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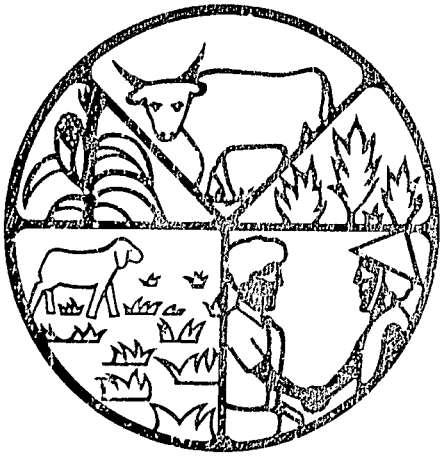
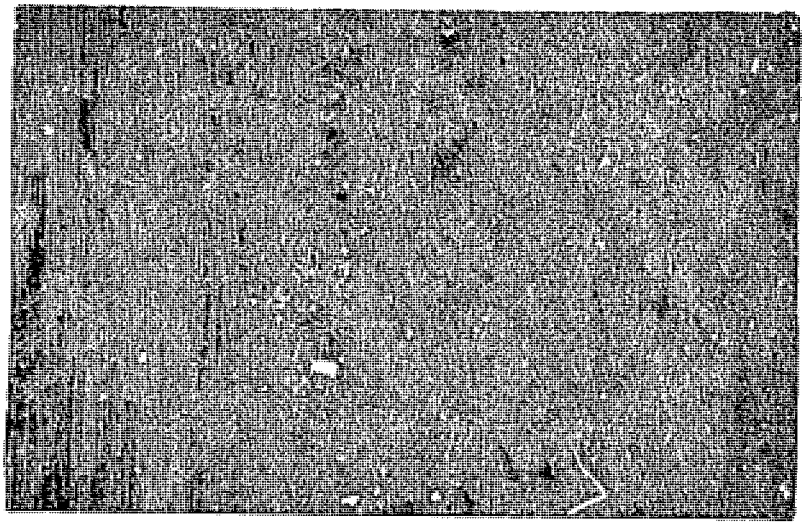
Mixed Farming Technical Report





GAMBIAN MIXED FARMING AND RESOURCE MANAGEMENT PROJECT

Ministry of Agriculture and Natural Resources
Government of The Gambia

Consortium for International Development

Colorado State University

MIXED FARMING IN THE GAMBIA

by

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Technical Report No. 10
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CHAPTER I

INTRODUCTION

This monograph reports the results of a three-year study of agricultural systems in The Gambia, West Africa. Before presenting the statistical and analytical detail of subsequent chapters, an overview of the country is needed to set the appropriate context.

The Gambia In Synopsis

The River

The Gambia, with a land area of only 4,000 square miles is the smallest nation on the African continent. It is composed of land on the north and south banks of the Gambia River for a distance of 295 miles of the river's length. The Gambia is narrow on its north-south axis, ranging between 15 and 30 miles over most of its length. Consequently, The Gambian nation embraces only a small fraction of the watershed that drains to the sea across Gambian soil. The river itself reaches several hundred miles above The Gambia, draining large reaches of Senegal and Guinea-Bissau.

The Gambia is quite flat topographically and the river is its most prominent geographic feature. Upon entering the country at its easternmost end, the river is less than 100 feet above sea level. Nearby is Gambia's highest point at 152 feet. With a watershed of tens of thousands of square miles and a rate of fall in the Gambia of just less than 0.33 ft./mi., the river is slow, but deep, as it passes through the country. Approximately one-fifth of The Gambia's surface area is covered by the river itself and swamps along the river's banks.

The River Gambia is considered navigable over most of its length in Gambia and in former times provided the principal line of communication and commerce. The river remains important today as a fishery and its floodplains support widespread rice cultivation and dry season grazing for livestock. Its role in commerce, however, has been taken over by a road network constructed in recent years.

The Gambia fronts on the Atlantic ocean on the west at the river's mouth. Elsewhere the country is surrounded by Senegal. With no bridges and few ferries, the river constitutes a significant logistic barrier to North-South traffic that runs the length of the country. As a result, commercial and social contacts with Senegal to the north or south is often easier for Gambian villagers than is communicating with their compatriates across the river.

Climate

The Gambia is usually considered to have a Sahelian climatic pattern. There is a general gradient of mean annual rainfall from over 1000 mm in the South to 800 mm or less in the North. However, there is considerable variation around these long-term means as shown by recent years in which drought conditions prevailed and production of several crops declined.

The Gambia experiences a four and one-half month wet season and a seven and one-half month dry season. The wet season is conventionally considered as starting in June and ending in October or November. General rainfall patterns show localized variations, the most significant being the higher rainfall near the coast, where the isohyets trend northwest to southeast rather than west to east.

The daily pattern of relative humidity is cyclic, with diurnal cycles inversely following the temperature cycle. Relative humidity is lowest in the afternoons and highest soon after dawn reaching 100 percent even during the dry season. Relative humidity can reach peak values throughout the year, but

persistently high levels are maintained only during the wet season, especially near the coast.

During the dry season, relative humidity can fall to less than 20 percent, especially in the eastern part of the country. The range of variation is greater inland than at the coast, however, mean values inland are considerably less.

Annual rainfall figures also show a considerable degree of variation. The occurrence of below average rainfall during most of the last decade has prompted the opinion that rainfall fluctuations may be reflecting a long-term cyclical pattern.

An alternative opinion, based on annual data, suggests that the recent drought, roughly since 1970, which has been particularly severe, possibly indicates a significant, long-term change in the climate. Some observers feel that The Gambia is experiencing the early stages of desertification.

Vegetation

The vegetation of The Gambia has been aptly summarized by Dunsmore et. al. (1, p. 159) as follows:

> "The vegetation of The Gambia can be described as savanna woodland with grass and shrub understories. In the moister western area of the country, there are remnants of woodland similar to those elsewhere in West Africa in the Southern Guinea Savanna.
>
> "In the center and eastern area, the vegetation is similar to that found in the Sudan zone. The occurrence together of woody species from different zones could be attributed to high rainfall and river influence and to the long dry season.
>
> "There are few areas which have not been modified by fire or by cultivation and thus do not constitute secondary vegetation. The mangrove swamp is among the least changed, although many stands of mangrove are harvested for fuel. The Gambian vegetation can be closely related to edaphic factors and the limited number of vegetation categories can be identified easily on the basis of soil type."

Population

According to the 1973 Census, the total population of The Gambia was 493,500 of which 90 percent lived in the rural areas. The natural population growth rate was estimated at more than two percent per annum, with an additional growth due to net immigration of 0.8 percent. The population density in 1973 was 47 persons per square kilometer. In rural areas, density ranged between 28-43 persons per square kilometer.

The national census for 1983 indicated that the present population of the country is 695,886. This represents an increase of 41 percent over the 1973 census, and a 3.5 percent annual growth rate. It is estimated that by the year 2000 the population will increase to approximately 1,150,000.

An important future problem lies in the rapid rate of urbanization. Banjul's population is constrained by space limits on the island. Most urban growth has occurred in the Serrekunda-Fajara-Cape St. Mary's-Brikama area where the population is now believed to exceed 125,000, growing at 2-3 times the national average. This urban growth will shortly impact rural areas in significant ways. Among them will be a drain of capable rural manpower through rural-urban migration, and a need for vastly improved marketing systems to feed the urban population.

The Economy

The Gambia has only limited economic potential. It has few natural resources on which to capitalize, the primary ones being land, water and climate. Gambia's agriculture is heavily dependent on rainfall which is concentrated in little over four months of the year. The economy is predominantly rural, and 58 percent of the gross domestic product is from agricultural activities. Of this amount, 64 percent can be attributed to a single crop; groundnuts.

Subsistence cropping of cotton, maize, millet, sorghum and rice, plus livestock and fishing account for most of the remaining agricultural output. Agricultural output depends largely on unpredictable rainfall, which explains the sharp annual variation in economic growth often experienced.

The only secondary economic sector of much size is tourism. This sector is slowly gaining economic momentum, due to increased hotel accommodations, improved tourist opportunities and the extension of the tourist season. A third economic sector is Government/Quasi-Governmental services (Gambia Ports Authority, Customs, Income Tax, etc.) which effectively contributes to the economy through taxes, licenses and fees.

Trade

Over the years, the country has faced serious balance of payments deficits. Imports are principally consumer goods, transport equipment, petroleum products, construction materials and significant quantities of agricultural commodities, rice, flour, sugar and related products and tobacco. The cost of rice imports takes up a considerable proportion of export earnings.

There has been an upsurge in imports from a value of 88.3 million Dalasis in 1974/75 to 290 million Dalasis in 1979/80. In part this is due to an expansion of the re-export trade. But the main cause has been rapidly increasing imports of investment goods, consumer goods and intermediate products.

Such an increase is a direct reflection of the large public and private investment and the indirect effects of increased consumption based on the incomes generated by this investment. Because of Gambia's narrow domestic production base, most of the needs for both investments and consumption goods have to be met by imports.

The balance of trade has been in deficit throughout much of Gambia's history. The deficit in 1982/83 was as high as 132.7 million dalasis compared with the 1981/82 deficit of 146.8 million dalasis.

Government and Administration

The Gambia gained its independence in 1965 and in 1970 elected to become a republic. The government of The Gambia is made up of three branches: the Legislative, the Judiciary and the Executive branch. The legislature (House of Parliament) has 42 members of parliament who legislate laws designed to regularize the conduct of the Gambian people in general. The Executive Branch is composed of the President, Vice-President and his cabinet Ministers (13 in number). The main responsibility of this branch is the coordination of activities throughout governmental ministries and departments. The Judiciary is responsible for interpretation of the laws passed by the legislature.

The Central Government: The Central Government operates through 13 Ministries, each with a number of departments, and through several parastatal agencies. Each ministry has a Minister, and a Permanent Secretary answerable to the Secretary General in the Office of the Vice-President.

Administrative Divisions: The country is divided for administrative purposes into five divisions: Western Division (WD), North Bank Division (NBD), Lower River Division (LRD), MacCarthy Island Division (MID) and Upper River Division (URD). These units occur as stratification devices throughout the analysis in this report.

Each division has a Divisional Commissioner, appointed by the central government and responsible for general administration of government programs and responsibilities. The Divisional Commissioner also acts as an advisor and coordinator for all divisional development activities.

Within the five Divisions are several local authorities. These include six rural Area Councils, the Banjul City Council (BCC) and the Kanifing Urban District Council (K.U.D.C.).

Below the Divisional level are 35 District Authorities. These are headed by an elected chief (Seyfo) who has primary judiciary and administrative responsibility for customary law, particularly marriages and land rights. The Seyfo is assisted by a council of village headmen (Alkali) of his district. Village headmen are elected by heads of families within their villages.

CHAPTER II

METHODOLOGY

Two major long-term data collection efforts were mounted by the Gambian Mixed Farming and Resource Management project and subsequently buttressed by several smaller survey studies. The first of the larger studies was a nationwide baseline survey. This study occupied the bulk of the first year for the project's social scientists. The second study was an intensive investigation of farming and other activities which involved frequent visits to a limited number of respondents over a period of two years. For abbreviation the Baseline Survey and Intensive Village Studies are referred to as BLS and IVS respectively throughout this report. This report draws together both data sets to provide an overall analysis of farming in The Gambia. This chapter details methods used in both studies.

The Baseline Survey

The major objective of the Baseline Survey (BLS) was to develop a data base covering characteristics of rural households and farming systems in The Gambia. The study encompassed an extensive survey of the family, of cropping and livestock activities in which families engaged, the families' major crop and livestock problems, mechanisms for their solution, and the families' aspirations.

Sample Selection (BLS)

For the Baseline Survey, stratification of respondent compounds was based on two criteria resulting in six strata. The criteria were ecological (bottomland and upland soils) and

village size (small, medium, or large villages). In general, bottomlands are those areas bordering the River Gambia and falling within the river's floodplain; all other lands were considered upland. Village size categories were arbitrarily set by population number as follows: small (0-199); medium (200-599); and large (600-3000). An exhaustive list of all Gambian villages, excluding the urbanized areas of Banjul and Serrekunda, constituted the sample frame. Population size became a subset within ecological zones. That is, all villages falling within each soil type were classified as either small, medium, or large. Sample villages were then randomly selected within each stratum as were compounds within each village. A total of 582 compounds in 89 villages were finally selected, as shown below. This figure represents 2.3 percent of all rural compounds in The Gambia.

Table II-1. Distribution of BLS Sample by Stratification Criteria

Village Size	Number of Villages	Number of Compounds
- - - - - - - - - - - - - -	-Bottomland-	- - - - - - - - - - - - - -
Small	10	38
Medium	11	68
Large	14	140
Sub-total	35	246
- - - - - - - - - - - - - -	-Upland-	- - - - - - - - - - - - - -
Small	26	100
Medium	12	76
Large	16	160
Sub-total	54	336
Grand Total	89	582

Instruments and Procedures Used (BLS)

A questionnaire was constructed for interviews of the compound head covering characteristics of family members in the compound, cropping patterns and land use, maize cultivation, livestock ownership and management, integration of crop/livestock practices, on-farm and off-farm labor and credit and capital. Another questionnaire was constructed for the compound head's first wife. With it, information similar to that of the compound head was ollected--with special emphasis on women's participation in crop and gardening tasks as well as in household activities related to health and cooking.

Special precautions were taken in recruiting 25 Gambian enumerators. All had completed the Secondary IV level of education, had knowledge of English and at least one local language, and had passed an examination testing their mathematical skills and their ability to follow instructions. All enumerators received a three-week intensive training course dealing with topics such as the nature of socio-economic research, sampling techniques, questionnaire construction, and interviewing techniques. Practical, in-field experience in the last two topics was provided.

Enumerators compiled a list of compound heads in the 89 villages to be studied and within each village selected a sample of informants according to standard randomizing procedures. A total of 582 compound heads and 582 first wives were interviewed. Original data collection took six weeks. Close supervision was provided during this period by a Gambian survey supervisor with previous experience in survey work and by other members of the Mixed Farming Project. Most of the editing of completed questionnaires was done in the field by a team of four enumerators specially trained for that purpose.

The Intensive Village Study

Sample Village Selection (IVS)

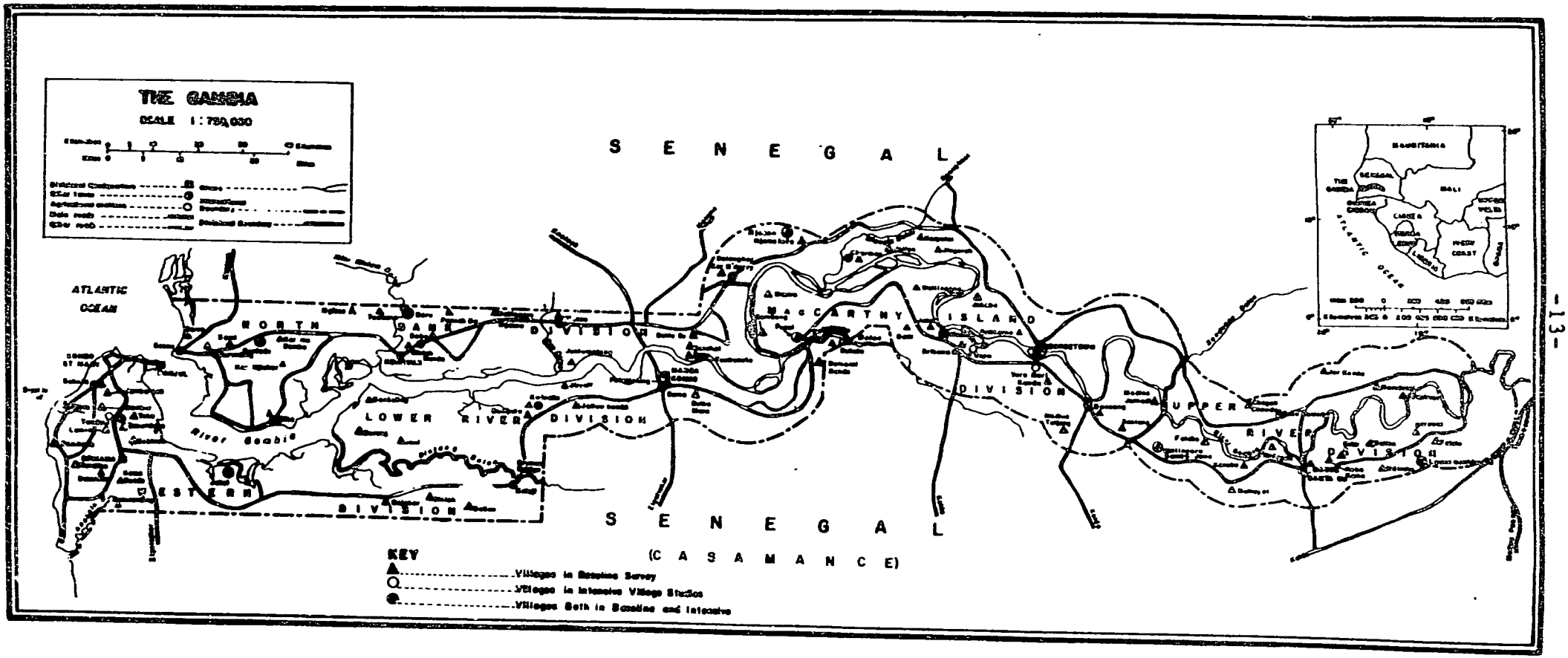
Villages for the intensive village studies (IVS) were taken directly from the BLS sample. The sample was small due to the nature of the data to be collected, e.g. detailed inputs and outputs, income and expenditure and resource utilization data requiring interviews on a frequency of two or three t mes weekly. The survey was carried out over two consecutive years using the same sample of farmers. Due to the small sample size, respondent selection was largely purposive, although conducted within the randomly selected baseline sample. In addition to the criteria used in the BLS study, ethnicity, location and livestock ownership became selection criteria. Ethnicity refers to the five major tribal affiliations found within The Gambia. These are the Mandingo, Wollof, Serehule, Fula, and Jola. Location of a village was defined as its proximity or accessibility to an urban center. Village location was of secondary importance, yet was still included because it directly or indirectly affects farmers access to markets and needed farm inputs. Proximity was defined as either "near" or "remote," with this subjective classification based primarily but not entirely on distance. Also included was an accessibility judgment, e.g. an urban center may be geographically close to a village and yet not accessible if roads are impassable during the rains.

Finally, since major MFP objectives involve improvement of livestock production systems and intensification of the interrelationship between livestock and cropping systems, IVS study areas were concentrated in portions of the country with the most extensive livestock holdings. Factors weighing on the selection of villages included the following considerations. Six villages were chosen from the central and eastern portions of The Gambia (URD and MID) because two-thirds of all cattle are located in those divisions. Two Fula and two Serehule villages were chosen, one each in URD and MID, because these ethnic groups are

the predominant cattle owners in these divisions. Two Mandingo villages were selected, one in MID and one in NBD, because in these two divisions cattle ownership by this tribe is significant. Two Wollof villages were selected in MID and NBD due to the importance of Wollof cattle ownership and cropping activities. One Jola village was selected in Western Division since the Jola are an important segment of that division's population. No villages were selected in Lower River Division because it has the least amount of cattle. Selected villages are shown in the map below.

The result was nine villages with location and ethnic characteristics as follows:

Division	Number of Villages	Village Ethnicity
McCarthy Island (MID)	4	Fula, Serehule, Mandingo, Wollof
Upper River (URD)	2	Fula, Serehule
North Bank (NBD)	2	Mandingo, Wollof
Western (WD)	1	Jola


THE GAMBIA
SCALE 1 : 750,000
S E N E G A L
ATLANTIC OCEAN
NORTH BANK DIVISION
LOWER RIVER DIVISION
MACCARTHY ISLAND DIVISION
UPPER RIVER DIVISION
EASTERN DIVISION
River Gambia
S E N E G A L
(C A S A M A N C E)
KEY
Villages in Baseline Survey
Villages in Intensive Village Studies
Villages Both in Baseline and Intensive

Selection of Production-Consumption Units Within IVS Villages

The major purpose of the IVS was to obtain an in-depth understanding of the major farming systems in The Gambia, especially those which incorporate livestock enterprises. This necessitates accurately measuring data of a technical, economic and social nature in considerable detail. Because of these considerations and the quantities of data anticipated, a small sample was desired. This sample was intended to be representative of the major livestock systems existing within the country.

