THE SIGNIFICANCE, VARIABILITY AND DETERMINANTS OF LABOR IN WEST AFRICAN SMALL FARM SYSTEMS: A CASE STUDY OF EIGHT ZARIA FARMERS

by

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CHAPTER 1

BACKGROUND AND OBJECTIVES OF THE STUDY

Section 1.1 Introduction

Agriculture is an important means of livelihood for a large majority of the people living in West Africa. Not only is a large proportion of the population directly engaged in farming, but much of the rural population is supported by agriculture in one way or another. The production of agricultural goods is carried out in various types of producing units, ranging from smallholder units several acres in size to the large commercial and state owned farms. Farming is generally traditional in nature with the main emphasis on the cultivation of crops, although pastoral and nomadic systems are important throughout West Africa as well.

The major emphasis in this paper is the study of labor in West African small farm systems, particularly those of the Hausa areas of northern Nigeria. A discussion of the larger producer organizations and the nomadic and pastoral systems is intentionally avoided. Even though these systems are of economic importance throughout Africa, their discussion lies beyond the intended scope of this paper.

The importance of the small farm, in Africa, is indicated by Cleave (1974, p. 2) who mentions that over 90 percent of the value of agricultural production is provided by smallholders. The farms considered are typically small in size, falling mainly in the range of two to ten acres, and most of the labor applied on the farm is provided by the family. Culti-

vation is primarily carried out with the aid of hand tools and low applications are made of purchased inputs (i.e. fertilizers, pesticides, seeds, etc.).

Increased attention has been given to smallholder development, in recent years, and to the importance this has to the economic growth and development of rural regions. Agricultural development strategies have concentrated on raising farm output and family incomes as a key to improving the living standards of rural populations.

Labor performs an essential role in this scheme of development. Increased production, in the traditional farming system, comes about almost entirely from greater applications of labor (assuming the relative availability of land) and the introduction of land-improving technologies often requires added labor input. In the context of small farm development, the amount of labor that can be applied on the farm and the productivity of that labor become of upmost importance.

A substantial amount of work has been done in Africa, which has studied in various degrees, the use of labor on small farms. However, considering labor's importance as a factor of production in traditional farming systems, the nature of smallholder labor activity is still not clearly understood. Important questions still arise concerning the reasons for the specific labor allocations that are made and for the extent to which further labor can be diverted to productive effort.

Section 1.2 Objectives of the Study

This study hopes to go some way toward answering some of the questions that arise concerning the labor activities of smallholders. The specific

nature of the small farm's labor activity is determined by a complex set of political, social and economic factors. One general objective in this paper is to identify these forces and examine the nature of their relationship with labor on the small farm. The second general objective concerns research methodology. Several major hypotheses will be examined regarding the time frame over which labor surveys are conducted and analyzed. These objectives are discussed in a more specific manner later on in this section.

Two basic types of research were performed to provide the informational base for this study. First of all, an extensive literature review was made of various socio-economic studies which examined labor usage on the small farm. The literature review was primarily limited to studies performed in West Africa, but studies from other parts of Africa and Asia were included as well where they helped to strengthen the analysis. Secondly, empirical results are presented from the analysis of a small sample labor study (see section 1.3) that was conducted in northern Nigeria.

As will be indicated in the list of specific objectives discussed below, the results of the literature review are primarily presented in Chapters 2 and 3, while the empirical research is presented in Chapters 4 through 6. This separation was made for several reasons. First of all, the empirical results are presented in such a manner as to test several major hypotheses concerning research methodology. This lies beyond the scope of the literature review. Secondly, the complexity of the subject matter and the wide diversity of opinions that exist concerning smallholder labor activity necessitated a lengthy review of literature being performed. Combining the literature review with the empirical analysis then, would have obscured the presentation of the empirical results. Separating the

literature review from the empirical analysis, on the other hand, enabled the results of the labor survey to be presented in a systematic and autonomous manner. However, a certain degree of repetition occurred between the literature review and the empirical analysis as a result. Though this was undesirable, it did help to clarify and substantiate certain conclusions found in the literature review. The following is a more specific list of objectives for this labor study.

Objective 1: An attempt was made in the literature review (in Chapter 2) to tie together the voluminous and diverse types of information that exist concerning labor use on the small farm. Considering labor's importance as a factor of production, however, many gaps in the analysis still exist. The analysis then not only examines the nature of small farm labor decisions, but it also tries to highlight important areas where further research needs to be done.

Objective 2: The literature review examines in detail (in Chapter 2) the various socio-economic forces that influence the household's labor decisions. The analysis has the objective of identifying and studying the major determinants of labor activity as well as studying the effect of varying incentives and opportunities on the application of household labor. Similiarly, an attempt was made to identify those factors which constrain labor usage on the farm. The results of the empirical analysis in Chapters 5 and 6 help to clarify or substantiate the results presented in the literature review (and vica versa) as well as touch on certain new areas.

It is recognized in literature that different distributions in society possess different opportunities and constraints (Hill, 1972,

pp. 57-59). An attempt was made in the literature review (Chapter 2) then, to examine the differences in labor activity that exist between different social and economic groups in society. Similiarly, inter-farm variations were examined in the empirical analysis (Chapters 5 and 6).

