/64	6	0	9	2	17	-	-	-	-	-	-	X	X	X	-	-	-		
Hibiscus	sp.	77/10	6	1	1	0	21	-	-	-	X	X	X	X	-	X	-	-	X		
Indigofera	sp.	91/26	6	1	2	2	17	-	-	-	X	X	X	X	-	-	-	-	-		
Jussiaea	sp.	43/2	6	1	4	1	16	-	-	-	-	-	-	-	X	X	-	-	-		
Leguminosae	sp.	- - -	6	1	5	0	19	-	-	-	-	-	-	X	-	-	-	-	-		
Sesbania	sp.	91/24	6	1	6	0	24	-	-	-	-	-	X	X	-	-	-	-	-		

BIBLIOGRAPHY

1. Berhaut, J., 1967. Flore du Senegal, Clairafrique, Dakar (French)
2. Berhaut, J., 6 volumes, 1971-79. Flore Illustrée du Senegal, Clairafrique, Dakar (French)
3. Deffendol, S., N. A. Patrick, S. L. Russo. "Conducting Village-Level Feeding Trials in The Gambia," The Mixed Farming and Resource Management Project, Banjul.
4. Dunsmore, J. R., A. Blair Rains, G. D. N. Lowe, D. J. Moffatt, I. P. Anderson, and J. B. Williams, 1976. "The Agricultural Development of The Gambia, Land Resource Study 22," Ministry of Overseas Development, Surbiton, Surrey, England.
5. Gambian-German Forestry Project, 1981-1983. GGLUC Photo Overlays, (526) Scale 1:10,000, DFS Forest Inventory Service Ltd. and Haumann and Zulsdorf Consultant Surveyors Ltd. for GTZ Ltd..
6. Harman, Jane L., DVM, August 1982, "The Risk of Livestock Toxicosis Resulting from Agricultural Pesticide Use in The Gambia," Technical Paper, Mixed Farming and Resource Management Project, Operations Crossroad participant assigned to MFP, Banjul.
7. Hedrick, Don and Musa Bojang, 1983. "Final Report of Forage Agronomist," Mixed Farming Project, Banjul.
8. Hutchinson, J. and J.M. Dalziel, 5 volumes, 1954-1968. Flora of West Tropical Africa, Crown Agents for Overseas Governments and Administration, Millbank, London.
9. ILCA Monograph, "Trypanotolerant Livestock in West and Central Africa," in Volume 2: Country Studies, International Livestock Centre for Africa, FAO, Addis Ababa.
10. Innes, R.R. with W.D. Clayton, 1977. A Manual of Ghana Grasses, Land Resource Division, MOD, Surbiton.
11. Jarvis, A., 1980. A Checklist of Gambian Plants, British Council, Sc. Ed. Advisor, Banjul.
12. Mark Hurd Aerial Surveys, Jan. 1982-Jan. 1983. Orthophotos, B/W, Scale 1:25,000, Minneapolis. OMVG/USAID, Surveys Department, Ministry of Public Works, Government of The Gambia, Banjul.
13. Mol, L., J. B. Eckert, J. C. Crouch, P. Vesseur, E. D. Hurkens, December 1982. "The Gambian Cattle Herds," Technical Report 13, Mixed Farming Project, Banjul.
14. National Laboratory for Livestock and Veterinary Research and IMVT, 1970. "Agrostology Study 27, Natural Pastures of Upper and Middle Casamance, Republic of Senegal," Dakar (French)
15. Rains, A. Blair, 1975. "Report on Surveys of Cattle Owners and Herdsmen in The Gambia," Misc. Report 180, Land Resources Division, Tolworth Tower, Surbiton, Surrey, England, KT6 7DY.

16. Soil and Water Management Unit, 1981. "A Checklist of Gambian Plants," Ministry of Agriculture, Government of The Gambia, Banjul.
17. Teledyne Geotronics, Oct./Nov. 1980. Aerial Photos B/W and Infra-Red False Color, Scale 1:25,000, Long Beach. MFP/USAID, Surveys Department, Ministry of Public Works, Government of The Gambia, Banjul.
18. USAID, 1979. "The Gambia Mixed Farming and Resource Management, Project Paper," Washington, D.C.