Using information collected in the earlier Baseline survey, and recognizing that livestock were the focal point of the study, prospective categories of farm systems or subsystems were defined. First, nearly everyone grows crops (97% of BLS respondents). Groundnuts are the major cash crop, with millet, sorghum, rice, and maize constituting the major food crops. Therefore, some cropping activities were assumed for all respondents. Second, most farmers raise livestock (90% of the BLS sample), however, the pattern of ownership varies. From the BLS sample seven ownership patterns were delineated:

		% of Livestock Owners
1)	Cattle + Sheep/Goats	12%
2)	Cattle + Sheep/Goats + Draft/Pack	33%
3)	Sheep/Goats only	20%
4)	Sheep/Goats + Draft/Pack	25%
5)	Cattle + Draft/Pack	2%
6)	Cattle only	3%
7)	Draft only	5%

Examining these categories it is apparent that groups 1 through 4 comprise the majority of livestock owners (90%) and nearly 80 percent of the rural population. Categories 5, 6, and 7 were excluded from the sample because they represent only 10 percent of those compounds owning livestock. Therefore, the first four groupings plus the five major ethnic groups became the matrix within which informants were selected. Assuming the proportions found in the BLS to be accurate, by sampling farmers who grow crops and own livestock in categories 1-4, sampling was from 79 percent of the rural population (.97 x .90 x .90 = .786). Finally, in order to more closely examine livestock issues, sub-classes were defined according to the extent of ownership. Nationally the number owned of the different species varies widely. Thus some variation was sought with respect to this characteristic when selecting the IVS sample. Ownership size classes which were initially sought appear in Table II-3.

Informant selection within these categories required a number of procedures, one of which was to define the sampling unit. In the Baseline Survey the compound head was the male respondent while his first wife was the female respondent. In the Intensive Village Study it was necessary to select the head of each Production-Consumption Unit (PCU). This unit was defined as those people in the compound who work and eat together. There is usually only one of these units per compound, but exceptions exist. In the latter case, the PCU led by the compound head was selected.

The second task required listing all PCUs within the nine sample villages and identifying the livestock ownership categories to which they belonged. A preliminary survey was conducted to develop this sample frame. Small and medium villages were no problem, however, large villages necessitated acquiring a listing of all compound heads within the village. This was accomplished through the village head, known as the "Alkalo." A random sample was then selected from each class and these individuals were interviewed for the main survey. The number of respondents per village depended on its size, the general rule being: small villages, 4 informants; medium villages, 6 informants; and large villages, 9 informants.

At the time of actual selection all but one of the livestock ownership sub-categories were represented with the distribution being fairly uniform. However, six months later when a livestock inventory was taken ownership patterns had changed affecting the distribution. There are three possible reasons for this, one or all of which could hold true: 1) the preliminary survey did not accurately represent actual ownership, either because a recall method was used or the question was not well understood, (the later inventory was confirmed by the enumerator); 2) the second inventory occurred after harvest of groundnuts, so some purchases could have increased stock numbers; 3) an increase in herd size occurred due to births. (It is interesting to note that in all cases but one, ownership was larger than originally stated). The unfortunate result is that only one PCU was studied which actually owned less than 6 cattle. Table II-3 below locates the entire 46 PCUs within the classification structure.

Table II-3 Distribution of the 46 Farms Sampled in 1982, by Ethnicity and Livestock Ownership Category.

Livestock Category*	Ethnicity					Row Totals
	Mandingo	Fula	Wollof	Jola	Serehule	
A1						0
A2		2		2		4
A3	1					1
B1	1					1
B2	2	1	3	1	3	10
B3	1	2	1		5	9
C1	1		3		1	5
C2		1	3		1	5
D	3	1	2	1	4	11
Column Totals	9	7	12	4	14	46

*A= Cattle + Sheep/Goats. Subgroup 1=1-5 cattle; 2=6-10 cattle; 3=>10 cattle
B= Cattle + Sheep/Goats + Draft. Subgroups the same as A above
C= Sheep/Goats + Draft. Subgroup 1=1-10 Head; 2=>10
D= Sheep/Goats only.

One of the topics of interest in this research is the extent to which draft animals affect cropping systems. Further, it was assumed that interactions between cropping and livestock subsystems would differ significantly depending on the presence or absence of cattle on the farm. That the IVS can shed light on these issues is suggested by the distribution of cattle and draft animals shown by the 2 x 2 matrix below.

Livestock Owned	With Draft	Without Draft	Row Total
Cattle, S/G	20	5	25
S/G only	10	11	21
Column Total	30	16	46

Instruments and Procedures Used (IVS)

The survey instrument used for data collection was the FAO Farm Management Data Collection and Analysis System (FMDCAS)(2). The instrument was designed to handle large, detailed farm level data bases acquired through frequent interviews. The instrument allows for country specific formatting which the researcher develops as needed.

A total of eleven enumerators were posted in the nine villages. Each of the two large villages had 10 informants, therefore two enumerators were assigned per village to insure adequate coverage. As a general rule, informants were interviewed twice weekly so that, while daily data were collected, the recall period was only a few days. Some enumerators and informants preferred daily interviews: where there was mutual agreement this was done. No form of cash or kind incentive was provided to the informants and all graciously cooperated throughout the effort. However, at the end of the first year's data collection, each work unit received 10 kgs of clean rice as a token of appreciation. At the end of year two, respondents received kola nuts and a photograph.

In addition to the interviews, enumerators were expected to acquaint themselves with each member of the various work units and all the fields belonging to their work units. Maps were drawn of all fields cultivated and these were mapped in geographic relation to the village and to the compound of the informant. Each field was demarcated for identification. Two enumerators were trained in field measuring techniques, crop cutting sampling methods and

yield estimation methodology. Individual fields were measured for total area and yield plots were laid out in each. To provide a more accurate estimation of production, additional measures (other than plot projections) were taken. For each crop the farmer was asked his yield in local units. Measuring units varied according to ethnicity, therefore standardized tins were provided to each enumerator and the enumerator calculated the number of tins which constitute one local measurement. Finally, in the case of groundnuts and cotton, sales receipts from the Gambian Produce Marketing Board were used to cross-check our own estimations. Production kept by the work unit or given away was also accounted for.

Field supervision was conducted by the MFP expatriate personnel plus the Senior Supervisor and Junior Supervisors. All enumerators were visited at least once weekly by the junior supervisors (centrally based up-country) and by the Senior Supervisor. MFP staff visited each enumerator twice monthly. All enumerators were graded twice monthly on their performance (poor, fair, good, excellent). Any enumerator with more than two consecutive poor marks was terminated.

Data editing occurred in three phases:

1) In the field on a regular daily or weekly basis.
2) In-depth editing on a quarterly basis when questionnaires were collected for transfer to project headquarters.
3) Final editing at Abuko (Project Headquarters) prior to processing.

Due to the nature of the FMDCAS program, a large mainframe computer was mandatory. It was decided that processing would be done at Colorado State University on their CYBER. Therefore, all data was transferred from the questionnaires to 80 column Fortran code sheets, verified, copied and sent to CSU for processing. The aggregated data was then sent back to Gambia where micro-computers (IBM-XT and portable Compaq) were used to further process and conduct basic statistical analysis.

Ethnic Composition of BLS and IVS Samples

Table II-2 contrasts the ethnic composition of these two samples with that reported for The Gambia as a whole. The distribution of tribes sampled in the BLS parallels closely that found in national statistics, whereas the IVS does not. This result was expected given the differing sampling techniques involved. It can be concluded that for parameters which should vary by ethnicity, the BLS data will provide a fairly representative sample of the national picture. In fact, given the procedure on which national ethnic distribution figures are based, there is no reason to expect that they might be more or less accurate than the BLS data.

Table II-2 Ethnic Distribution of Two Samples Compared to National Aggregates.

Tribe	Baseline Survey	Intensive Village Survey	The Gambia's Population
Mandingo	42%	20%	42.2
Fula	22	15	18.1
Woloff	13	26	15.6
Serehule	10	30	8.7
Jola	9	9	9.5
Other	4	-	5.9

Summary

In overview, the two larger studies fill different niches in The Gambia's data system. The Baseline Survey covered the entirety of the country except for two urbanized areas, Banjul and Serrekunda. Its intent was to develop a national statistical picture of agriculture. A detailed sampling procedure was used. Each rural compound in The Gambia which was located in a village had an equal probability of being selected. Therefore, the 582 households enumerated can be considered representative of the rural population as a while.

The Intensive Village Study sought to sample the population of rural farmers who raised livestock among their farm enterprises. The baseline survey showed that 90 percent of farmers owned some combination of cattle, sheep, goats and/or draft animals. By limiting the IVS to the four dominant livestock ownership patterns, we were sampling from a population that included 79 percent of all rural residents. The sample was not spread nationwide but was limited to districts where livestock agriculture predominated.

Livestock ownership patterns actually captured in the IVS approximate those measured by the BLS. Thus, this sample is a fair representation of farming systems including livestock in The Gambia. In some of the analysis which follows, IVS statistics which might be ethnically influenced are weighted by the BLS ethnic weights in order to develop national estimates.

CHAPTER III

THE RURAL COMPOUND
Selected Characteristics

The rural family is central to agricultural and economic development programs in The Gambia as in most of Africa. Ultimately the objective of development is the well-being of the population, and in The Gambia most of the population are rural residents. Families constitute a decision-making unit. In the rural setting, farm families manage both consumption and production activities. Production on the farm along with off-farm work are the main determinants of consumption. And consumption is the principal determinant of well-being. Thus, the family can be viewed as a management unit or as a production-consumption unit. Furthermore, rural African families are enmeshed in the fabric of village society through an extensive system of social linkages that act to enhance and/or constrain both production and consumption. Therefore, it is important to develop a basic understanding of Gambian rural families in order to provide the context for the technical analysis and recommendations which follow in subsequent chapters.

It is common among African scholars to use very precisely defined words to distinguish between the many possible groupings of people. The purpose of this report is more pragmatic than esoteric. The analysis attempts to generally characterize the Gambian rural sector, particularly its agricultural activities, with reasonably high accuracy, and in ways that are useful to agricultural development policy. Therefore, we use the terms family, compound and production-consumption interchangeably in the text that follows. Nevertheless, we provide a brief description of each here.

The rural population of The Gambia generally resides in villages. Very few families live alone, on or near their land. Within a village, population clusters by family unit, each of which is likely to live in a small group of buildings on a single piece of ground. This family residential area is usually fenced or in some other way enclosed. The term "compound" can be used in a narrow sense to identify the physical space, including buildings in which a family resides.

"Family" denotes the collective of persons who are related by kinship or affinity (usually marriage). In the older established compounds, it is not uncommon to find three generations co-resident.

It is not uncommon that non-family members reside in a compound. In the Gambia, this will often be an unrelated farm laborer, such as a "strange farmer," or a young boy interned as a Koranic student. Usually, the collective of family and others who live together also eat and work together under the management of the compound decision-making proc

In more general usage, "compound" refers to this collection of individuals, mostly family but occasionally including others. Since this is the basic management unit for both household and farming activities, most of the analysis in this report refers to characteristics and activities of "compounds" used in this general sense.

It should be noted that both the BLS and IVS covered only compounds that were cultivating some land. No rural compounds were enumerated that were completely dependent on non-farm income sources or on livestock alone. Respondents in the IVS were selected from among livestock owners only but the more general BLS chose broadly from all farming compounds. Thus, data and conclusions in this report most properly refer to rural farming compounds only. Urban areas were not sampled. And if there are rural compounds in The Gambia which are not farming, the sample did not find them.

The senior family male in each compound is denoted the "compound head" in the analysis. This is not to denigrate the roles of women, particularly the senior wife, but simply to be consistent with Gambian social custom.

The term compound is more or less synonymous with the term "production-consumption unit." This latter term raises minor difficulties. It is conceivable that a family unit may farm together yet eat from different kitchens, or conversely. It will also occur that joint farming activities can be found involving distantly related individuals living in separate compounds. The principal strength of the "production-consumption unit" terminology is to emphasize the common practice, that being the joint management of both production and consumption activities by the family.

Unless otherwise noted, the description that follows draws almost exclusively on the Baseline Survey (BLS) data. To reiterate, the sample was conducted in 1981, containing 582 compounds randomly selected throughout The Gambia. These patterns should reflect rural society relatively accurately.

Characteristics of the Compound

Compound Size: Respondents were asked the number of persons in their compounds. Responses ranged from two to 90. Some 3.8 percent of sample compounds had more than 50 persons. Responses averaged 18.5 persons with a median value of 13.8. Values of 7, 8, 9 and 10 were definitely the most common. Few compounds (2.7 percent) were found with less than five members. Table III-1 summarizes the distribution.

Table III-1. Size of Rural Compounds

Interval	% of Total	Cum. Pct.	Interval	% of Total	Cum Pct.
2-5	6.7	6.7	26-30	7.4	86.3
6-10	24.9	36.1	31-35	3.0	89.3
11-15	21.6	57.7	36-40	3.5	92.8
16-20	12.1	69.8	41-50	3.4	96.2
21-25	9.1	78.9	>50	3.8	100.0

Members of each compound were identified by age groups. Responses were clustered into three groupings (0-13, 14-60, >60) in an effort to identify the proportions that could be considered available to the household/farm work force under control of each compound. On the average, Gambian compounds contain 18.5 people, 7.7 of which are under 14 years old and 0.8 of which are over 60. Thus, 10.0 are of working age (defined here as 14-60 inclusive), or 54 percent of the total compound membership.

Nearly all marriages in rural society occur within ethnic groups rather than across ethnic lines. Thus it can be assumed that compounds are ethnically homogeneous. The principal exception may be those few compounds in which farm laborers live as well, although it is possible these laborers are of the same tribe as the family.

Since modest differences exist in compound size, the ethnic distributions for number of compounds will differ from that for the rural population. In particular, Serehuli compounds exceed the overall mean by 10 persons. Thus while only 9.5 percent of all compounds are Serehuli, this ethnic group constitutes 14.5 percent of the population. Table III-2 presents these data.

Table III-2. Ethnic Distribution of Rural Compounds, and Their Population

	Percent of Compounds	Compound Size (No.)	Percent of Population
Mandinka	42.4	19.1	43.9
Wollof	12.7	17.4	12.0
Fula	22.3	15.6	18.9
Serehuli	9.5	28.7	14.7
Jola	9.3	14.9	7.5
Other	3.8	16.7	3.3
Total	100.0	18.4	100.0

Rural Gambian society is predominately Islamic; more than 99 percent of the sample were of that faith, at least nominally. According to the tenets of the Islamic faith, polygamy may be practiced. Of 582 compound heads interviewed, 35 percent had two wives, 16 percent had three and six percent had four wives. Forty-three percent were monogamous when interviewed.

This factor leads to the large, conglomerate nature of rural compounds. Forty-seven percent of sampled households were composed of a compound head, his wife or wives and their children. Thirty-eight percent contained three generations or more. These households were characterized by the presence of a compound head, one or more wives, their married sons and the sons' wives plus all unmarried children. A third combination, some 11 percent of the total, consisted of a compound head, his wives and children plus female relatives and their children. Finally, four percent of the sampled compounds consisted of one of the above combinations plus one or more unrelated farm workers.

Family Structure: In general, Gambian rural men marry first wives who are several years their junior. Subsequent wives are even younger. Table III-3 presents reported age distributions for compound heads and their first wives. Differences between the means are significant at the .999 level of confidence.

Table III-3. Distribution of Ages for Compound Heads and First Wives in Rural Gambia.

Age Group	Percent of Sample	
	Compound Head	First Wife
<20	None	2.1
20-29	2.6	24.8
30-39	16.5	31.7
40-49	21.5	24.3
50-59	26.3	11.0
>60	33.2	6.0
Mean	46.1 years	32.6 years
Median	47.6 years	31.3 years

The family normally is extended, male and age-dominated. The oldest male is recognized as its head. If this person is too old for the responsibilities associated with the position, his younger brother or his oldest son takes over in the name of the elderly person. Age commands respect. Married sons of the same father often live with their wives and children in the same physical area called the compound. The offspring of these married males call them "fathers" and call each other "brother" and/or "sister," regardless of actual biological relationships. Unmarried sons and daughters of the family head live in the compound and are called "fathers" and/or "aunts" by the offspring of their married brothers. Females leave the compound and take up residence in the compound of their husbands upon marriage.

On occasions when a male son, married or unmarried, leaves his father's compound to set up residence elsewhere, close kinship ties are still maintained. He is still a "father" to his brothers' children and is expected to contribute to his family-of-origin (either in cash or in kind). Not to honor this obligation will gain him the title of "bad son."

The physical compound contains various structures. These include separate sleeping quarters for males and females. Each married man will have his own sleeping place and each wife will have a separate sleeping place. Small children will very likely sleep with their mothers. Adolescent and young unmarried boys will have their own sleeping quarters; likewise unmarried girls. The compound will often have structures for storing food and seeds. Where there are several married brothers and wives, there will be separate stores for them, and in some cases, different stores for husband and wives. Depending on the number of wives in the compound, there may be more than one kitchen in the enclosure. There may also be areas set aside for keeping animals. There are some ethnic variations in this pattern.

Factors Affecting Technology Adoption

The BLS study sought a number of statistics on education level, communications abilities and mobility of the population as a guide to possible extension strategies. Results are summarized in this section.

Education: Compound heads and first wives were asked for the number of years of school they had attended. Ninety-eight and 99 percent respectively had not attended school. However, this pattern is changing with time. The Intensive Village Study (IVS) enumerated 133 children between the ages of 8-14 years old in 45 sample households[1]. Seventy-eight were boys while only 55 were girls. However, 12 boys (15% of the boys) and 12 girls (22% of the girls) were currently in school or had attended school in the past.

The World Bank indicates a primary school enrollment ratio of 48 percent for 1980, up dramatically from only 12 percent two decades earlier. Secondary school enrollment is only 13 percent of those of secondary school age, up from 3 percent in 1960. These figures emphasize the transition in progress, with education and literacy only recently becoming available on a broad basis. These World Bank figures are for the nation as a whole including the urban population which was estimated at 18.5 percent of the total in 1980. Educational attainments in rural areas can be expected to lag somewhat behind.

Our focus on the compound head and his first wife is founded on the assumption that these two senior individuals represent the two most influential individuals in the compound decision-making matrix. Therefore, considerable detail is available from the BLS data on these two household leaders.

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[1] Elsewhere in this report it is noted that the IVS study dealt with 46 households. Shortly after the first interview in which family data was collected, one household separated into two compound units. Both of the new units were retained in the sample.

Language: Language competency was assessed in the BLS with the results tabulated below. It should be emphasized that these percentages are based on respondent answers and not on actual testing for fluency.

Languages Spoken	Compound Head	First Wife
1	26%	52%
2-3	63%	46%
4 or more	11%	2%
	100%	100%

Five ethnic languages are recognized as separate by Gambian rural residents (Mandinka, Wollof, Fula, Serehuli and Jola). Tables III-4A and III-4B tabulate reported language skills by ethnicity of respondent.

Mandinka constitutes something of a lingua franca in rural Gambia. Eighty-six percent of compound heads can be effectively reached through the Mandinka language. The Wollof people constitute an exception with less than one-third of Wollof compound heads speaking Mandinka. Among the Wollof, the Fula language is second most prevalent.

Examination of raw data showed only 12 compound heads (2.1%) who spoke neither Mandinka or Wollof. Thus if Extension messages are available in these two languages, they can reach nearly all the rural compound heads.

Patterns for first wives mirrored those of their husbands but at a lower level of language fluency. Across the whole sample, compound heads averaged nearly 2.2 indigenous languages each while their first wives averaged only 1.6.

Information was sought on skill with three exotic languages: Arabic, French and English. Among compound heads, one individual spoke French. Fifteen heads spoke English, ten of which were

Mandinka. Arabic skills were more prevalent as the last line in Table III-4A shows. Among first wives there were too few positive responses to warrant tabulation.

Table III-4A. Percent of Compound Heads Speaking Given Languages

	Ethnicity of Compound Head						
Language	Mandinka	Wollof	Fula	Serehuli	Jola	Other	Total
Mandinka	100.0	32.4	80.0	100.0	94.4	95.5	86.3
Wollof	38.1	98.6	62.3	32.7	24.1	81.8	51.0
Fula	38.1	51.4	100.0	87.3	9.3	40.9	55.7
Serehuli	5.3	1.4	6.9	96.4	1.9	0	13.2
Jola	4.0	0	3.8	1.8	94.4	9.1	11.9
Arabic	46.6	62.2	44.6	47.3	29.6	22.7	45.7
Average[a]	1.85	1.84	2.53	3.18	2.24	2.27	2.18

[a]Average number of languages per respondent, excluding Arabic.

Table III-4B. Indigenous Languages Spoken by First Wife

	Ethnicity of First Wife						
Language	Mandinka	Wollof	Fula	Serehuli	Jola	Other	Total
Mandinka	98.8	10.8	60.8	67.3	75.9	72.7	73.0
Wollof	9.3	98.6	33.1	3.6	29.6	77.3	29.9
Fula	21.1	27.0	95.4	34.5	1.9	13.6	37.6
Serehuli	5.3	0	5.4	87.0	1.9	0	11.7
Jola	2.8	0	4.6	0	90.7	0	10.7
Average[a]	1.37	1.36	1.99	1.91	2.00	1.64	1.63

[a]Average number of languages per respondent.

Data presented at the beginning of this section showed that the availability of schooling is increasing and that the younger generation will ultimately have considerably more formal education than their parents. It follows that their linguistic skills with respect to exotic languages may differ as well. Since compound heads and their first wives are likely the senior male and female, it is probable that their skills with English may be less than those found in the compound as a whole.

Tables III-5A and 5B substantiate this point in several ways. For example, among compound heads only 15 spoke English. Yet in these compounds some 294 could read and write English, at least at a rudimentary level. Nearly all these individuals were under thirty years old with more than two-thirds under twenty. English is taught at all schools beginning at primary level.

Arabic is usually learned during the study of the Holy Koran as opposed to within primary or secondary school. Patterns found differ substantially from those found for English. Nearly twice as many compound members spoke or read Arabic. Females were much less likely to be capable in Arabic, reflecting a lower participation by females in Koranic schools. Finally, the age distribution of Arabic speakers (or readers) is skewed toward persons over 20 and particularly over 30 years old, just the opposite from those listing English capacities.

One word of caution. Language abilities reported here are based on respondent answers, not tests. It is likely that, although respondents claimed Arabic capabilities, their abilities are limited to reading the Koran or understanding Koranic verse and do not represent a true functional command of the language.

Table III-5A. Distribution by Age and Sex of Persons Able to Read or Write English (294 persons identified in 582 compounds)

Age		Male	Female	Total (No.)	Total (%)
1-9		2	1	3	1.0
10-19		166	36	202	68.7
20-29		57	8	65	22.1
>30		24	0	24	8.2
Total	(No.)	249	45	294	100.0
	(%)	84.7	15.3	100.0	

Table III-5B. Distribution by Age and Sex of Persons Able to Read or Write Arabic (584 persons identified in 582 compounds)

Age		Male	Female	Total (No.)	Total (%)
1-9		12	0	12	2.1
10-19		128	17	145	24.8
20-29		151	6	157	26.9
>30		266	4	270	46.2
Total	(No.)	557	27	584	100.0
	(%)	95.4	4.6	100.0	

Mobility: Villages in The Gambia are not closed entities. Physically, they are relatively close to each other, a few kilometers apart in many cases, and the many roads that traverse the country facilitate social interaction. In nine out of 10 cases, most of the purchases of food, clothing and medicine items occurs beyond the small village, very likely in the district village. Purchases of farm equipment and other farm inputs occur in larger district towns and in areas beyond it including Senegal. Villagers also are in the habit of attending weekly open-air markets (lumos), particularly if they are held in areas close to their village.

Families were asked if they had visited major population centers in the country. Information is presented in Table III-6 on such visits, including visits made in 1984. These data were collected in 1984 from 44 of the 46 IVS households.

Table III-6. Compound Head and First Wives Who had Visited Various Localities in The Gambia and Senegal

Locality	Compound Head		First Wife	
	Had ever Visited	Last Visit In 1984*	Had ever Visited	Last visit In 1984
Banjul	84%	43%	51%	27%
Brikama/Bwiam/ Sibanor	61	37	23	30
Farafenni	68	37	33	29
Soma/Mansakonko	55	33	21	0
Georgetown	57	50	30	31
Bansang	59	73	47	56
Basse	55	54	37	13
Senegal	93	76	77	73

*Percentage of those who "had ever visited" the locality.

CHAPTER IV

FARM RESOURCES

Individual Production Resources

A common error in agricultural development programs is to assume that all farms are approximately alike and that a technology package designed for the "average farmer" will be widely applicable to most, if not all, farmers. In fact, farms are not all the same and the stereotype defined by national average parameters (e.g. farm size, family size, number of cattle) may not be at all useful for policy or technology design.

The resources available to the farmer influence the type of farming enterprises, the extent of involvement in each, their productivity levels and thus farm income and household consumption. It is at the resource level that significant va ation normally exists within rural society. Some farms will control resources far in excess of national average levels. These farms, while relatively few in number, control a disproportionately high amount of the nation's agricultural land, labor, capital and the scarce services of public and private institutions.

Normally there will be a large number of "resource poor" farms characterized by very limited amounts of some or all of these farm resources. In addition to the sheer scarcity of their resources, the relative proportions between resources controlled by these farms will differ from larger farmers. Small farmers likely have higher labor supplies and less capital per land unit than do larger farmers.

These two characteristics, factor scarcity and factor proportions, act to determine what technologies are appropriate to each type of farm. Designing technologies for agricultural change must recognize these differentials and attempt to fit the technology to the resource mix of each major farm type. Often the differentials between farm types will be great enough that a technology developed for one type will be sub-optimal, or completely infeasible for another group. Thus, defining farm groups on the basis of resources owned (or controlled) serves to identify target groups within the farm population and to specify the resource parameters for each which control the type of development that will be feasible for each.

This chapter looks at resource ownership patterns among Gambian farmers. We examine the family labor supply, cultivated land, cattle, animal draft power and small stock.

The Compound's Labor Force

The one resource found on every farm is the family which comprises the labor force for farming as well as household and other tasks. Chapter III presented figures on the population of compounds, showing an average of 18.49 persons per compound. Labor force equivalency is estimated here by converting all compound members to "adult equivalents" using the following relationships: age 0-13 = 0.2, age 14-60 = 1.0, and over 60 = 0.5. Males and females were given the same weights.

As with compound populations, a skewed distribution was measured for adult equivalent labor supply. The average across all 582 compounds was 12.0 adult equivalents. The median was 9.2. Observations ranged as high as 85 adult equivalents in a single compound.

Ethnic differences in labor force were noted as shown in Table IV-1 below, however, most of these distinctions are not statistically significant. Only the Serehuli differ at a reasonable significance level (.90), having larger families. Thus, while constituting less than ten percent of total households, Serehuli are fourteen percent of the rural labor

force.

Not surprisingly, a close relationship (R^2 = 0.93) was measured between the number of compound members and the estimated adult equivalent labor force for the compound. Furthermore this relationship did not vary ethnically, indicating that the forces affecting population structure within the household affect all tribes equally.

Table IV-1. Average Size of Family Labor Force by Ethnic Group

Ethnic Group	Average Family Labor Force (AE)[a]	No. of Households	Pct. of Households	Pct. of Labor Force
Mandinka	12.6	247	42.4	44.9
Wollof	11.1	74	12.7	11.7
Fula	10.0	130	22.3	18.6
Serehuli	18.1[b]	55	9.5	14.0
Jola	9.7	54	9.3	7.5
Other	10.5	22	3.7	3.3
Gambia	12.0	582	100.0	100.0

[a] Adult Equivalents
[b] Differs from other ethnic groups at the .90 level of confidence. None of the others differ from each other significantly.

Thus future surveys need only count compound members to estimate effective compound labor force without the tedious effort of identifying each member by age. Labor force can be estimated using the following regression equation:

$$\text{Adult Equivalents} = 0.183 + 0.659\ (\text{Compound Population}).$$

In any skewed distribution it is important to examine, not just resources per farm, but also the distribution of the total

resource. Taking total rural labor force as an aggregated resource we find the following:

a. One half the farms, those with the smallest families, add up to only 23 percent of the total labor force.
b. The smallest 75 percent of all farms contain only 46 percent of The Gambian's rural labor force.
c. The largest 10 percent of farms, as defined by the size of their labor force, have within them 30 percent of The Gambian's rural labor.

Land

Due to the large sample size in the BLS it was impossible to measure all fields being cultivated. Fields were, however, enumerated by crop grown. Thus cultivated area was estimated for each farm in the BLS by assigning to every field the average size in hectares measured for that crop in the IVS study. No data were collected on fields owned or borrowed that were fallow in the year of the survey.

The resulting distribution is more normally distributed than the distribution of adult equivalent labor force or livestock. For all compounds, the mean and median measured 4.2 and 3.9 cultivated hectares per compound respectively. First and third quartiles are found at 1.9 and 5.1 hectares. Of 582 compounds, only one exceeded 15 hectares; a single observation of 41 hectares.

Looking at the total cultivated land resource the distribution is somewhat more egalitarian than the distribution of labor and considerably better than the distribution of cattle. Ranking farms from smallest to largest in order of cultivated area, one finds the following:

a. One half the farms, those with the smallest cultivated areas, cultivate 26.9 percent of the total.
b. The smallest 75 percent of farms are cultivating 54.8 percent of all cropped land.

c. The largest 10 percent of farms, defined by cultivated area, cultivate 23 percent of all cropped land.

Ethnic differences in area cultivated were examined. Per compound averages are as follows:

Ethnic Group	Average Area Cultivated
Mandinka	4.33 hectares
Wollof	4.64
Fula	4.04
Serehuli	4.08
Jola	3.98

While it is tempting to suggest from the above that those ethnic groups with more livestock cultivate less land, none of these figures are significantly different from each other in a statistical sense.

Cattle Owned

Cattle play several important socio-economic roles in the rural and national economies. At the rural level cattle provide the following:

a. Rural economic savings to be drawn upon in times of economic stress.
b. Meat and milk for human consumption.
c. Some recurrent cash flow from sale of animals or animal products.
d. Draft power for tillage and transportation needs.
e. Soil fertility.
f. A basis of exchange which cements several social relationships at the local level.
g. A source of status.

From the national perspective, cattle have been a small source of foreign exchange earnings through the export of hides and skins and live N'Dama animals to other African nations.

Table IV-2 presents selected statistics on cattle ownership drawn from the BLS for The Gambia as a whole. Nearly 48 percent of rural households own one or more cattle. The average herd is 13.7 head, the median is 6.4, again indicating a skewed distribution with a limited number of large holders. Nearly 44 percent of those households with cattle owned 1-5 head and this figure is approximately equal for all tribes.

Ethnic differentials are shown above. These data would suggest that cattle are treated differently by different groups with two tribal clusters apparent. Comparing the Mandinka and Jola with national averages, a lower percent of compounds hold cattle and the individual herds are smaller. The Fula and Serehuli, on the other hand, exceed the average in both respects. Approximately half of the herds owned by Fula and Serehuli exceed 10 animals while less than 30 percent of Mandinka and Jola herds are so large.

Wollof households very nearly approximate the national average, midway between these other two groupings. Thus cattle ownership patterns provide an important example of the point made earlier, that average figures may not represent many farmers.

Looking at the distribution of total cattle, one obtains a picture of a highly concentrated resource as shown in Table IV-3. Over half of Gambia's rural compounds do not own cattle. Most of the rest have relatively small herds. Looking only at compounds with cattle one can calculate the following:

a. Fifty percent with the smallest herds own only 8.3 percent of all cattle.

b. The smallest 75 percent own 32.3 percent of the nation's cattle.

c. The ten percent with the largest holdings own almost exactly 40 percent of the total of all cattle.

Table IV-2. Cattle Ownership Patterns in The Gambia

Item	Ethnic Group					Gambian
	Mandinka	Jola	Fula	Serehuli	Wollof	Total
Percent of Compounds with Cattle	43.0	40.4	58.6	58.6	47.4	47.8
Mean Herd Size	11.7	8.8	16.9	19.5	14.2	13.7
Median Herd Size	5.5	5.0	8.5	8.5	6.5	5.9
Distribution:						
1-5 head	45.7	47.6	41.3	44.1	44.4	43.9
1-10 head	71.4	71.4	54.6	50.0	63.8	63.0
11-30 head	19.1	23.8	28.0	23.5	22.3	23.4
over 30 head	9.6	4.8	18.6	26.5	11.2	13.0
Percent of:						
a. Total compounds[a]	42	9	22	10	13	100.0
b. Cattle Owning Compounds[a]	38	8	27	12	13	100.0
c. Cattle Population[a]	31	5	31	18	13	100.0

[a] Small numbers of households belonging to minority ethnic groups are not included. Thus ethnic figures do not sum horizontally to 100 percent.

Table IV-3. Concentration of Gambian Cattle

Cattle Ownership	Pct. of Rural Compounds	Pct. of Cattle Owning Compounds	Pct. of Total Cattle
none	52.2	-	-
1-4	19.1	39.9	7.0
5-19	16.2	33.9	22.9
20-39	7.0	14.7	27.5
over 39	5.5	11.5	42.6
Cumulative			
less than 5	71.3	39.9	7.0
less than 20	87.5	73.7	29.9
less than 40	94.5	88.5	57.4

Who are these largest cattle owners? Herds of 40 animals or larger make a convenient definition that identifies the largest owners. Thirty-one compounds met this definition from the 582 compounds in the BLS. Table IV-4 provides selected data on these compounds. The reader is cautioned that this subset of the BLS constitutes a very small number of observations. The patterns in Table IV-4 should be considered suggestive only. Fula and Serehuli appear to bulk disproportionately large among owners of large herds. In the BLS sample these two tribes comprised 61 percent of the 31 households with herds of 40 or more animals, even though they were only 32 percent of the total sample of 582 compounds. Regardless of ethnic origin the larger owners averaged a uniform 52-54 head of cattle in their herds.

Table IV-4. Cattle Ownership by 31 Owners in BLS with 40 Head or More.

	Ethnic Group				
	Mandinka	Wollof	Fula	Serehuli	Total
Number of Compounds	8	4	11	8	31
Pct. of Compounds[a]	3.3	5.3	8.6	13.8	5.3
Pct. of Compounds with Cattle[a]	7.6	11.1	14.7	23.5	11.2
Number of Cattle	434	216	570	428	1648
Average Herd	54	54	52	54	53
Pct. of Total Cattle[b]	10.7	5.3	14.1	10.6	40.7

[a] Within ethnic group where applicable

[b] Percent of all cattle in the sample. Estimates the percentage of the nation's cattle owned by largest holders only.

Sheep and Goats

Sheep and goats are commonly combined as "small stock" in analyzing third world agricultural systems. In The Gambia small stock are more commonly owned than cattle. Over 85 percent of rural households own one or both species. However the two species are not always owned by the same compound, as shown in Table IV-5.

Table IV-5. Distribution of Compounds Owning Sheep, Goats, Both or Neither

	Percent of Farm Compounds		
	Sheep	No Sheep	Row Total
Goats	46.0	21.5	67.5
No Goats	17.9	14.6	32.5
Column Total	63.9	36.1	100.0

Nationwide, sheep and goat holdings are nearly identical thus supporting the thought that the two species fill the same role in household/farm needs and can be combined for analysis. Compounds which own sheep average 6.38 head, a figure exactly matched by the average number of goats in goat owning compounds. Median herd size for both species is exactly 5.0 animals. Since many compounds own both sheep and goats, the average herd of small stock is 9.8 animals.

An important consideration is the relatively large proportion of farm compounds which own small stock; more than 85 percent. Seventy five percent of farm compounds own three head or more; 50 percent of farm compounds own at least six head. Thus, a program designed to improve the productivity of small stock has the potential of reaching a large number of rural compounds. In

contrast, 52 percent of farm compounds own no cattle and will thus not be directly affected by cattle improvement programs.

Another interesting aspect of the small stock distribution is the relative scarcity of really large herds. Three-quarters of the small stock herds are a dozen or less, 90 percent include 20 or fewer animals. Thus the benefits of small stock improvement will be fairly equally spread among farm compounds and not concentrated among a few large holders.

Draft Animals

Three animal types provide draft power in rural Gambia; horses, oxen and donkeys. This section focuses on oxen and donkeys. Horses were enumerated in only 14 percent of farm compounds.

Distributions of donkeys and oxen by number owned are given in Table IV-6. Donkeys are part of the resource mix for less than half the farm compounds while draft oxen are owned by only one-third of them. The clustering of oxen owning compounds at two and four animals indicates the use of oxen in pairs for tillage and cultivation purposes.

By comparison with other livestock, neither donkeys nor oxen are numerous. In the 582 farm compounds of the BLS, 487 oxen and 443 donkeys were enumerated along with 4,050 cattle and 4,885 head of sheep and goats.

Table IV-7 shows highly aggregated data on the mix of donkeys and oxen among farm households. Most donkey owners do not own oxen whereas a modest majority of oxen owners also own donkeys. However, the largest group of farm compounds owns neither.

Table IV-6. Distribution of Ownership of Donkeys and Oxen

Number Owned	Percent of Farm Compounds		
	Donkeys	Oxen	Combined
0	53.4	66.0	38.7
1	28.4	6.7	19.9
2	10.1	18.7	16.7
3	5.7	1.0	10.7
4	1.7	5.3	5.2
5 or more	0.7	2.2	8.9

Table IV-7. Distribution of Compounds Owning Donkeys, Oxen, Both or Neither

	Percent of Farm Compounds		
	Oxen	No Oxen	Row Total
Donkeys	19.2	27.3	46.6
No Donkeys	14.8	38.7	53.4
Column Total	34.0	66.0	100.0

Resource Interrelationships

In most agricultural settings, the distributions of various productive resources are not independent. REsource rich farmers tend to control a disproportionately large share of several resources at once while the resource poor are relatively deprived across more than one resource simultaneously. Beyond simple abundance or scarcity, relative proportions of one resource to another affect the nature of technology best suited to a particular group of farmers.

For these reasons, the remainder of this chapter examines joint resource distributions and relative factor proportions among Gambian farmers. This analysis uses the BLS data. Since the BLS constituted a 2.3 percent stratified random sample of all rural households, this analysis probably portrays farm resource ownership fairly accurately.

Earlier sections of this chapter examined livestock ownership by individual type of livestock. It is of interest to examine the prevalence of various combinations of livestock. Over 90 percent of rural farm compounds hold some type of livestock. In most cases more than one species is involved.

	Percent of Farm Compounds
Cattle Only	2.4
Cattle, Sheep, Goats	11.0
Cattle, Sheep, Goats, Draft	30.6
Cattle, Draft	1.9
Sheep and Goats Only	19.4
Sheep, Goats, Draft	21.0
Draft Animals Only	4.3
No Livestock	9.5

Table IV-8 indicates the extent of BLS coverage of several resources and provides selected average statistics and relationships. Subsequent tables are based, in part, on comparisons with these overall figures.

Table IV-8. Baseline Survey (BLS) Coverage, Averages per Compound and Average Resource Proportions

	Total Enumerated in BLS	National Average per Compound
Compounds	582	
Cultivated Hectares (HA)	2,446	4.2
Small Stock (SS)[a]	4,885	8.4
Cattle (CA)[b]	4,050	7.0
Compound Labor Force (AE)[c]	6,956	12.0
Draft Animals (D)[d]	930	1.6
Labor:Land Ratio (AE/HA)		2.84
Cattle:Land Ratio (CA/HA)		1.66
Small Stock:Land Ratio (SS/HA)		2.00
Cattle:Labor Ratio (CA/AE)		0.58
Small Stock:Cattle Ratio (SS/CA		1.21

[a] Sum of sheep and goats
[b] All bovine animals except oxen
[c] Expressed in adult equivalents
[d] Sum of draft oxen and donkeys

Our initial assumption was that three variables, land, labor and draft power, would be the most important determinants of how farming systems were organized. Accordingly, these three resources became initial stratification devices in the search for farm resource differentials. Table IV-9 indicates the extent of average resources owned by farms of various classifications.

Table IV-9. Average Resources for Compounds Classified by Single Resources.

	No.of Farms	Ha	SS	CA	AE	D
Farm Size (HA)						
0 < HA ≤ 2.0	111	1.1	9.3	7.3	13.5	1.9
2.0 < HA ≤ 4.0	191	3.0	7.7	7.2	11.5	1.6
4.0 < HA ≤ 6.0	164	4.9	9.1	6.4	12.1	1.6
6.0 < HA ≤ 8.0	75	6.7	8.0	6.6	11.3	1.5
8.0 < HA	41	10.6	7.0	7.5	10.2	1.1
Labor (AE)						
0 < AE ≤ 5	114	4.4	4.0	1.1	3.8	0.5
5 < AE ≤ 10	217	4.1	6.4	4.1	7.2	1.2
10 < AE ≤ 15	110	4.6	8.2	8.3	12.3	2.0
15 < AE ≤20	58	4.4	12.2	13.7	17.4	2.2
20 < AE	83	3.6	17.2	16.1	31.2	3.0
Draft Animals (D)						
D = 0	225	4.2	4.6	2.5	9.2	0
D = 1	116	4.5	7.1	4.9	9.9	1
D = 2	97	4.3	11.3	9.5	13.2	2
D = 3	62	4.0	10.6	12.2	15.1	3
4 ≤ D	82	3.7	15.4	15.1	18.6	5.3

The most significant positive conclusion evident in Table IV-9 is that labor force and numbers of all animals (SS, CA, D) vary together. Since labor force is a direct linear function of compound size, one can say, on average, that the larger the compound family, the larger will be their holdings of all livestock classes. Linear regression equations quantifying these relationships follow. (In these equations, CP = compound population. Standard errors for the regression coefficients are given in parentheses). All relationships depicted in these

equations are highly significant. However, they explain only a small portion of the variance in the dependent variables.

$$SS = 3.13 + \underset{(.04)}{.44AE} \quad R^2 = .16, \quad F = 112.9$$

$$CA = 1.30 + \underset{(.06)}{.47AE} \quad R^2 = .09, \quad F = 57.8$$

$$D = 0.73 + \underset{(.007)}{.07AE} \quad R^2 = .14, \quad F = 98.0$$

$$SS = 3.08 + \underset{(.03)}{.29CP} \quad R^2 = .16, \quad F = 113.8$$

$$CA = 1.22 + \underset{(.04)}{.31CP} \quad R^2 = .09, \quad F = 59.0$$

$$D = 0.71 + \underset{(.005)}{.05CP} \quad R^2 = .15, \quad F = 103.9$$

Equally interesting are some of the negative conclusions; hypotheses which these data did not support. First, cultivated area apparently does not vary systematically with compound size, livestock numbers or animal draft power. An initial hypothesis had been that larger families would cultivate greater areas for their subsistence needs and further, that larger livestock holdings would be associated with more extensive crop farming as well. Neither of these two patterns can be observed in the BLS data. One is left to conclude that factors other than family size or animal draft power determine cultivated area. It would also appear that subsistence needs of larger households are met by something other than crop production. The correspondence between compound size and livestock numbers suggests that livestock based incomes rather than crops may be a major source of family income.

Table IV-10 looks at the same resource based stratifications and the variation in factor proportions among them. As expected, ratios between cultivated area and other resources vary systematically. Higher ratios of labor per hectare, cattle per hectare and small stock per hectare are found on smaller farms and on those with the largest family sizes.

Table IV-10. Variation in Selected Factor Proportions Between Different Resource Stratifications

	AE/HA	CA/HA	SS/HA	CA/AE	SS/AE	SS/CA
Farm Size (HA)						
$0 < HA \leq 2.0$	12.45	6.73	8.52	0.54	0.68	1.27
$2.0 < HA \leq 4.0$	3.80	2.39	2.59	0.63	0.67	1.07
$4.0 < HA \leq 6.0$	2.46	1.31	1.85	0.53	0.75	1.41
$6.0 < HA \leq 8.0$	1.68	0.99	1.19	0.59	0.71	1.21
$8.0 < HA$	0.96	0.71	0.66	0.73	0.69	0.94
Labor (AE)						
$0 < AE \leq 5$	0.85	0.24	0.91	0.28	1.07	3.78
$5 < AE \leq 10$	1.78	1.00	1.58	0.56	0.89	1.57
$10 < AE \leq 15$	2.56	1.79	1.75	0.68	0.66	0.98
$15 < AE \leq 20$	4.00	3.14	2.80	0.78	0.70	0.89
$20 < AE$	8.76	4.51	4.83	0.52	0.55	1.07
Draft Animals (D)						
$D = 0$	2.16	0.58	1.09	0.27	0.50	1.86
$D = 1$	2.20	1.10	1.59	0.50	0.72	1.44
$D = 2$	3.09	2.24	2.64	0.72	0.85	1.18
$D = 3$	3.74	3.02	2.63	0.81	0.70	0.87
$D \geq 4$	5.01	4.06	4.16	0.81	0.83	1.03

Tables IV-9 and IV-10 provide evidence that small stock are proportionally more important to small families than are cattle. In the smallest labor category ($0 < AE \leq 5$) nearly four times as many small stock are part of the resource mix as compared to

cattle. The SS/CA ratio shifts to approximately 1:1 as compound labor force grows to more than 10 adult equivalents. Beyond this point, as compounds continue to grow in size, both small and large stock increase apace.

Labor vs. Land Intensive Farms

Since family size, as measured in adult labor equivalents, and farm size, measured in hectares, apparently are independent of each other, the possibility exists of a significant range in labor:land ratios between farms. Table IV-11 presents a matrix of labor:land ratios for farms cross tabulated by family size and farm size. The range is indeed extreme, varying by a factor of 100 from 0.36 AE/HA to 36.76 AE/HA.

Table IV-11. Matrix of Labor:Land Ratios (AE/HA) for Gambian Farms Classified by Labor and Land Size Categories

Labor Force Groups	Farm Size in Hectares				
	0-2	2-4	4-6	6-8	8+
0-5	2.99	1.30	0.77	0.55	0.36
5-10	6.40	2.33	1.50	1.13	0.72
10-15	11.06	4.25	2.50	1.75	0.89
15-20	24.00	5.63	3.40	2.50	2.19
over 20	36.76	9.45	6.39	4.00	4.47*

* Only 3 farms out of 582 fell in this cell.

A certain amount of variation is to be expected but within limits farms can be clustered and treated homogeneously. In Table IV-11 it has been arbitrarily assumed that labor:land ratios between 1.5 and 5.0 constitute a mid-range group.

Isolated in the upper right corner of Table IV-11 are a group of farms that might be considered land abundant relative to their labor supply. These compounds might be candidates for labor saving farming practices, since in general they have low labor:land ratios which might cause labor shortages at certain stages of the agricultural cycle. In the lower left corner are land restricted compounds whose available labor greatly exceeds their available land. Labor intensive farming practices might be suggested for these farms.

These three generalized groupings may be further characterized by their shares in national resource totals. Both land restricted and land abundant classifications each constitute about one-quarter of total rural farm compounds. With respect to livestock and labor force, the land restricted group controls over 40 percent of the national resource, as does the mid-range group. With land, however, land restricted compounds, as defined in Table IV-11, cultivate only 14 percent of the cropped area. By contrast, land abundant compounds have small shares of other major resources but cultivate nearly 40 percent of the area farmed each year. Comparative resource shares are given below:

	Land Restricted	Mid-Range Group	Land Abundant
Pct. of Compounds	27.1	48.3	24.6
Pct. of Cattle	44.8	46.4	8.8
Pct. of Small Stock	41.4	43.0	15.6
Pct. of Draft Animals	41.6	46.8	11.6
Pct. of Cult. Land	14.1	48.7	37.2
Pct. of Labor Force	46.6	53.3	10.8

A Central Target Group

Agricultural planners and technicians are interested in developing improved technologies for wide spread adoption and maximum impact. For this purpose, they need to target a group of farmers with relatively homogeneous characteristics who constitute a significant fraction of total farms.

A central target group of farmers can be defined by taking the "mid-range" from Table IV-11 and eliminating its extremes; that is farm sizes of less than two hectares or greater than eight and compounds with more than 20 adult equivalent workers. The remaining seven cells are characterized by resource ownership that approximately equals the proportion of total farms in each cell. In other words, looking at labor, cattle, small stock, land and draft animals, the proportion of the total sample for each resource i each cell is not more than twice, nor less than half, the proportion of farms in the same cell.

Thus, the resource characteristics of the central target group for agricultural development in The Gambia can be generalized as follows:

a. between 2 and 8 hectares
b. between 5 and 20 adult equivalents
c. between 4 and 13 small stock
d. between 4 and 15 cattle
e. between 1 and 2 draft animals each

Farms thus defined constitute 42.4 percent of Gambia's farms, enough to be the main body of farmers. Within the resource ranges given above, average values for the whole central target group are, respectively: 4.3 ha, 10.1 adult equivalents, 7.5 small stock, 6.6 cattle and 1.6 draft animals. The central tendency of this target group can be seen by comparing these figures with those for the nation as a whole in Table IV-8.

Capital

Of the various factors of production, capital and credit appear to be relatively insignificant in traditional farming systems. Institutional credit is generally unavailable to the average rural Gambian with the exception of credit for groundnut fertilizer. A high proportion of the loans that are made are provided by a village shopkeeper or a trader. Interest rates generally exceed one hundred percent, thus farmers restrict borrowing to absolutely essential needs. In fact, because of the paucity of credit data in the survey responses, there was no analysis conducted.

Capital as an input is significant for the average farmer although their capital stock is severely limited. For our purposes capital is defined as money that is available for investment purposes (liquid capital) or money that has already been invested in the farm (fixed capital). Conventional uses of liquid capital include purchase of seed, fertilizer, farm implements and tools, and machinery in some cases. In addition, farmers purchase household necessities such as food items, clothes and school fees. They also purchase additional livestock, either draft animals, cattle or small ruminants. Finally, liquid capital is used on social and religious occasions, e.g., marriages, funerals, and tabaski (the major Muslim feast day). The only use of liquid capital for investment is in livestock purchases, as no other viable alternative is believed to exist by rural people. Women will frequently buy gold and make earrings, a form of savings, which can be liquidated if the need arises (such as a total crop failure). Or the jewelry will be handed down to a daughter at the time of her marriage.

Liquid Capital

Liquid capital is largely derived from two sources; cash from annual crops and off-farm earnings. Off-farm sources can include petty trading, remittances received from family members working abroad, public sector employment (District Chief or Area Council member, etc.), fishing, blacksmithing, arts and crafts, carpentry, and the like. All are common for The Gambia and comprise a significant portion of their liquid assets.

Table IV-12 provides details concerning the sources of cash for farms stratified in several ways. All three show significant differences between categories. Farm size has expected results, that is, annual cash crop income increases in direct proportion to the size of family holdings. However, this positive correlation does not hold when considering off-farm earnings.

Table IV-12. Liquid capital representing actual average 1982 farm earnings, (in dalasis, excluding livestock)

Strata	Cash from Annual Crops		Off Farm Earnings		Total Earnings (1 + 2)
Farm Size	Mean	S.D	Mean	S.D	Mean
F. S. 1	636.71	318.07	484.23	497.23	1121.03
F. S. 2	1015.97	456.98	290.02	278.11	1305.99
F. S. 3	2207.28	343.64	2026.67	3428.18	4233.95
F. S. 4	5591.07	3064.08	720.59	824.73	6311.66
Ethnicity					
Mandingo	1303.33	681.10	1114.89	1941.18	2418.22
Wollof	4022.32	3902.04	209.06	339.57	4231.38
Serehuli	2258.65	1788.97	825.34	719.86	3083.99
Fula	1621.09	1452.11	1882.66	3613.91	3503.75
Jola	1674.47	920.84	232.47	339.70	1906.94
Labor Category					
Manual	796.14	444.66	497.47	479.80	1293.61
Draft	2994.16	2765.18	961.78	2088.75	3955.94
Total	2408.20	2569.9	597.70	976.50	3006.10

Income variation by ethnicity is substantial, not only by tribe but also in comparing levels in off farm earnings. The Wollof receive a substantially larger proportion of total income from crop sales than do the other ethnic groups. Off-farm earnings vary from a high of Dalasi 1882.66 for Fula to Dalasi 209.06 for the Wollof. Variability is largely caused by the diversity in off-farm income opportunities. A case in point is the Fula and Wollof, several of whom had family members employed by the government. Income generated from public sources skews the average beyond normal parameters. In the absence of such revenue their income would still be higher, yet much closer to the mean.

Finally there are differentials by labor category (animal traction vs. manual) which are again significant, particularly for income derived from cash crops. One should be cautious when interpreting these results. This large variation arises from two inter-related sources. First, animal traction is bound to be more efficient and contribute to family income. Second, those people who are farming with manual means will be less affluent, almost by definition. Such farmers do not choose to be without draft power. They are aware of the output gains that are possible. It would probably be safe to assume that many people within this category borrow draft power whenever the opportunity arises. Lending of equipment, even among work units is common.

Fixed Capital

Farm buildings, tools and machinery, draft and productive animals are all categorized as fixed capital for our purposes. Fixed capital is largely the result of investing liquid capital. Investment priorities vary significantly be ethnicity and by labor category. Fixed capital resources were inventoried and valued at the beginning of a 12-month period and again at the end. Data are presented in Table IV-13. Initial values of buildings range from a low mean of D 35.10 for Mandingos to a high of D 161.50 for Serehuli. (Ending values for the year are generally less than opening due to a depreciation factor; if the

ending value is greater it usually refers to purchases or births of livestock.)

The Mandingos have few farm buildings of any type while the Serehuli have an abundance of all. For instance, it is customary for Serehuli wives to have individual store rooms for their cereals. If a farmer has one wife she will have one storage facility for the grains she is responsible for; if he has four wives, they will each have their independent stores. The Wollof, Mandingo, and Fula are similar to the Serehuli in that they provide housing for draft animals and small ruminants. Facilities may range from a simple structure, to dual level buildings for sheep and goats. Large draft animals such as horses or oxen will frequently have solid ground-level structures that are repaired on an annual basis. Why this variation exists is an open question; suffice it to say that the Mandingos give livestock housing a very low priority. As for cereals, they are commonly stored within the main house of the compound head, in an available room, but usually close to the kitchen area where smoke from cooking fires deters insect pests. Buildings used only for human occupation are not included within this inventory.

Table IV-13. Opening and ending values for fixed capital[a].
(46 IVS farms in 1982. Figures in Dalasi)

Strata	Buildings	Tools/Machines	Draft Animals	Productive Animals	Total
-by Ethnicity-					
Mandingo					
opening	35.10	213.10	760.00	3110.00	3731.60
ending	26.70	184.40	773.10	3040.50	3679.90
Wollof					
opening	144.70	248.30	1336.30	1288.30	2950.80
ending	111.10	229.40	1117.40	1240.20	2611.40
Serehuli					
opening	161.50	310.40	598.00	4384.20	5260.20
ending	142.40	541.80	495.80	4278.00	5087.10
Fula					
opening	130.90	260.90	1550.00	4866.20	6605.60
ending	105.50	216.10	1407.60	3907.10	6358.60
Jola					
opening	90.40	170.50	900.00	955.00	1650.80
ending	48.10	146.90	720.00	925.80	1476.40
Labor Category					
Manual					
opening	43.10	86.70	----	438.70	581.30
ending	34.10	105.50	----	368.40	486.20
Draft					
opening	144.50	328.60	1008.40	4007.20	5491.00
ending	116.60	378.00	881.10	3744.80	5253.60
Total					
opening	125.20	265.50	998.70	3076.20	4210.20
ending	100.80	306.90	848.80	2864.00	4009.90

[a] Opening values represent actual values at the start of the resource inventory period (May 82) while ending values represent final valuations one year later, in April 1983.

The column consisting of figures for tools and machines, by ethnicity, has two noteworthy values: a low ending value of D 146.90 for Jola and a high ending value of D 541.80 for Serehuli. The low value for Jola is explained by the fact that they own fewer draft animals than any other ethnic group, thus their machine requirement is less. The Serehuli have an unusually high machinery value because they own a high proportion of draft carts (either ox, horse or donkey drawn) which are more expensive than any other component of the sine hoe package. This, of course, shifts the mean upwards. Draft ownership is lowest for Serehuli and highest for Fula. The latter own mostly donkeys, a few farmers own large numbers. Donkeys are the least valuable of the draft animals (about half the cost of a healthy ox) but their higher numbers gives them the largest total value among draft animals. Wollof will keep oxen for draft power, but a large fraction of this ethnic group own no draft thereby diminishing their recorded mean. (Variability is high within the Wollofs in our sample; one farmer had 6 large work oxen and a horse to assist in cultivating his 40 hectares).

Values of animals owned, averaged by tribe, ranged from a low ending value of D 925.80 (Jola) to a high ending value of D 4278.00 (Serehuli). The Serehuli generally have substantial flows of off-farm income which they invest in livestock. Jolas in our sample have the smallest total income (liquid capital) and thus have less capacity to invest. The large differential between opening and ending values for the Fula is primarily due to livestock mortality. Some of the Fula live in a harsh region in the Gambia where feed and water are extremely minimal towards the latter dry season months. Old animals or the very young may die as a result.

A quick overview of the labor category shows a stark difference between the two groups, for all assets. As was mentioned earlier, those people owning no draft seem to have insufficient resources to the point where investment opportunities are beyond their reach. These people represent the poorest group within the IVS sample.

Table IV-14 summarizes total capital (liquid plus fixed) available to the 46 farms within our sample.

Table IV-14. Value of available capital held by 46 farms, various groupings (Ending values for April, 1982, in 1982 Dalasis)

Strata	Total Liquid	Total Fixed	Total Capital
by Ethnicity			
Mandingo	2418.22	3679.90	6098.12
Wollof	4231.38	2611.40	6842.78
Serehuli	3083.99	5087.10	8171.09
Fula	3503.75	6358.60	9862.35
Jola	1906.94	1476.40	3383.34
Labor Category			
Manual	1293.61	486.20	1779.81
Draft	3955.94	5253.60	9209.10
Total Mean	3006.10	4009.90	7016.10

CHAPTER V

CROPPING IN THE GAMBIA

Overview

Farmers in The Gambia produce only a limited number of field crops. For simplicity they may be grouped into cash crops and food crops. To set the context for the analysis that follows, these are described in generalities here.

Cash Crops

Groundnuts: Groundnuts constitute 97 percent of all cash crops grown. The crop has a long history as a cash crop for farmers and, through exports of groundnut oil and cake, as the main source of Gambia's foreign exchange. Groundnuts are felt to be relatively drought resistant although production can vary widely in association with rainfall. As a legume groundnuts should fix nitrogen through the action of rhizobium bacteria. However, soil conditions are not conducive to prolific nitrogen fixation and farmers treat groundnuts as an exhausting crop. Despite their primary role as a cash crop, groundnuts make a significant contribution to household food consumption. The nuts are consumed in various forms and the oil is one of the primary cooking media.

Cotton: Though cotton is the second largest cash crop it represents only a small fraction of cash cropped area. Since its initial introduction, total production and area planted have not met expectations. The crop is difficult to grow, experiencing insect and climatic difficulties, and it does not compete well for farmer's resources. Yields under local conditions are generally quite low.

Pepper: Normally pepper is considered a compound crop to be used for cooking by the household. However, in the Western Division it is widely grown, often by the Jola tribe, as a cash crop for sale in urban markets.

Food Crops

Early Millet: This crop is a preferred cereal in local diets. It is generally grown close to the compound where it can be protected from birds and utilize the nutrients deposited by tethered animals. Millet is relatively resistant to the affects of drought and thus assures a stable source of household cereals year after year. Early millet matures early in the season and is thus one of the first cereals available to end the "hungry season". Early millet is particularly susceptible to bird attack and this factor partially determines where it can be successfully grown. Central and northern portion of the country are favored, partly because of the presence of a local grain ("jajewo") which matures at the same time and substitutes for millet in the diet of birds.

Late Millet: This millet variety matures somewhat later, but it is a consistent producer under variable climatic conditions. It requires less protection from birds and can thus be grown in distant fields as well as in the eastern and western regions of The Gambia.

Maize: Maize matures prior to, or simultaneously with early millet and is thus considered a hungry season crop. Until recently most maize was grown as a backyard or garden crop, harvested in the late dough stage (semi-mature) and eaten as roasting ears. Conventional wisdom suggests that the Serahule differ from other tribes, growing maize as a field crop, harvesting mature grain and consuming it by preference.

Recently maize production has increased markedly under the joint "commercial maize" program of the Department of Agriculture and the AID sponsored Mixed Farming Project. The expanded hectarage is entirely grown for maize grain although some ears are picked for household use prior to maturity. The price of maize grain has remained high and the crop is on the threshold of emerging as a significant cash crop as well.

Early Sorghum: This crop is not a particularly favored cereal. However, it matures at approximately the same time as maize and early millet so it is considered a hungry season crop and grown by some farmers for this reason.

Late Sorghum: Late sorghum was introduced in the Basse area in the late 1950s. It has not been widely successful, perhaps because of its susceptibility to drought.

Rice: Rice is definitely the most preferred cereal in local diets. Three separate rice cultivation methods are distinguished, although it is not known whether different varieties are used for each. Upland rice is grown in gardens near the village, in backyards or close to river sides. This early maturing variety has been on the decline in recent years due to a period of insufficient rainfall. Swamp rice is grown along the river flood plains where water is available. These plots are often several kilometers from the village. Irrigated rice is concentrated in the McCarthy Island Division along The Gambia river. Introduced by Taiwan in the 1960s and 1970s, acreage has recently increased through the Jahally-Patchaar project.

Draft Animals, Machinery, and Hand Implements

Draft animals in The Gambia fall under three subtypes; oxen, horses, and donkeys. Oxen are for the most part located in the Western Division where they were first introduced, though it is

not uncommon to find them in the northern part with the Wollof, or in the eastern section with the Serahule. Of the three draft types, oxen are the strongest and capable of the most work in a given day. Oxen are of the N'Dama breed. Young bulls are removed from the herd and trained for draft work. Generally they require supplemental feeding in the dry season, especially just prior to the next rains. It is estimated that there are presently 8-10 thousand N'dama oxen in the country.

Horses are scattered throughout the country, but found least in the Western Division where trypanosomaisis is most prevalent. Generally they are small and thin by western standards, most not exceeding three to four hundred kilograms. Like oxen, they too need additional feed to maintain them through the long dry season months. Donkeys are the most numerous of the draft animals, due in part to their cheaper price and the fact that they require less feeding. Despite their small size, these animals are capable of handling a wide range of farm activities and are appreciated for their draft power input.

Machinery designed for these draft animals was first introduced in The Gambia during the early 1950s. The first machine, called an Emcot Ridger, was designed to be pulled by a pair of oxen for cultivation purposes. Though somewhat limited in its capability, it was viewed by the farmers as a labor-saving device and did well until the introduction of the "Aplos" Package. Designed by a British manufacturer, the "Aplos" was introduced in the mid-1960s and consisted of: a) plow, b) weeder, c) seeder, d) ridger, e) lifter. The package also has a cart where all components were surmounted with a seat for the driver. Unfortunately the Aplos equipment was difficult for the N'dama oxen to pull, required that tree and bush stumps be removed prior to use, and was considered too expensive by most farmers. Its use dwindled.

Soon farmers began looking into Senegal for more suitable implements. This led to the introduction of the Sinehoe Package which consisted of a weeder, seeder, cultivator, and groundnut lifter. This package, introduced in the early 1970s had several advantages over earlier models; it was cheaper and could be drawn by oxen, horses, or donkeys. Finally, if a farmer could not

afford the entire package, he could purchase individual components. The Sinehoe is presently in extensive use in The Gambia.

In spite of the introduction of draft power over thirty years ago, crop cultivation is still largely a manual effort. Some farmers do own draft animals, however, the average farmer generally has insufficient draft power given his planted area and often an incomplete set of cultivation equipment (e.g., a seeder but no weeder). Furthermore, some cultural practices require hand labor despite the availability of draft machinery. For example, the Sinehoe weeder is capable of weeding between crop rows, but not within the crop row itself. Therefore in-row weeds must be removed by hand. The use of hand implements can be extremely labor intensive, often requiring many person-days per hectare. Listed below are traditional hand implements with their local names and common uses.

Implement	Local Name	Common Usage
1) Axe	Terango	-cutting firewood or clearing land
2) Cutlass	Muruba	-cutting grasses, sticks
3) Hand hoe	Dabo	-weeding, land preparation for rice
4) Seeding hoe	Konkoduwa	-seeding
5) Long hoe	Dabajang	-weeding, ridging, cutting
6) Short hoe	Dibongo	-lifting groundnuts,plowing rice fields
7) Sickle	Worrto	-cutting grass for roofing, harvesting rice and findo
8) Calabash	Mirango	-milking, broadcasting seed or fertilizer

Land Use in Crop Production

Allocation of cultivated land among various crops represents a series of optimizing decisions made by farmers. It reflects priorities among their various objectives, their mix of available resources, resource quality and quantity, market prices, subjective values and other factors. The crop mix depends not only on physical factors such as rainfall and soil fertility, but also on economic and social considerations. Given their mix of production factors, farmers utilize them within a structuring framework of goals, management abilities and expectations as well as variations in physical and institutional conditions as the season unfolds.

Cultivation in The Gambia is largely confined to a single season by the rainfall pattern. Rice and some vegetables are grown in the dry season with irrigation of various types but these areas are not extensive when compared to rainy season cropping.

Land Tenure and Availability

Under communal traditions, land is thought of not only as a factor of production, but also as a significant element in the social fabric of the community (Dunsmore et al., 1976). The view that there is no personal ownership of land in rural Gambia is questionable. Uncleared lands within the villages are communally owned and anyone has a right to clear and use land for farming purposes after seeking permission from village "Alkalo". In accordance with customary law, land rights are vested in, and administered by the district authorities headed by the district "Seyfo" and village "Alkalo".

The ownership of land is usually established through the act of clearing and bringing land under cultivation. Once ownership is established, no one else can claim the land. Parcels of land may be loaned or rented to non-compound members by the owner. Some 35 percent of the farmers interviewed in the IVS rented land

to augment their holdings. These were generally the middle sized farms. Only nominal land renting was observed among farmers with very small or very large holdings. Normally, land is not sold, mortgaged or pledged for credit.

The population density of the country is rapidly increasing, creating a trend of decreasing land availability per compound for farming. Presently, farmers are finding it more and more difficult to get quality land near the village, causing them to go further away from the village to farm. As the distance walked to the fields increases, the amount of time available for productive work declines.

Soil Types: In the Baseline Survey, two types of land were differentiated in the cropping patterns; upland and bottomland soil. This distinction is based on the Land Resource Study No. 22 which outlined a total of 24 soil associations that characterized Gambian soil, 12 each of upland and bottomland. These two broader land types were used as the ecological stratification criterion for selecting villages for the BLS study.

Table V-1 indicates the percent of the crop fields enumerated on each soil type with separate answers for fields cultivated by the compound head and his first wife. The vast majority of crops cultivated by compound heads are located on upland soils. However, rice was predominantly planted on bottomland soils where access to water permits rice cultivation. In contrast, various crops planted by the first wives, except groundnut, were relatively evenly distributed between the two soil types.

Table V-1. Fields Grown on Three Soil Types

Crops	Compound Head			First Wife		
	Upland	Bottomland	Swamp	Upland	Bottomland	Swamp
Groundnut	94	6	-	82	19	-
Maize	93	7	-	55	45	-
Millet	94	6	-	55	45	-
Sorghum	92	8	-	50	50	-
Findo (digitaria)	99	1	-	64	36	-
Cotton	97	3	-	75	25	-
Rice	20	56	24	26	41	33
Mixed: Groundnut +Cereals	86	14	-	46	54	-
Maize + Other	100	-	-	58	42	-

Crops Grown

Table V-2 provides an estimate of the distribution of cultivated area among major crops. These data indicate that millet and groundnut account for two-thirds of the total in almost equal shares. The data below provide additional details for each crop based on BLS responses.

In the Baseline Survey single crop fields accounted for 64 percent of the total crop fields planted during the cropping season. Mixed cropping and fallow fields were 24 and 13 percent respectively. As the BLS survey revealed, 97 percent of the compound heads and 89 percent of the first wives stated that they cultivated one or more crops.

Eighty-four percent of the compound heads interviewed grew groundnuts, which are the main cash crop in The Gambia. Most of the groundnut fields are planted on upland soils (85%) and in single stands.

Table V-2. Land Allocation Among Principal Crops in The Gambia

Crop	Average Field Size (HA)[b]	Percent of Cropped Area[c]
Groundnut[a]	.79	33.9
Millet	1.44	33.3
Maize[a]	.50	13.2
Sorghum	.63	10.0
Rice	.18	4.9
Findo	.70	3.9
Cotton	.34	0.7

[a] Includes mixed crop fields.
[b] Calculated from IVS data.
[c] Percentage of total area in crops listed.
Calculated from BLS data using mean IVS field size

Of the cereal crops, millet (both early and late varieties), maize and sorghum are the most important food crops nationally, in that order. Seventy--six percent of the compounds heads indicated that they grew millet. Of those cultivating millet, only 61 percent cultivated it as a single crop. Most (94%) of the compound heads' millet fields were located on upland soil.

Sorghum is cultivated by sixty-one percent of the compound heads. Some grew sorghum inter-cropped with groundnut. Only 46 percent of the compound heads surveyed planted it as single crop. In addition, 92 percent of the compound heads' sorghum fields are located in the upland soil especially in areas near the village that have been well manured by cattle during the dry season.

Maize was grown primarily as a backyard crop before the introduction of the Mixed Farming Project maize technology package. Eighty-two percent of the compound heads grew maize. Sixty-four percent of those who grew maize planted it as a single crop.

Cotton is heavily subsidized by government in the hope of generating an exportably commodity. Only six percent of the sample compound heads grew cotton. Findo (digitaria) which is of limited significance in terms of area of fields is normally grown in small plots. Of the 582 compound heads interviewed, only 106 (18%) grew findo as a crop. Findo fields are normally cultivated as single stand and located in the upland soils.

Traditionally, rice has been grown by women. Thirty percent of the compound heads indicated cultivating rice. In contrast, 68 percent of the first wives cultivated one or more rice fields. In the upland areas where rice production is impractical, women cultivate groundnut, millet, sorghum, maize and occasionally cotton in fields which are recognized as separate from those of the men.

Based on the major factors of soil types, implements used, rainfall, etc., the organization of crop production varies according to region of the country. This variation between the five divisions of the country is considerable and needs to be highlighted. The key features of the crop production system by division are as follows:

1. Groundnut is mainly cultivated in the McCarthy Island and North Bank Division. About 50 percent of the cultivated area was in groundnut in these two divisions.
2. Millet cultivation is undertaken by 46 percent of the sample in McCarthy Island and Upper River Division.
3. About 73 percent of the sample farmers cultivated sorghum in McCarthy Island, Upper River and Western Divisions.
4. Maize was concentrated in Upper River Division and part of McCarthy Island Division.
5. McCarthy Island, Western Division and Upper River Division contained 82 percent of the observed fields of rice.

All of these crops are important throughout the country. However, there are variations in the concentration of these crops by division. Traditionally, cultivation of groundnut as the cash crop of the country is throughout the area but the percentage is relatively high in two divisions. Likewise, cotton is cultivated mainly in Upper River and part of McCarthy Island Division.

Table V-3. Percentage Distribution of Crop Fields Grown by Compound Heads Between Administrative Divisions

Crops	Divisions					Total
	MID	URD	NBD	LRD	WD	
Groundnuts	26	17	22	15	20	100
Millet	23	23	19	16	19	100
Maize	26	22	18	13	21	100
Sorghum	29	22	15	13	21	100
Rice	32	25	1	17	25	100

Single and Multiple Cropped Fields

Standard economic theory suggests that resource-poor subsistence farmers are normally risk averse. Allocation of land to crops is subject to the same principal, that is to optimize production without jeopardizing some minimum level of final output. One traditional method is to plant a field with more than one crop, called mixed or multiple cropped fields. The logic, apparently, is that if one crop fails, or does poorly, perhaps the others won't, thereby increasing the probability of at least marginal success. As in other West African countries, mixed cropping is also practiced in The Gambia. Table V-4 below shows the breakdown between mixed and single planted fields.

At first glance, it is quite clear that the majority (76%) of crops are planted as single stands. Crops that are planted in multiple stands are usually intercropped in rows. In nearly all observed cases the primary crop is groundnuts with the secondary crop being either millet or sorghum. Spaces between rows of the secondary crop range from five to ten meters, wide enough to allow adequate sunlight to reach the shorter groundnut crop. An advantage to row planting, whether in single or intercropped fields, is that it facilitates cultivation using draft power.

Concentrations of either single or multiple planted fields vary regionally. Regional variation is usually explained by ethnic preferences or outside influences, such as that from neighboring Senegal. For example, looking at Table V-5 below, it is apparent that farmers in the North prefer to plant the large majority (94%) of their crops as single stands whereas in the

West, 59% of the sample planted multiple crops. Farmers in the north are mostly Wollof who have been influenced by Senegal's SISCOMA machinery and planting practices. Sample farmers in the Central region have less total cultivated hectares yet nearly twice the number of fields. Draft mechanization is more labor efficient with larger, single cropped fields. Eastern region farmers allocate an almost equal proportion of land to the two cropping methods. These are generally Sarahule and Fula who are not as mechanized as the Wollofs. In addition, this region is the driest and hottest part of the country. With periodic drought, these farmers may have done better over the years when they diversified their cropping system.

Table V-4. Distribution of fields into single or multiple cropped, by crop grown. (46 farms, 1982)

Crop Type	Total Hectares	Mean Field Size (Ha)	No. of Fields	Percent of Total Ha.
Single				
Groundnuts	102.33	.75	136	33.4
Millet	69.16	1.44	48	22.5
Rice	25.89	.18	144	8.0
Sorghum	24.58	.63	39	8.4
Maize	8.92	.32	28	2.9
Cotton	3.13	.34	9	1.0
Pepper	1.11	.14	8	0.4
Sub Total	235.12	.57	412	76.6
Multiple				
Gnuts/Coos	61.19	.86	71	20.0
Maize/Others	10.51	.29	36	3.4
Sub Total	71.70	.65	107	23.4
Total	306.82	.59	519	100.0

Table V-5. Regional variation in land allocation to single or multiple cropped fields for 46 farms, 1982.[a]

Crop Type	West		North		Central		East	
Single	HA	%	HA	%	HA	%	HA	%
Groundnuts	----	—	60.53	47	38.82	37	2.98	7
Millet	8.31	25	49.64	39	6.64	6	4.57	12
Sorghum	1.89	6	5.14	4	10.27	10	7.28	18
Maize	----	—	5.12	4	3.58	3	----	--
Rice	2.79	8	----	-	22.65	22	----	--
Cotton	----	—	----	-	-----	—	3.01	8
Sub Total	12.99	39	120.51	94	81.96	78	17.84	45
Multiple								
Gnuts/Coos	19.61	59	6.58	5	16.05	15	18.95	47
Maize/Others	-----	—	----	-	7.53	7	3.16	8
Sub-Total	19.61	59	6.58	5	23.58	22	22.11	55
Total	33.26	98	127.09	99	105.54	100	39.95	100

[a] Hectares = total area cultivated. % = percent within Region. Totals may not sum to 100 percent due to rounding.

Crop Rotations

Crop rotation is a specific facet of agricultural practice in which the farmer attempts to sequence his crops in a particular way in order to maximize his output or meet other objectives. Crop rotations recognize that there are ways in which a crop in one year or season can affect the production of crops on the same field in the next time period. Many of these interrelationships are due to soil fertility considerations. Yet others are based on buildups of certain soil flora or fauna, residual toxicity or simple timing problems when a late maturing crop cannot be harvested in time to plant crops that might succeed it.

In a traditional agriculture such as The Gambia's, the scientific bases for interseasonal crop interrelationships are not generally understood by farmers. Yet their effects have been experienced over many years, if not many generations. And farmers have adapted their cultural practices to accommodate these affects. Thus, built into the wisdom of traditional farming practices are several patterns which are rational and explainable and which serve to protect and/or enhance the farmer's welfare.

Crop rotations are one of these practices which was examined in the Intensive Village Study (IVS). Data were collected on each field cropped by respondent farmers. For each field and parcel (portion of a field), crop histories for the previous three years were recorded. Thus a four year sequence of crops is known for 365 fields or 649 parcels.

Unfortunately no data were collected on fields that were fallow in the years of the survey. Therefore, all rotations that include fallow are under represented in direct proportion to the frequency of fallow in the rotation.

With this caution in mind the data below give at least some idea of prevalent rotations. The data are examined in two time dimensions, two years and four years. The two year analysis looks at crop sequences over only one seasonal transition. For example, how often is a groundnut field followed by a millet field. By looking only at single season transitions of this type, data for three such sequences could be pooled, thus partially abstracting from any single season abnormality such as a drought. Table V-6 summarized the results for 971 observations of one crop following another.

Examining the two year data in Table V-6, several patterns emerge. First, continuous upland cropping is confined largely to maize. This undoubtedly reflects farmers' propensity to plant maize on the field nearest the compound where it can be better protected and easily harvested by daily picking of a few roasting ears.

Second, the most prevalent upland crop rotation in The Gambia, in terms of the number of fields involved is a two year rotation in which a field simply alternates between groundnut and fallow. This reflects the farmers' view that groundnut is a depleting crop with respect to soil fertility.

Table V-6. Prevalence of Various Two Season Crop Sequences for Major Upland Crops in the Gambia[a]

Succeeding Crop	Initial Crop: Early Millet	Late Millet	Sorghum	Maize	Groundnut	Fallow
E. Millet	17.6	1.4	6.0	2.6	19.3	6.3
L. Millet	-	1.4	24.0	2.1	11.5	5.5
Sorghum	5.5	32.4	9.0	6.8	21.5	9.8
Maize	4.4	7.0	8.0	85.3	1.5	1.6
Groundnut	60.4	36.6	29.0	2.6	-	52.0
Fallow	12.1	21.1	24.0	0.5	46.3	25.0

[a] Based on 971 observations of two crops in sequence on the same field. Years recorded were 1979 to 1980 and 1980 to 1981. Excludes all combinations which involved rice, cotton, or findo. Percentages sum downwards.

Table V-6 includes 256 fields which were initially fallow. One hundred thirty three of them were planted to groundnuts in the following season. Two hundred and seventy fields were initially in groundnuts. Of these 125 were left fallow in the following season. In this sample groundnut and fallow fields (and area) are approximately equal each year. And approximately half of each are involved in a groundnut-fallow two year rotation.

Another observation from the two year sequences is that groundnut is often followed by, or preceded by a small grain cereal. Of early millet fields, some 60 percent of them will be followed by groundnuts. Groundnut is also the most probable crop after late millet and sorghum. A modest tendency to alternate sorghum and late millet may be seen as well.

Table V-6 plus a review of the raw data suggested that small grains (early millet, late millet and sorghum) are considered interchangeable in several farm rotations. Consequently, the data were retabulated with these three crops pooled into Table V-7. Rice was added as well.

Table V-7 reinforces most of the above conclusions. Groundnut fields are followed about equally by either fallow or small grains. Small grains are most frequently followed by groundnut. However, a significant portion (32.7%) of the small grain fields observed were followed by another small grain.

Table V-7. Prevalence of Various Two Season Crop Sequences for Major Upland Crops in The Gambia (Small Grains Pooled)[a]

Succeeding Crop	Initial Crop: Small Grains	Maize	Rice	Groundnut	Fallow
Small Grains	32.7	11.5	-	52.2	20.6
Maize	6.5	85.3	-	1.5	1.5
Rice	-	-	100.0	-	4.1
Groundnut	41.8	2.6	-	-	49.8
Fallow	19.0	0.5	-	46.3	24.0
No. of Obsv.	263	191	256	270	267

[a] Percentages, summing to 100 downward.

Where paddy rice is grown, there is little opportunity for cultivating any other crop because of water table and soil conditions. Rice in The Gambia is apparently continuously cropped. All observed rice fields were followed by another rice crop. In eleven cases (of 267 sequences beginning with fallow), a fallow field was subsequently converted to rice. Since no rice-fallow-rice rotation was observed, this would suggest a small increase in rice area at the expense of fallow land during the 1979-82 period covered by these data.

Four years of cropping history were collected for 649 fields. In each case, the standing crop was recorded and the farmer indicated from memory what the preceding three crops had been. As noted above, enumerators failed to examine fields that were fallow in the year of the survey. Consequently, the prevalence of particular rotations including fallow would have been underenumerated in direct proportion to the proportion that fallow was in the sequence. For example, if fallow constituted half of the rotation (as in Fallow-Groundnut-Fallow-Groundnut), then the survey would have missed half the fields involved in this sequence because they were fallow in 1982. The actual

prevalence of this particular rotation would have been twice that observed.

Using this logic, observed four-year crop sequences were adjusted for underreporting of those including fallow. We, thus, estimate that the IVS farmers actually managed 867 fields, 649 of which were examined in 1982 and 218 which were fallow and thus overlooked. These farmers were thus fallowing 25 percent of their fields.

Table V-8 presents the four-year cropping sequences observed, after the above adjustment. Three types of continuous cropping were observed, two of which (rice, maize) were important. Three alternating patterns were observed. In this usage, an alternating pattern is a two-year rotation, which was twice repeated in the four year history. Alternating groundnut with fallow is the most prevalent regular crop rotation sequence in The Gambia.

Table V-8. Estimated Prevalence of Observed Four-Year Cropping Sequences, Adjusted for Omissions of Fallow in 1982

Pattern Number	Crops Included	No. of Fields	Pct.of Total
	-Continuous Cropping-		
1	Small grains	14	1.61
2	Maize	69	7.96
3	Rice	127	14.65
	-Alternating Crops-		
4	Small grains and maize	4	0.46
5	Small grains and groundnut	73	8.42
6	Fallow and groundnut	142	16.38
	-Mixed (Not Alternating)-		
7	Small grains and groundnut	37	4.27
8	Small grains and maize	19	2.19
9	Small grain, maize, groundnut	12	1.38
10	Small grain, fallow, groundnut	178	20.53
11	Small grain and fallow	17	1.96
12	Small grain, maize, fallow	3	0.35
13	Rice and fallow	33	3.81
14	Maize, fallow, groundnut	4	0.46
15	Groundnut and fallow	64	7.38
16	Maize and fallow	10	1.15
17	Other combinations and crops	61	7.04

A variety of mixed patterns were observed. The most common included small grains, fallow and groundnuts, each at least once on a particular field in the four years. Yet the variety of sequences (22 in all) in this combination suggests that the operative management criterion was to mix them up rather than follow a particular sequence with these three "crops".

One could also consider the alternating, two-year sequences as special cases of the mixed patterns. Under this assumption, patterns 4-6 could be added to patterns 7-17. When combined in this way, the following conclusions are reached:

a. 23.76 percent of all fields in the sample had only groundnuts and fallow.

b. 12.69 percent grew groundnuts or small grains continuously.

c. 58.94 percent grew mixtures of small grains, groundnuts and fallow but no other crops.

d. Maize was grown on 13.95 percent of these fields at least once, but more than half the observations were cases of continuous cropping.

e. 40.94 percent of these fields were <u>not</u> fallowed during the four year period.

f. 58.82 percent of all sampled fields grew at least one crop of groundnut during the four years. Of these, 76 percent also included at least one fallow in the four years.

Several conclusions reached above shed light on the role of fallow in Gambian crop rotations. It was estimated that 25 percent of the crop fields are fallowed each year. Yet in four years of record, 40 percent of the fields were not fallowed. Thus, fallowing as a practice is concentrated on selected fields which are fallowed some 40 percent of the time.

Table V-8 showed that of the 451 fields which were fallowed at least once, 388 (86%) also grew at least one groundnut crop during the period. Thirty-three fields involved combinations of rice and fallow. Thus, of upland fields, 93 percent of those which were fallowed at least once also grew groundnuts at least once. The association in farmers' minds between growing groundnuts and the need to fallow the same fields is clear.

Labor Use and Costs of Production

Aside from the obvious importance of land as a critical farm resource, the most essential input for a subsistence farmer is labor. Labor availability often establishes maximum potential levels of production that can be achieved by an individual farmer. The term subsistence farming suggests limited or no use of modern inputs such as capital or credit and implies that the two predominant farm inputs are land and labor.

In The Gambia there are two types of labor available to agriculture; family labor and non-family labor which can be either permanently or seasonally hired. Both types play a critical role in production. Family labor consists of all family members who live, work and eat together throughout the year. Permanent or seasonally hired labor is fairly common in The Gambia, although later it will be shown how use of this resource varies significantly between compounds of different ethnic affiliation. A typical family contains a few elderly people, many small children, and those individuals, from 15 to 60 years of age, which are considered the major part of the labor force. Not all family members have an equal capacity to perform agricultural work, particularly the very young or very old. Therefore, for the analysis in this section, which is based on the IVS data, a system of weights was used to aggregate family members into an approximation of effectively available manpower. All persons in the compound are converted into adult equivalents (AE) with the following conversions.

1) male and female adults, aged 15-60 = 1.0
2) permanent or seasonal hired labor = 1.0
3) youth (10-15 yrs) and elderly (> 60 yrs) = 0.5
4) small children (< 10 yrs) = 0.0

Another term useful in labor analysis is "person-days" (PD) A person-day consists of an eight-hour work day by an individual with a weight of one. A person with a weight of .5 would need to work for 16 hours to achieve one PD.

Labor: Availability and Use

Labor supply and use as measured among IVS respondents appears in Table V-9. The sample average farmer had approximately 10 AEs available for work on and off the farm. On an average of more than seven hectares managed, the labor:land ratio in the IVS was 1.3 AE/Ha. Table V-9 shows the use of family and non-family labor for a one year period. Figures represent both crop and livestock labor uses; thus include most farm work. As farm size increases, so does total labor use In the IVS, in contrast to the BLS, there is a strong association between farm size in hectares and family size.

Table V-9. Figures Showing Family Labor Availability On-farm and Labor Use (Family/Non-family) for 46 Farms, IVS, 1982.

Strata	Average Adult Equivalents		Total Labor Use (Person Days)			
			Family Labor		Non-Family Labor	
Farm Size[a]	Mean	S D[b]	Mean	S D	Mean	S D
F. S. 1	4.8	2.9	301.7	123.0	80.4	96.1
F. S. 2	6.9	2.8	649.2	179.5	103.2	122.1
F. S. 3	11.0	4.5	1032.4	318.1	244.4	110.6
F. S. 4	17.7	8.4	1326.9	854.3	519.7	653.9
Ethnicity						
Mandingo	6.7	5.1	589.4	375.8	131.4	155.9
Wollof	10.7	3.5	717.2	478.9	745.2	755.6
Serehule	12.4	7.4	926.0	547.2	165.8	122.0
Fula	11.1	9.7	1112.6	897.3	96.0	80.5
Jola	2.5	0.4	540.7	263.4	170.0	146.6
Total	10.1	7.2	810	578.3	249.2	404.7

[a] F.S.1 = (0.00 - 2.50 Ha) F.S.3 = (5.01 - 10.00 Ha)
F.S.2 = (2.51 - 5.00 Ha) F.S.4 = (Greater than 10 Ha)
[b] Standard Deviation

Of particular interest in Table V-9 is the large variation due to ethnicity. Work unit size is much larger for the Wollof, Fula, and Serehule. Even the Mandingos have relatively small family units. It is suggested this may be due to the tendency of Mandingo and Jola compounds to fragment more easily than other tribes. When they split they form their own compound and work unit.

Finally, turning to family and non-family labor by ethnicity, there are again visible differences. Total utilization ranges from a low of 540 PD of family labor for the Jolas to a high of 1113 PD for the Fula. The ratio of non-family labor to family labor shows the following ethnic differences:

Ethnic Group	Non-Family:Family
Mandingo	.22
Wollof	1.04
Serehule	.18
Fula	.09
Jola	.31

A simple explanation of this variability is seen when contrasting the two extreme cases; the Wollof and the Fula. Non-family labor is largely restricted to livestock activities, particularly herding of cattle. The Wollof actually utilize more non-family than family labor. The Wollof own livestock and hire outside labor, generally the Fula, to manage them. Conversely, despite the fact that Fula also own cattle, their use of non-family labor is low. Management of Fulani herds is conducted almost entirely by family members.

Labor Use by Production Activity and Month

As reported in Table V-10, an average compound requires just over 660 person-days of labor to complete all crop production activities for a year. The crop year starts in May and ends in February. Reviewing the monthly total column, it is apparent that for four months (August-November) Gambian farms require some three adult equivalent days per day for farm labor needs. Figure 2 shows the proportion of farms participating in crop activities, by month.

For many farmers these can be crisis periods if they face labor shortages. Of the four crop activities (land preparation, planting, cultivation, and harvesting), planting and cultivation are most sensitive to labor deficiencies. Labor shortages at this time can have a profound affect on final production. Planting is critical because of precipitation levels in The Gambia. Rains are generally adequate, but two factors make time of planting significant. First, though total precipitation may be sufficient, its distribution can cause problems. If a farmer plants his crop after the first rain, and then a three week period elapses before the next rain, germination can be significantly reduced. At that early stage, root systems are not adequately established to provide needed moisture. Second, some farmers may wait too long, trying to avoid a false start. However, rains terminate in October and if farmers plant too late (or the rains stop early) crops may not mature. Farmers are keenly aware of these two possibilities and are forced to contend with them, year after year. Therefore, when they decide to plant, they must do so as quickly as possible if they hope to obtain a better than mediocre harvest. This can put significant strains on the available labor supply of many farm families. It can be seen in Table V-10 that planting continues throughout the rainy season into October.

Cultivation is the other important factor heavily influencing final crop output. This is particularly true at the early stages of plant growth. At the end of the dry season nearly all grasses and weeds are either dead or have been burned. But with the onset of the rains, weeds and grasses compete directly with crops for both nutrients and moisture. Many farmers have insufficient labor to adequately cope with this burse of growth. Reduced crop outputs are often the result.

Table V-10. Labor Use by Average Compounds in Cropping by Activity

	Activities (in person days)								
	Land Prep		Planting		Cultivation		Harvest		Monthly
Month	Mean	S D	Mean	S D	Mean	S D	Mean	S D	Totals
May	8.0	8.4	-	-	-	-	-	-	8.0
June	39.4	33.1	22.2	31.8	1.5	0.5	-	-	63.1
July	20.6	26.6	25.8	25.2	20.3	24.9	-	-	66.7
August	13.2	15.2	8.7	13.1	72.3	54.1	-	-	94.2
September	8.4	11.3	23.6	19.1	58.0	32.9	13.1	14.2	103.1
October	-	-	22.3	12.0	43.5	41.2	36.6	28.7	102.4
November	-	-	-	-	14.5	13.0	84.6	53.0	99.1
December	-	-	-	-	5.4	5.0	72.1	56.6	77.5
January	-	-	-	-	-		-33.4	38.9	33.4
February	-	-	-	-	-		-12.5	11.6	12.5
Total	89.6		102.6		215.5		252.3		660.0

Figure 1. LABOUR USE FOR CROP ACTIVITIES

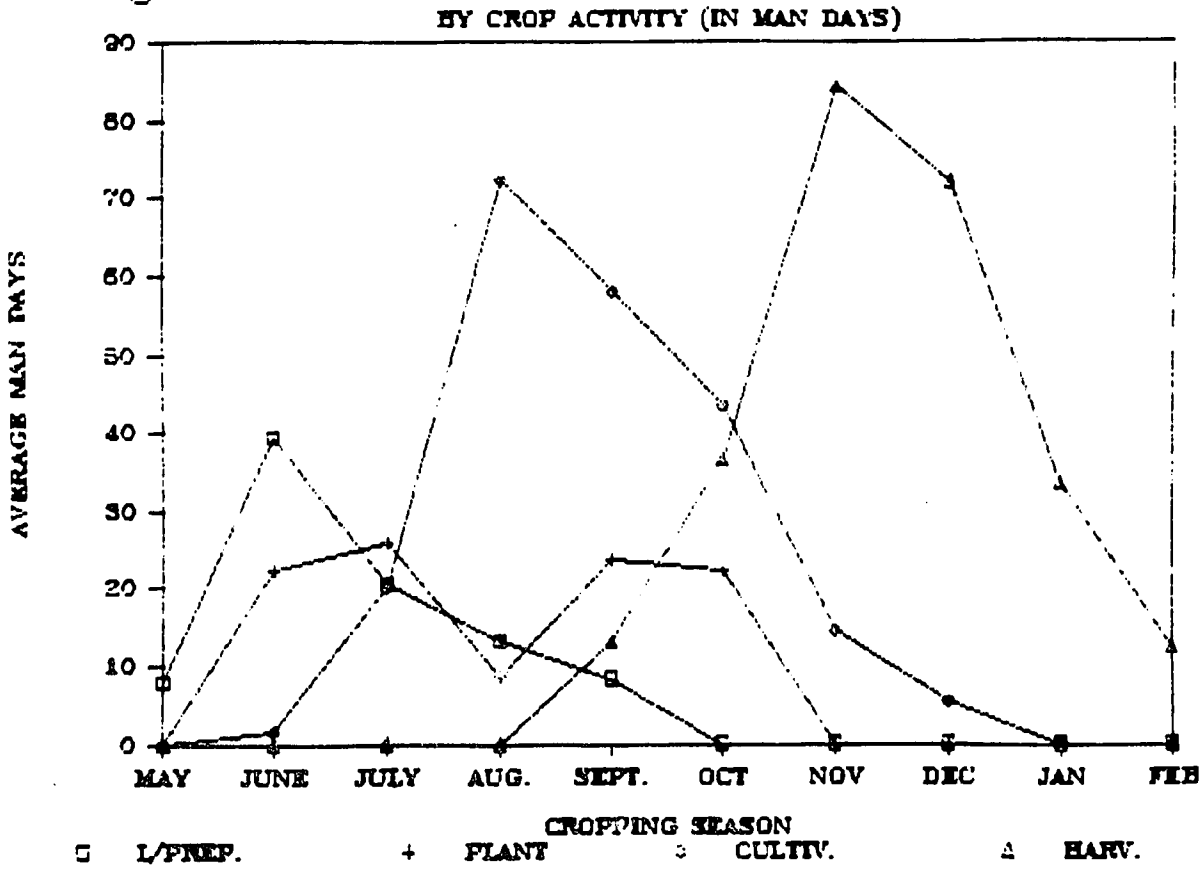
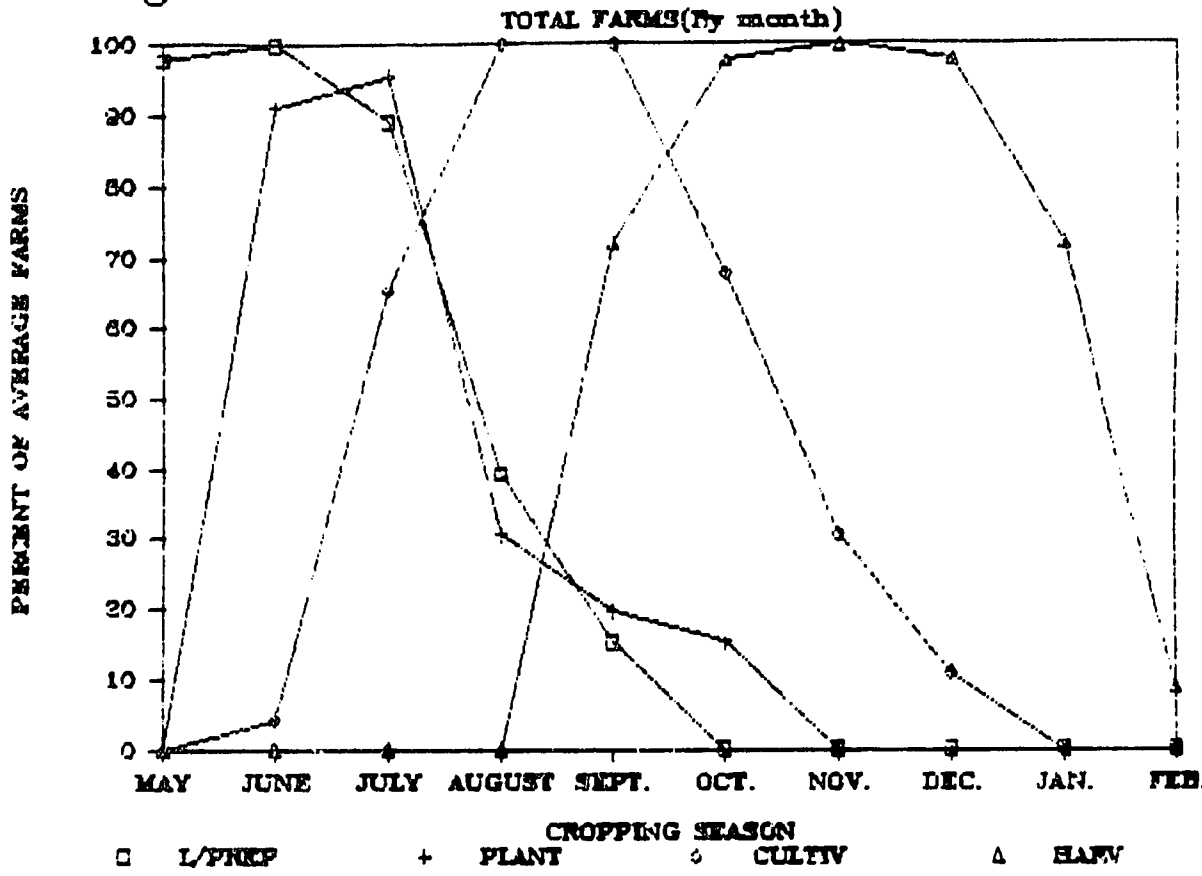


Figure 2.PARTICIPATION IN CROP ACTIVITY



Labor Use and Costs of Production for Single and Multiple Crops

Table V-11 below shows average labor inputs to single and multiple cropped fields with comparisons by ethnicity. Figure 3 depicts sample wide averages graphically. It would appear that significant differences exist between single and multiple cropped fields. Tests of significance are not included but a visual scan of the table shows fairly large differences. For example, single cropped groundnuts average 91.7 person days as compared to 119.6 for the groundnut/coos (millet or sorghum) mixture. The additional 28 days required for the mixed crop could result from several factors, however, the primary reason is the difference between cultivation methods. A pure stand groundnut field can be planted at one time with the aid of a seeder, assuming the farmer has access to one. A multiple cropped field requires the cereal to to planted after emergence of the groundnuts, and this must be done so by hand. Two plantings are thus required. There are also two harvesting and transporting periods as opposed to one for the pure stand. In short, the total duration of the cultivation process is extended with multiple cropped fields.

Maize is the other crop that shows a large difference in total labor requirements between the two crop types. Single stand maize has the lowest labor requirement of any crop, as is shown in Table V-11 and Figure 3. Mixed maize requires nearly double the labor application. These mixed combinations include maize/millet, maize/sorghum, maize/coos/tubers. Tubers can be cassava or potatoes, but are generally the former. The maize/coos/tuber combination is exceptionally labor intensive. The tubers require that slips or cuttings be transplanted by hand into various sized mounds. Earthing-up the mounds is done with either the short or long ridging hoe, an arduous task. There is also an extra weeding amd a second harvest required for the cassava after the maize has been harvested.

Figure 3. AVERAGE LABOUR USE

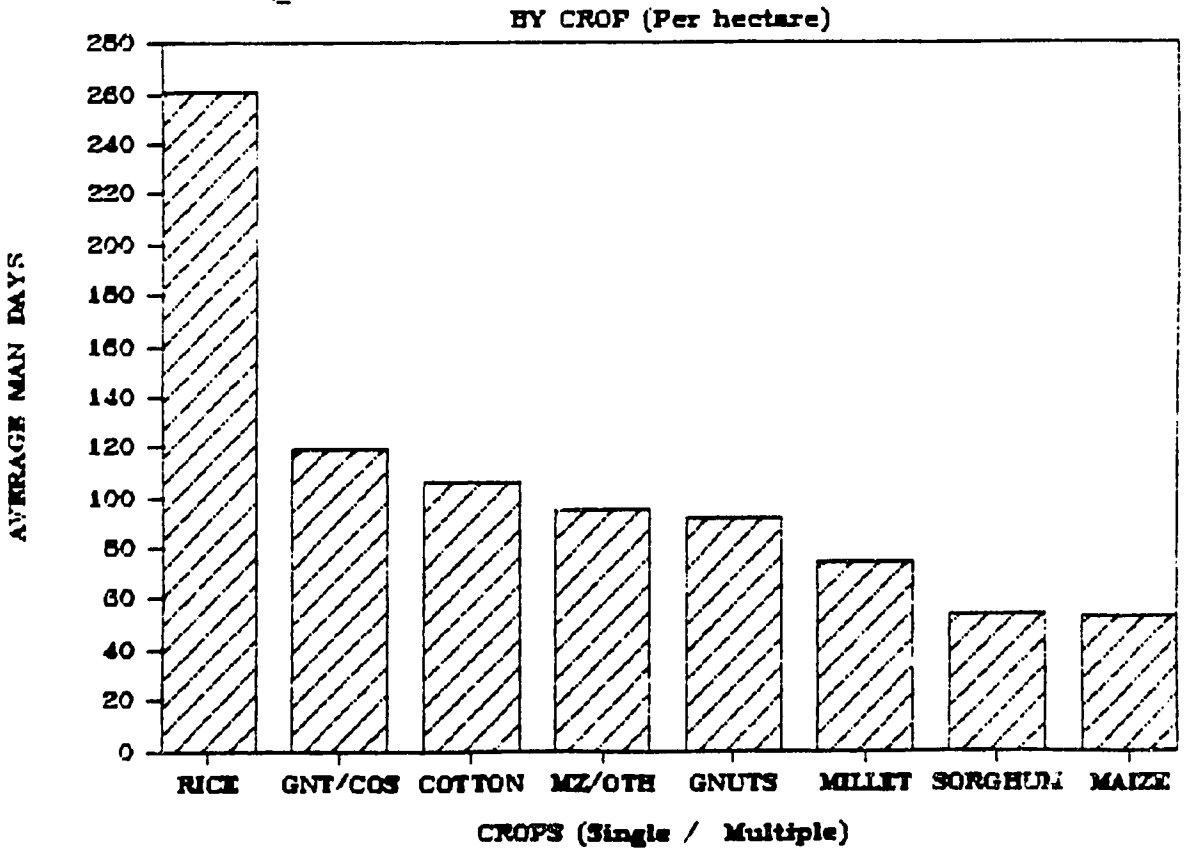


Table V-11. Labor inputs (PD/Ha), by ethnicity and crop, 1982.

Crop Type	Mandingo		Wollof		Serehule		Fula		Jola	
	Mean	S D	Mean	S D	Mean	S D	Mean	S D	Mean	S D
Single Crops										
Gnuts	108.9	32.2	74.5	31.0	104.6	37.3	115.5	29.9	-	-
Millet	86.6	51.6	89.2	49.0	50.6	39.1	68.5	19.3	43.2	10.6
Sorghum	60.2	17.6	58.3	22.8	44.8	21.7	61.4	17.1	59.8	10.8
Rice	323.6	225.3	511.5	208.6	173.3	147.7	415.7	191.0	19.19	102.7
Maize	44.0	8.1	53.1	22.9	51.1	14.6	54.5	28.1	66.2	33.7
Mixed Crops										
Gnuts/ Coos	105.6	45.6	51.5	11.0	130.4	38.1	136.1	46.3	88.7	34.8
Maize/ Others	107.0	49.7	-	-	93.8	40.7	93.4	31.1	-	-

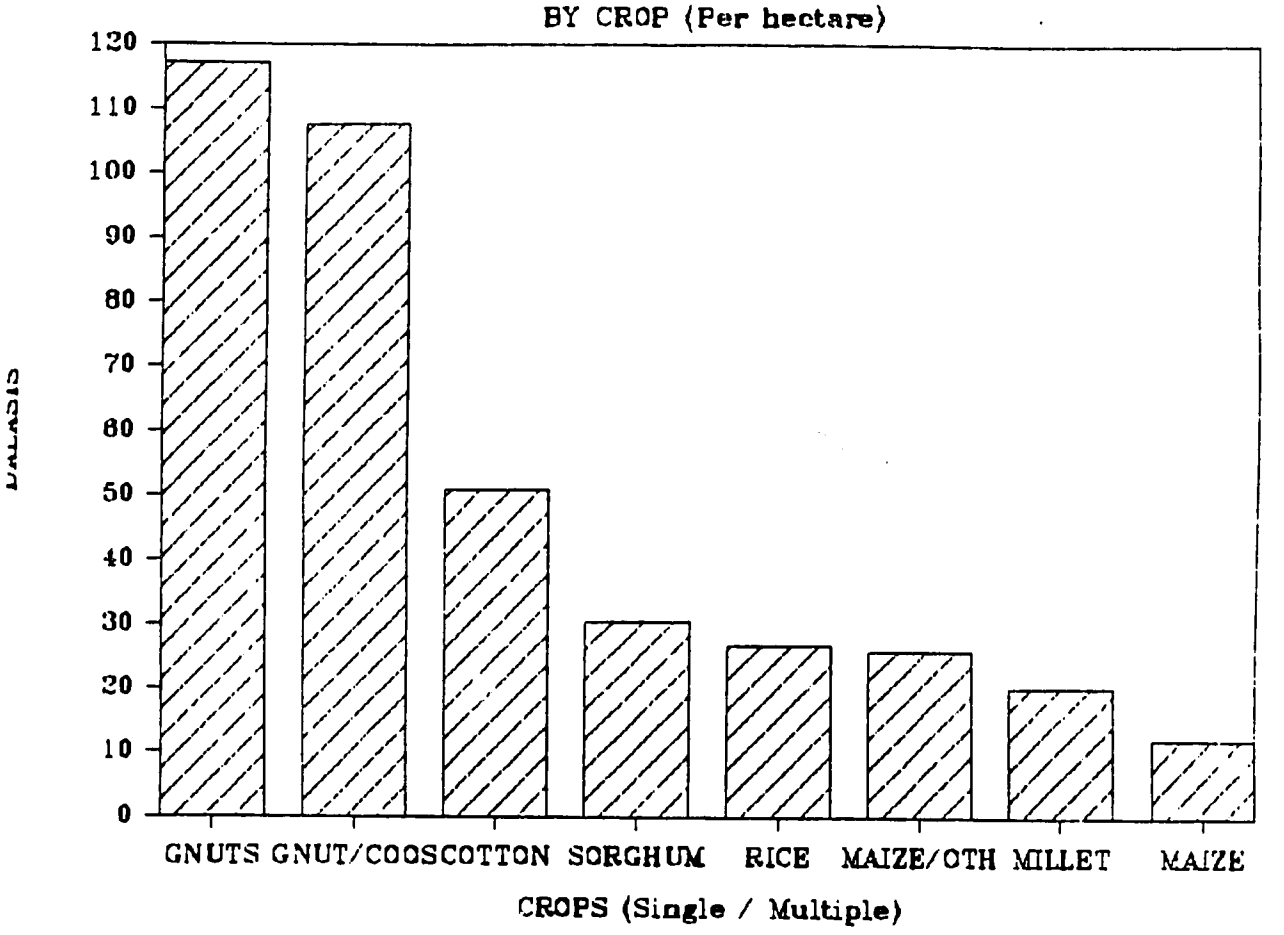
Variation in labor input by ethnicity also appears significant, especially for single groundnuts and millet and multiple groundnuts/coos. Single groundnuts have a relatively low labor input for the Wollofs. This may be explained by their higher degree of mechanization and the fact that they have larger average field sizes. With multiple cropped groundnuts, Wollofs spend less than half the average labor. They are the only tribe (in our sample) that does not prefer multiple cropped fields. Thus, the sample of mixed fields managed by Wollofs was very small. Jolas use less labor than average for this crop. This is due to planting the crop on ridges, which is initially labor intensive but negates the need for a second weeding. Single stand millet fields are allocated limited labor by Serehule and Jola. The Jola plant on ridges, conduct only one weeding and also cultivate late millet which requires little or no bird scareing. The Serehule in our sample are found in two separate regions, the Central and East. In the Central region they grow early millet but in the East they plant late millet. Since the latter cereal requires no bird scareing (a major labor requirement) the average for Serehule is reduced.

Costs of production, interpreted as cash costs, refer almost exclusively to costs of seeds and fertilizer. In some cases outside labor or a tractor is hired. Family labor is not included as a cost of production in this analysis. With the exception of groundnuts, very little fertilizer is applied to crops. Fertilizer use is restricted largely to cash crops; cereals receive negligible amounts, except for animal waste. Table V-12 and Figure 4 depict costs of production by ethnicity and in total for both single and multiple cropped fields. Both single and multiple cropped groundnuts show high variable costs when compared to other major crops. High variable costs correlate strongly with levels of fertilzer applications. One would expect farmers to spend more on their food crops, especially since many cereals are very responsive to even moderate levels of fertilizer. Through the efforts of growers associations, more fertilizer is now being made available for cereals, but this transition is slow.

Table V-12. Variable Costs of Production by Ethnicity and Crop, 1982.

Crop Type	Mandingo		Wollof		Sarahule		Fula		Jola	
	Mean	S D	Mean	S D	Mean	S D	Mean	S D	Mean	S D
Single Crops										
Gnuts	120.8	30.4	100.9	13.1	123.8	54.6	105.4	27.1	-	-
Millet	16.0	4.0	16.6	3.4	24.0	9.0	21.8	5.9	33.4	7.1
Sorghum	39.2	14.7	19.0	5.8	34.0	17.5	35.3	9.0	19.8	0.7
Rice	38.6	24.4	16.5	3.3	24.7	14.2	14.8	4.6	24.6	16.6
Maize	8.1	1.6	10.7	10.4	16.1	19.0	13.6	6.1	10.4	2.6
Mixed Crops										
Gnuts/ Coos	119	23.8	116	6.4	98.5	27	110.9	12.9	105.6	21.1
Maize/ Others	20.9	17.8	-	-	30.8	19.4	7.6	3.6	-	-

Figure 4. AVERAGE VARIABLE COSTS



Crop analysis by field size

When analyzing detailed farm level data with a relatively small sample, variation can become significant even within strata. The Gambia is a very small country with fairly narrow physical and technological parameters which should make farm systems relatively homogeneous. Unfortunately this is not the case. It appears that even small differences in farm sizes, degree of labor technology, ethnic variations, crop species, soil types, precipitation levels, and other factors can contribute to fluctuations in input-output relationships. Attempting to explain this variation can be a frustrating exercise.

An attempt was made to derive relatively homogeneous categories within which cropping could be analyzed. For this analysis, crops were grouped into three classes: cash, food and rice. While a food crop, rice, was treated separately because of the vast difference between its cultural practice and those for upland crops. In the IVS sample, the amount of upland rice encountered was negligible.

Each crop class was further subdivided by size of field. Table V-13 presents the resulting classification scheme with data on the frequency of occurrence of fields within it. Upland crops, both the food and cash groups, have approximately the same size distribution of fields. (Note that data presented earlier indicated considerable difference if individual crops are separated out). By contrast, rice fields are much smaller.

Referring to Table V-14, there are seven field size delineations for cash crops. Means, standard deviations and coefficients of variation are included to compare labor inputs and variable costs of production (dalasis/ha.) between field sizes. The coefficients of variation are generally relatively low for both statistics which implies that the cells are relatively homogeneous internally. Costs of production show almost no variation by field size suggesting that seed and fertilizer inputs are fairly constant on a per hectare basis. Labor inputs do vary with field size. With a scarce labor resource, farmers with large fields cannot provide the same labor intensity as can farmers with smaller fields. This is shown dramatically in rice production.

Table V-13. Frequency Distribution of Field Sizes for Cash, Food, and Rice Crops, IVS Farms, 1982.

Crop Type	Cultivation Size (ha)	Number of Fields	Percent of Total	Cummulative Percent
Cash				
	1=0.01-0.25	33	14.9	14.9
	2=0.26-0.49	79	35.6	50.5
	3=0.50-0.75	45	20.3	70.7
	4=0.76-0.99	25	11.3	82.0
	5=1.01-1.49	18	8.1	90.1
	6=1.50-2.50	14	6.3	96.4
	7=2.51 +	8	3.6	100.0
Total		222	100.0	100.0
Food				
	1=0.01-0.19	37	25.9	25.9
	2=0.20-0.39	28	19.6	45.5
	3=0.40-0.69	33	23.1	68.6
	4=0.70-0.99	21	14.7	83.3
	5=1.00-5.72	23	16.1	99.4
Total		143	99.4	99.4
Rice				
	1=0.01-0.05	39	27.6	27.6
	2=0.06-0.10	30	21.3	48.9
	3=0.11-0.31	42	29.8	78.7
	4=0.32-0.86	30	21.3	100.0
Total		141	100.0	100.0

Table V-14. Descriptive Statistics on Labor Use and Costs of Production for Cash Crops (Gnut, Pepper, Cotton)

Input Type/ Field Size	Mean	S. D.	C. V. (Percent)
0.0-0.25 hectares			
V.C./ha	D 125.87	49.4	39
Labor PD/ha	214.70	90.3	42
0.26 - 0.49 hectares			
V.C./ha	D 105.44	27.4	26
Labor PD/ha	127.15	51.6	41
0.59 - 0.75 hectares			
V.C./ha	D 111.29	29.8	27
Labor PD/ha	88.40	29.2	33
0.79 - 0.99 hectares			
V.C./ha	D 113.65	27.0	24
Labor PD/ha	79.12	28.4	35
1.01 - 1.49 hectares			
V.C./ha	D 107.38	11.8	11
Labor PD/ha	6[illegible].17	26.8	39
1.50 - 2.50 hectares			
V.C./ha	D 104.43	20.7	20
Labor PD/ha	62.70	16.8	27
>2.51 hectares			
V.C./ha	D 113.10	16.1	14
Labor PD/ha	49.64	15.6	30

Field size delineations for food crops are shown in Table V-15. Coefficients of variation in Table V-15 are significantly higher than they were for cash crops. Food crops consist of millet and sorghum (both early and late) as well as maize. Production methods vary significantly from groundnuts. Most cereals are planted and cultivated by hand, and only the more affluent farmers will apply fertilizer to cereal crops. As with cash crops, labor input per hectare decreases with larger fields. The inverse relationship between labor input/ha. and field size is best explained by labor insufficiency for larger field sizes

Finally Table V-16 shows the four field sizes associated with rice production. Mean labor input for the smallest field size class is 442 PDs as compared to 96 PDs for the largest field size class. Figure 5 shows this inverse relationship between PDs and field size with a graphic representation. Changes in variable costs are the result of variation in fertilizer application and hired labor per hectare.

Table V-15. Descriptive Statistics on Labor Use and Costs of Production for Food Crops Excluding Rice. (Millet, Sorghum, and Maize)

Input Type/ Field Size	Mean	S. D.	C. V. (Percent)
0.01 - 0.19 hectares			
V.C./ha	D 15.67	10.5	67
Labor PD/ha	80.35	53.5	67
0.20 - 0.39 hectares			
V.C./ha	D 26.86	20.5	76
Labor PD/ha	95.80	49.2	51
0.40 - 0.69 hectares			
V.C./ha	D 24.76	16.4	66
Labor PD/ha	60.38	23.7	39
0.70 - 0.99 hectares			
V.C./ha	D 22.65	11.9	53
Labor PD/ha	57.52	23.8	41
1.00 - 5.72 hectares			
V.C./ha	D 21.28	7.3	34
Labor PD/ha	53.15	15.9	30

Figure 5. RELATION OF FIELD SIZE/MANDAY

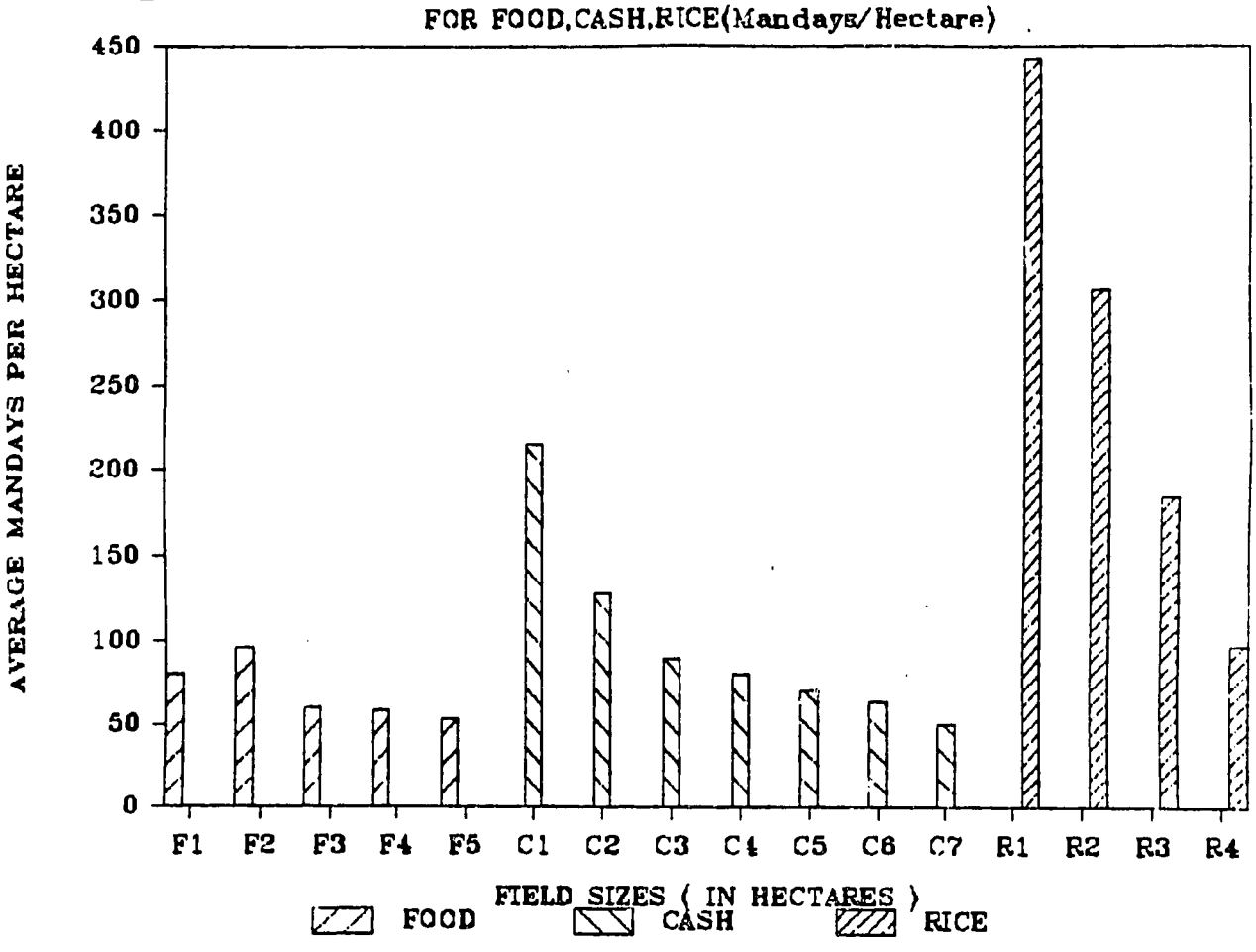


Table V-16. Descriptive Statistics on Labor Use and Costs of Production for Rice

Input Type/ Field Size		Mean	S. D.	C. V. (Percent)
0.0 - 0.05 hectares				
V.C./ha	D	34.29	25.8	75
Labor PD/ha		442.20	232.2	53
0.06 - 0.10 hectares				
V.C./ha	D	18.54	10.0	54
Labor PD/ha		305.60	163.7	54
0.11 - 0.31 hectares				
V.C./ha	D	26.27	15.5	59
Labor PD/ha		183.70	120.9	66
0.32 - 0.86 hectares				
V.C./ha	D	27.97	15.7	56
Labor PD/ha		95.60	40.9	43

Crop Yields

Crop production figures in this section are grouped three ways: by type of crop (food, cash, rice), by ethnicity of compound and by single vs. multiple cropping technology. Table V-17 below presents yield statistics for the three crop categories, subdivided by field size. As before, cash crops have seven field sizes, food crops five and rice four. An examination of the table shows little variation within crop category, which was anticipated. This stratification was conducted in order to provide information on typical field sizes cultivated, which would not surface under farm size delineations. Furthermore it reduced variation which was helpful when interpreting labor inputs to the farm. Coefficients of variation are highest for food crops and lowest for cash crops. Cash crops consist almost entirely of groundnuts which have similar input factors as well as relatively standardized output. Food crops consist of early and late millet, sorghum and maize, each with different cultivation methods and output parameters.

The most interesting comparisons of crop yields are by individual crop and ethnicity. Differences can be explained either by production techniques or food preference. Tables V-18 and V-19 present this data for both single and multiple fields. For single fields, groundnut production is fairly constant across ethnic group. Wollof are slightly higher. One might suggest that since everyone grows groundnuts and places similar priorities on it for cash income and production practices are relatively homogeneous, output variation will be minimal.

Table V-17. Average Crop Production, 46 IVS Farms in 1982

Field size	Kg/Ha Mean	Median	Standard Deviation	C.V.	Standard error of the mean
- - - - - - - - - - - - - - - - Cash Crop (Groundnut) - - - - - - - - - - - - - - - -					
0.01-0.25	1545.80	1607.50	455.80	29	91.20
0.26-0.49	1484.27	1600.00	449.80	30	50.90
0.50-0.75	1495.00	1533.00	432.50	29	65.20
0.76-0.99	1494.96	1687.50	427.80	28	86.70
1.01-1.49	1520.28	1482.50	404.30	27	98.10
1.50-2.50	1396.64	1550.50	528.10	38	146.50
2.51 +	1457.75	1581.50	441.10	30	166.70
- Food Crops -					
0.01-0.19	1127.81	1127.00	722.26	64	120.40
0.20-0.39	1129.39	1169.00	646.35	57	124.40
0.40-0.69	1157.97	1310.00	538.82	47	95.20
0.70-0.99	1394.38	1452.00	425.37	31	95.10
1.00-5.72	1032.61	1314.00	492.64	48	105.00
- Rice -					
0.01-0.05	1546.10	1367.00	686.10	44	111.30
0.06-0.10	1730.60	1452.00	858.30	50	165.20
0.11-0.31	1427.90	1395.00	459.60	32	73.60
0.32-0.86	1305.60	1356.00	247.60	19	46.60

Table V-18. Ethnic Variation in Crop Yields for Single Cropped Fields (Kilograms per Hectare, 46 IVS Farms in 1982)

Crop	Mandingo	Wollof	Sarahule	Fula	Jola
Gnuts					
mean	1471.10	1591.60	1492.90	1420.00	------
s.d	400.50	357.50	514.50	404.60	------
Millet					
mean	913.80	1418.30	489.10	993.10	595.20
s.d	656.60	114.60	639.20	569.00	444.40
Sorghum					
mean	1115.70	1381.70	600.90	926.20	1111.30
s.d	282.20	318.40	413.80	372.30	280.20
Rice					
mean	1170.30	1351.30	1376.40	2481.80	945.60
s.d	424.90	214.60	415.70	1016.60	251.40
Maize					
mean	741.50	1167.10	1907.80	1127.50	1126.50
s.d	241.50	695.70	135.20	918.00	806.50
Cotton					
mean	------	------	833.50	1868.00	------
s.d	------	------	450.50	529.10	------

Table V-19. Ethnic Variation in Yields for Multiple Cropped Fields. (Kilograms per Hectare)

Ethnicity	Primary crop		Secondary crop		Total production
	(Mean)	(S.D)	(Mean)	(S.D)	(Mean)
- - - - - - - - - - - - - Groundnuts and "Coos" - - - - - - - - - - - - - -					
Mandingo	1530.70	229.80	398.30	203.90	1929
Wollof	1566.20	------	162.30	------	1566
Sarahule	1437.60	173.10	494.40	189.70	1611
Fula	1469.30	107.80	414.90	140.70	1577
Jola	993.70	222.20	495.20	133.90	1216
- - - - - - - - - - - - Maize and other cereals - - - - - - - - - - - - - -					
Mandingo	1580.00	376.70	295.00	431.60	1957
Wollof	----	----	----	----	----
Sarahule	1591.90	139.90	584.50	226.20	1732
Fula	1512.60	59.20	502.50	118.40	1572
Jola	----	----	----	----	----

Food crops are another matter altogether. Millet production varies significantly with the Wollof producing the most (1418 kgs) and Sarahule the least with 489 kgs. Wollof production is high not only because it is their staple cereal, but also because they practice intensive cultivation methods, as they do with all their crops a premise reflected in yield figures for other crops as well. Sarahule millet production is low for two reasons. First, one of the two Sarahule villages in our sample is in the eastern region where only late millet with its lower potential yield is grown. Second, the other Sarahule village in the central region planted the higher yielding early millet but did so in fields more distant from the village than is normally done. Bird scaring was attempted, but damage was still significant. A few fields were destroyed entirely. Crop failure also affected the Sarahule for sorghum which caused the low mean and high standard deviation.

Rice production is fairly constant across ethnic groups with the exception of the Fula. The Fula in Piniai village plant significant amounts of rice in their swamp lands and during the survey year experienced good yields. Maize production is highest for the Sarahule precisely because it is a preferred food. They were the only tribe (with the exception of a few Wollof) who

cultivated it other than as a backyard crop. With the Department of Agriculture and the Mixed Farming Project's push for increased maize production, this is rapidly changing.

Multiple cropped fields are presented in Table V-19. There are two categories of multiple crops with production figures for the primary and secondary crop. The maize/other category groups about five combinations with a limited number of each. Two of the five tribes are not represented. Total yields are lowest for the Jola, which is somewhat surprising since the Jola concentrate on multiple planted fields. If anything, their production should be higher. Why this is not the case is unexplained at this point.

CHAPTER VI

LIVESTOCK SUBSYSTEM

Draft and Pack Animals

Draft animal ownership in the Gambia is quite extensive throughout all parts of the country and contributes significantly to agricultural production.Ownership patterns vary by region and by ethnicity, not only in terms of quantities but in draft subtypes. There are three types of draft power; oxen, horses and donkeys. Oxen are most popular in the Western Division where they were first introduced, yet they are found in varying degrees in other parts of the country as well. Superior strength is a primary advantage oxen have over the other draft types, a fact which is particularly needed in plowing and lifting of groundnuts. This strength also allows farmers to plow deeper and over longer time periods than can other draft animals. Oxen are always used in pairs with a wooden yoke connecting them. Usually two or three people assist the animals, one controling the plow with either one or two leading the animals along the crop rows.

Horses are used individually for all aspects of cultivation and are recognized for their power and speed advantage over donkeys. A primary use for horses is pulling carts. They are capable of pulling heavy loads at a steady trot over considerable distances. In urban areas, horse drawn carts are commonly used as passenger vehicles. This use is widespread in the northern region and in Senegal.

Donkeys are probably the most numerous of all the draft animals. They appear to thrive under existing conditions and at roughly half the price of one ox, are more affordable to farmers. Donkeys are utilized for a wide range of farm and off-farm activities. In the rainy season they are used for planting and/or cultivating while in dry season months they

contribute extensively to transportation of produce from fields to villages, or from villages to market centers. Like the horse they are commonly used for transport, and while they haven't the power of oxen, if the load is not too heavy and the distance not too far they are quicker and more efficient than the oxen.

Draft animal ownership varies by ethnicity. Figures in Table VI-1 below provide average work unit ownership patterns for the sample farms, with ethnic delineations and total means. Data presented depict overall sample mean ownership as well as averages for draft owners only.

Table VI-1. Prevalence of Draft Animals Owned by IVS Households

Ethnic	Oxen		Horses		Donkeys	
Group	Mean	S.D.	Mean	S.D.	Mean	S.D.
Mandingo	2.3	1.2	---	---	1.2	0.4
Wollof	2.8	1.4	1.2	0.4	1.7	0.5
Serehuli	2.2	0.4	---	---	2.1	1.2
Fula	---	---	---	---	3.0	2.9
Jola	2.0	0.3	---	---	---	---
Total	2.4	1.1	1.2	0.4	2.1	1.6

Labor Input and Husbandry Practices

Discussion in this section will be restricted to oxen and donkeys since very few farmers own horses within the sample. Labor input for draft animals includes three basic activities; watering, stall feeding, and tethering for grazing. All activities are divided into rainy season, dry season and total labor input. Table VI-2 shows these labor activities for oxen by ethnicity. As one might expect, watering requires less time in the rainy season than in the dry season. Stall feeding is negligible in the rainy season when grass is abundant yet

requires considerable work in the dry season when forage is scarce. Oxen are tethered in the rainy season as are many other livestock to prevent destruction of village crops. Watering occurs towards dusk when the animals are returned to their pens. Dry season stall feeding of crop residues also transpires once daily at evening time as a dietary supplement. Some farmers may not initiate supplemental feeding until March or April when the rains are approaching. Draft animals are given priority with respect to supplemental feeding to insure their health and labor output at cultivation in June and July. Feed usually consists of groundnut haulms with occasional bran from local cereals added.

Table VI-2. Livestock Labor Activities for Oxen by Ethnicity, in Man-day Equivalents, 1982. (averages per farm)[a]

Activity/	Mandingo		Wollof		Serehuli		Fula		Jola	
Season	Mean	s.d.[b]	Mean	s.d.	Mean	s.d.	Mean	s.d	Mean	s.d.
Watering										
rainy	19.0	5.6	11.0	8.4	9.0	2.8	—	—	---	---
dry	30.3	10.3	24.0	14.1	14.0	5.1	--	--	17.0	6.0
total	49.3	14.0	33.4	22.2	21.0	8.4	—	—	28.0	17.0
Stallfeed										
rainy	----	----	----	----	----	---	—	—	---	---
dry	22.0	----	25.5	22.4	7.0	2.8	--	--	22.0	---
total	22.0	----	25.5	22.4	7.0	2.8	—	—	22.0	---
Tethering + Grazing										
rainy	26.3	14.6	36.1	37.2	11.5	6.4	—	—	22.0	---
dry	----	----	----	----	----	---	--	--	----	---
total	26.3	14.6	36.1	37.2	13.7	6.3	—	—	22.0	---
Total PD	97.6	21.7	95.1	79.8	63.0	42.9	—	—	72.0	17.0

[a] Man-day equivalent are equal to an 8 hour work day by a mature male or female.

[b] s.d is the standard deviation.

Table VI-3 presents identical information for donkeys. Notice that of all the tribes, only Jola lack this draft type. This is largely because the Jolas in our sample live in the Western region where oxen are prevalent. Husbandry practices differ little between oxen and donkeys. Like the former they require watering, supplemental feeding and tethering for grazing. Labor inputs to draft animals maintenance requires comparison with levels of ownership. Fula's spend more total labor input with donkeys, but they are also the largest holders of this draft animal. Likewise Mandingo and Wollof contribute the largest portion of total person days to oxen but they also own the majority of these animals.

Table VI-3. Livestock Labor Activities for Donkeys by Ethnicity, in Man-days Equivalents, 1982. [a]

Activity/ Season	Mandingo		Wollof		Serehuli		Fula		Jola	
	Mean	s.d.[b]	Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d.
Watering										
rainy	11.2	7.3	13.0	7.4	8.0	3.0	20.5	4.7	---	---
dry	16.7	5.7	26.3	14.0	14.7	6.6	33.7	11.2	---	---
total	28.0	12.7	39.3	21.5	23.2	8.3	54.0	14.6	---	---
Stallfeed										
rainy	---	---	----	----	----	----	---	----	---	---
dry	18.6	5.4	24.0	16.3	9.0	2.8	29.6	10.8	---	---
total	19.7	5.1	24.0	16.3	9.0	2.8	29.6	10.8	---	---
Tethering/ Grazing										
rainy	15.2	6.9	35.6	25.7	10.8	4.9	31.7	16.3	---	---
dry	----	---	----	----	----	---	----	----	---	---
total	15.2	6.9	35.6	25.7	10.8	4.9	32.7	16.1	---	---
Total PD	63.0	22.9	99.0	63.5	40.8	12.7	108.2	42.4	---	---

[a] Man-day equivalents are equal to an 8 hour work day by a mature male or female.
[b] s.d is the standard deviation.

Cattle

Cattle are the most important component, numerically, in the livestock system of The Gambia. In our sample of 46 farms, the total mean for cattle ownership exceeded the sum of all other ownership means for the remaining livestock types. This average is somewhat skewed by a few individual farmers with extremely large herds. Cattle represent an integral part of the total farm/family system and are literally a store of wealth, even if ownership is minimal. As a rule of thumb, any excess cash from off-farm earnings or annual crops is likely to be used to purchase additional cattle or small ruminants.

Sale of these animals is infrequent, and if done it is usually confined to the old or sick. Young bulls are rarely sold, although some are selected for training as draft animals. Cattle losses can be significant in the dry season months, either from malnutrition, insufficient water, or sickness, the latter likely caused from the first two conditions. Even if cattle owners expect an impending drought, few will sell their animals in advance. If a farmer must sell one due to financial need, it is not unlikely that the transaction will occur in evening hours to minimize the chance of others becoming aware of his plight. Cattle are also given as a dowry for a daughter, and thus it is possible for women to own cattle and even control them.

There are two methods of cattle management, that done by the owner's family and that done by hired herders. The latter will often be Fula herdsman. As with other livestock, peak herding occurs in the rainy season months when animals attempt to infiltrate and damage crop fields. Cattle are divided into two groups, the mature animals and the very young of roughly 4-12 months of age. The young are kept apart from the adults during daylight hours, then returned to the herd in the evening.

Milking is done twice daily, particularly in the rainy season when the majority of calves are born and forages are abundant. Dry season milking depends largely on geographic location within the country. Livestock owners near bottomlands may be fortunate enough to obtain a reduced quantity of milk;

those farmers well up the alluvial slopes and far from the dry season grazing areas are less fortunate and will obtain little or no milk. Distribution of milk will differ according to the livestock management system. Milk obtained from owner-managed herds will be partially consumed within the family with the balance sold for cash. Where herding services are contracted, however, milk is used as payment and little reaches the market. Figures on values of milk production vary by size of herd, but for the average herd payment in kind will approximate D 600.00 per annum.

Labor Inputs and Husbandry Practices

Labor inputs for cattle can be summarized into three basic categories; watering, herding, and milking/collecting. Table VI-4 presents this data by ethnicity and in totals for the year. First of all, total labor expenditure is by far the greatest for cattle herding, which is the case for all tribes. Furthermore, the bulk of herding is done in the rainy season months when cattle are kept in village lands and crops require maximum protection. In the daylight hours livestock are herded away from village farms and out into distant range lands. There the herder leads the animals to areas where optimal forages and watering points are likely to be found. Food sufficiency is not an overriding concern in the rainy season; close management is a more critical factor.

Dry season herd management is typically more relaxed at least for the first half, depending on location within the country. Toward the end of the dry season, both food and water generally become scarce. At this time some herds, particularly in the eastern and northern portions of the country, travel out of their District lands and seek other feed sources, most likely in the bottomland areas of McCarthy Island Division. With emphasis on irrigated rice increasing, the displacement of these grasslands has an ever increasing negative impact on long-term livestock viability.

Table VI-4. Livestock Labor Activities for Cattle by Ethnicity, in Man-day Equivalents, 1982. (averages per farm)[a]

Activity Season	Mandingo		Wollof		Serehuli		Fula		Jola	
	Mean	s.d[b]	Mean	s.d	Mean	s.d	Mean	s.d	Mean	s.d
Watering										
rainy	----	----	18.6	5.4	30.5	16.7	17.0	6.0	---	---
dry	22.2	0.4	44.0	24.5	62.2	32.0	30.2	18.9	---	---
total	24.4	4.8	58.0	33.0	85.1	49.4	37.0	27.1	---	---
Herding										
rainy	132.2	44.5	153.7	24.7	139.7	13.8	127.4	17.9	159.5	0.5
dry	36.0	27.0	73.5	29.7	65.5	21.4	61.4	24.9	79.5	10.5
total	168.2	58.6	227.2	253.5	205.0	30.4	188.8	36.6	239.0	11.0
Milking										
rainy	23.0	16.2	---	----	40.7	27.0	23.0	---	---	---
dry	33.5	19.9	37.3	10.8	32.2	10.7	38.2	28.6	---	---
total	50.7	36.8	45.0	----	73.1	36.1	52.0	26.6	---	---
Total MD	233.2	91.1	319.0	75.4	354.2	97.9	277.8	77.7	290.0	6.0

[a] Man-day equivalent are equal to an 8 hour work day by a mature male or female.
[b] s.d is the standard deviation.

Watering of cattle can also be a problem, depending on location within the country. Despite the fact that the country is long and narrow with a river flowing through its center, a very flat gradient results in sea water encroachment for nearly half the length of the River Gambia. Thus, the river is unsuitable as the only source of livestock water, especially during the dry season. Farmers need to water from existing hand wells with the heavy labor requirement that this entails.

Furthermore, at points beyond this salt intrusion, the banks of the river are sometimes too steep for animals to reach the water. Those that try frequently drown. In summary, an inadequate water supply is cited by most farmers as one of their primary livestock problems (along with dry season food). Farmers

complain of dropping water tables and the excessive time spent in providing minimum amounts of water for their livestock. Some villagers in the northern and eastern regions are forced to rise repeatedly throughout the night to draw water, allowing their well to replenish itself between uses. The 1982-83 season had average precipitation levels, so water was not an overriding factor within the sample of villages. (Person days spent watering by Jola's is not reported due to an insufficient number of cases.)

Milking of the animals is also a time consuming task, particularly in dry season months when cattle may be a considerable distance from the villages. On the other hand quantities obtained are substantially reduced at this time, and for some areas there is no dry season milking (e.g., the Wollof's in the north are in an area where grasses dry quickly and milking ceases). The Serehuli show more time spent milking in the dry season than in the rainy season, which is different from the norm. In the rainy season a contract herder manages the herd and does the milking; in the dry season the cattle are left unmanaged with the exception of milking which is carried out by the women and children. They are not as experienced or as capable as a contract herder which accounts for the time differential.

Output

In estimating out for the various livestock species, several types of products were considered. For cattle, milk production and births were the principal sources of total production. It was not possible to establish a value for draft power services nor for the contribution of tethered animals to soil fertility using survey methods. Cattle sales, although infrequent, were included when reported. Total output for small ruminants is derived from sales and births alone. Table VI-5 presents what data were calculated. These figures are averages for compounds and not per animal. Very large standard deviations were measured between ethnic means. The implication is that variation in the numbers of animals held is large within each ethnic group. This

fact probably masks true ethnic differences in the ability to obtain incomes from livestock, if, in fact, ethnic differentials do exist.

Table VI-5. Per Farm Average Values of Total Production for Various Livestock Species, by Ethnic Group of Compound Head.

Ethnic Group	Cattle		Sheep		Goats	
	Mean	s.d.	Mean	s.d.	Mean	s.d.
Mandingo	644	434	111	92	61	58
Wollof	496	412	173	213	117	48
Serehuli	1445	566	66	74	21	61
Fula	2257	2120	46	46	8	43
Jola	na	na	36	31	23	47

Crop - Livestock Interrelationships

In small farm agriculture in The Gambia, household and farm activities are both managed together to meet the compound's objectives. The cropping and livestock components of the farm each require management time, labor and other scarce resources, and they must both contribute to satisfying farmer needs. In a mixed farming setting, one might expect several

interrelationships between cropping and livestock in which events or decisions in one sphere affect the other.

This study sought to discover crop-livestock interrelationships of three different types. First, it was expected that the presence or absence of draft power would influence the type of cropping followed. Second, was the area of product-product relationships, where the output of one enterprise becomes an input to another enterprise. Lastly was competition for farm resources used as inputs.

Draft Power and Cropping

Area Cultivated: One of the original hypotheses was that draft power would permit farmers to till more land. If such were the case a positive relationship would exist between draft animal numbers and planted hectarage. Data in Chapter IV suggested that the hypothesized relationship might not exist.

Details from the BLS data for oxen specifically confirm that, in fact, the relationship is negative. Farms with larger numbers of oxen cultivate fewer hectares on average, as shown here:

No. of Oxen	Average Hectares Cultivated
0	4.4
1-2	4.1
3-4	3.1
5-6	3.0
7-8	3.0

Distribution of Land Among Crops: Using the BLS sample on crop fields and the IVS average sizes for fields in each crop, we sought to discover differences in crop mix between farms with and without draft oxen. Results are given below in Table VI-6. Land allocation among major crops was almost identical between the two farm classes. A slightly higher percentage of fallow was

observed among farms without oxen as might be expected. And a slightly higher percentage of land in sorghum and millet occurred on farms with oxen. However, none of these differences is statistically significant.

Table VI-6 is useful in depicting the actual allocation of land to the major crops and to fallow in The Gambia, based on a large, randomly drawn, nation-wide sample. The total column gives weighted averages for the sample as a whole. Fallow ties with small grains (sorghum and millet) as the most common claimant of hectarage.

Table VI-6. Allocation of Hectares Managed to Crops by Farms with and without Draft Oxen (1982).

Item	With Oxen	Without Oxen	Total
Farms in Sample	198	384	582
Hectares Managed	778.57	1669.12	2447.69
	-Percent in each use[a]-		
Groundnut alone	12.9	13.8	13.5
Groundnut mixed	14.0	12.0	12.7
Groundnut (all)	26.9	25.8	26.2
Maize	5.8	5.5	5.7
Sorghum	8.7	7.9	8.2
Millet	24.8	21.8	22.7
Sorghum + Millet	33.5	29.7	30.9
All rice	2.7	3.3	3.1
Fallow	29.1	31.7	30.9

[a] Will not sum to 100 due to omission of several minor crops

Given the prevalence of fallow land, one must question whether or not there truly exists a land shortage in The Gambia. From data at several points in this report, it is suggested that the operative constraint to agricultural output is not cultivable area, but some other factor. If, in fact, fallow is absolutely essential as part of one or more crop rotations, then fertilizer or manure could well serve as a substitute. More likely, however, is that labor and/or operating capital are the true constraints in agriculture today.

Product-Product Relationships

Feeding Crop Residues

The most important contribution of cropping to animals lies in the use of crop residues as livestock feed. This occurs in two ways. First, under traditional land tenure, once an individually cultivated cereal crop is harvested, the standing stubble reverts to common property status. At this point grazing of stubbles is permitted by anyone's livestock.

Second is the practice of harvesting crop residues specifically to be saved for feed. This is common with groundnuts, a crop that cannot be harvested without removing the vegetative portions. Feeding of groundnut haulms leaves and dust and other residues is an old accepted practice in The Gambia.

A more recent innovation being promoted by the MFP is the explicit harvest and storage of cereal stovers, especially maize and sorghum, for later use. This practice suggests a deviation from traditional tenure mores since what was formerly a communal good (stover) becomes a private good when harvested and stored. Nevertheless, the practice seems to be spreading well, especially in regions where maize production for grain is expanding.

To examine contemporary use of crop residues, the BLS included several questions. The reader is reminded that this study took place before MFP's recommendations were developed or extended.

Table VI-7 presents the prevalence of various uses and management practices for crop residues reported in 1982. All parts of groundnuts, except the nuts themselves, are commonly fed. However, with cereals, bran is a common feed while other plant parts were much less readily used. Very little effort to collect and store stalks and/or leaves of cereals was noted. Feeding trials run by the MFP established that maize and sorghum stalks and rice straw were valuable feedstuffs in The Gambia. Apparently this fact was not well appreciated by farmers in 1982. Further, almost no market existed in crop residues.

Table VI-7. Utilization and Handling of Crop Residues. (percent of compounds growing each crop).

Type of Residue	No. of Growers	Feed Residue	Collected in Piles	Store for Later Use	Sold
Groundnut	488				
Haulm		84	83	81	3
Leaves		89	88	86	4
Maize	479				
Stalks		32	5	2	0
Leaves		37	5	2	0
Bran		75	73	42	2
Sorghum	356				
Stalks		24	4	3	0
Leaves		40	4	2	0
Bran		80	78	45	1
Millet	441				
Stalks		27	2	2	0
Leaves		39	4	2	0
Bran		81	82	53	2
Rice	176				
Stalks		32	2	2	0
Bran		69	62	38	0

Table VI-8 examines the same process with an emphasis on the type of stock being fed.

Table VI-8. Percentage of Crop Growers that Fed Various Crop Residues to Different Animals, 1982.

Residue	Cows + Bulls	Calves + Heifers	Oxen	Donkeys	Horses	Sheep + Goats
Groundnut						
Haulms	24	16	38	60	17	41
Leaves	22	21	38	37	14	60
Maize						
Stalks	51	33	35	61	17	51
Leaves	37	41	37	59	19	59
Bran	16	13	34	37	14	53
Sorghum						
Stalks	61	40	42	68	19	52
Leaves	63	51	40	56	18	56
Bran	12	10	40	38	17	48
Millet						
Stalks	60	40	46	63	20	50
Leaves	60	48	45	61	20	59
Bran	15	12	40	39	18	48
Rice						
Stalks	80	60	39	41	7	42
Bran	21	17	31	41	5	58

Tethering Cattle

Other than draft power, the principal means by which livestock contribute inputs to cropping is through their excreta and its use for fertilizer. In The Gambia most cattle are tethered together in herds for the night. Deposited urea contributes to soil fertility with some loss to evaporation. Fecal matter is allowed to dry, then usually collected and burned. Farmers claim the burning is necessary to kill weed seeds in the droppings. Despite the loss of valuable organic matter, the mineral rich ash is spread over the field and plowed (or trampled) in, thus providing some nutrient value.

Of all cattle owners in the BLS, 70 percent tethered cattle in their harvested upland cereal fields. Few tethered cattle in rice fields, partly due to the distance of these fields from the village. Of farmers without cattle, 29 percent arranged with cattle owners to have herds tethered on their fields.

Field observations indicate that the most common practice is to tether a herd on a particular field for about one month although they will be moved about within the field every few days. The most common location is in harvested cereal fields, before a second cereal crop in a cereal-cereal rotation or before groundnuts in a cereal-groundnut rotation. While these practices have obvious value in terms of soil fertility, and this fact is understood by farmers, paying to have animals tethered on one's fields is rare.