Objective 3: The objective of Chapter 3 is to discuss the various problems associated with measuring and analyzing farm labor flows. This includes a discussion of the various units of time used to measure labor, the weighting systems used to adjust for productivity differences among different labor types and the aggregation periods used to study the flow of labor.

Objective 4: One of the main objectives of the empirical analysis is to examine the representativeness of one year's agro-economic activity to the activity existing in other years. Farm management surveys in West Africa are generally carried out over a 12 calendar month period. Some question arises as to whether the results of a single year study are representative of the year to year variations that occur in farming activity. This question is approached in two ways. First of all, an 'average' years labor profile (calculated from 5 years of time series data) for seven Zaria farmers is compared with the labor profiles of these same farmers for the single year 1966 (in Chapter 4). Secondly, the year to year variations in farming activity are analyzed for the sample of seven Zaria farmers (in Chapter 6). The representativeness of a single year survey then, can be examined in view of the actual inter-annual variations that are observed.

Objective 5: Another main objective of the empirical analysis is to compare the effects of using different aggregation periods (i.e. weekly versus monthly) to study labor flows at peak labor times. One of the most serious problems facing West African agriculture is the labor constraint incurred during the peak labor periods (due to the seasonality of agriculture). Labor studies generally analyze the intra-year variations in labor activity in terms of monthly aggregation periods. Since labor delays of even a week can greatly decrease yields, it is hypothesized that a monthly aggregation period is not short enough to accurately reflect the labor bottlenecks that occur. The labor profiles for seven Zaria farmers are disaggregated into weekly periods (in Chapter 5) to determine whether greater peak week labor constraints are revealed.

Section 1.3 The Zaria Over Time Survey and Research Methodology

This section discusses some of the methodology used in conducting the Zaria 'over time' study along with some of the shortcomings incurred in the analysis. During the period April 1969 to March 1975, the Rural Economy Research Unit conducted an agro-economic study of nine farmers in four separate villages in Zaria Province, Nigeria. The data were to be collected bi-weekly and recorded in daily records, for a continuous 6 year period of time. For certain stock variables such as the size and age-sex profiles of the family and the quantity of land owned and cultivated, data were collected only once or twice a year. The study is unique in the sense that few other studies have been conducted in West Africa that have recorded and analyzed labor data over a period of years.

The definition used to identify the family unit was "those people eating from one pot". This definition identified a group of family members who

usually work and eat together. Certain difficulties arose with this definition, since the family can split into two pots during the dry season and regroup during the wet season. But all things considered, this definition proved to be a useful one. A family farm or holding was defined as the total number of hectares left fallow or farmed by members of the family at a specific time during the year. This measurement was usually made during April, May or June for each year in the study.

The Zaria 'over time' study was carried out using a sample size of nine farmers. Seven of the nine farmers were originally included in Normans 1966 Zaria study and use mostly 'hand' power in their farming operations. The two remaining farmers originally included in the sample used oxen in their farming operations. During the course of analyzing the data, however, it became apparent that one of the draft farmers had to be excluded from the study. Due to special circumstances, the total labor activity on his farm declined from quite a substantial labor activity to virtually no activity over the six year period of time. As a result, the sample size was reduced to eight farmers, seven of which use hand power and one which used draft power.

The procedure used to select the farmers was by no means random in nature. The primary criterion used was that the farmers be cooperative and willing to participate in the survey. Most of the farmers selected were previously acquainted with the Rural Economy Research Unit (RERU) from the earlier study conducted in 1966 and good relations between RERU and the farmers was certainly a determining factor in the selection. As will be shown later in the paper, the farmers in aggregate appear to represent the larger farmers in society, in regards to a number of agro-economic character-

istics studied. The small size of the sample and their location also detract from any notion of randomness in the selection procedure. The eight farmers were located in four different villages with varying distance and access to the major city of Zaria, Nigeria. Hanwa village, for instance, borders Zaria city; Doka and Shika villages are situated about 25 miles and 11 miles, respectively, from Zaria city, but both are connected by a major road; and, Dan Mahawayi is relatively isolated, the last seven miles of the 20 mile distance to Zaria city being motorable only during the dry season.

The sample of farmers and details concerning their location, source of power used and length of study period are shown below.

Table 1.1: Some Details Regarding the Small Sample of Farmers

Village	Farmers (code names)	Power Source	Survey Period
Dan Mahawayi	TF	Hand	1969-1974
	NJ	Hand	1969-1974
Doka	MS	Hand	1969-1974
	DN	Hand	1969-1974
Hanwa	SH	Hand	1969-1971, 1973-1974
	YR	Hand	1969-1971, 1973-1974
	BL	Hand	1969-1971, 1973-1974
Shika	RW	Draught	1969-1971, 1973-1974

As shown in Table 1.1, the survey period differs between farmers in the sample. During data collection, the records for those farmers in the Hanwa and Shika villages were lost for the year 1972. As a result, four farmers in the sample have a complete 6 years of data recorded, while the remaining four farmers have only 5 years of data.

Several other major problems were encountered during the analysis of the data. The first main problem was the difficulty of maintaining a satisfactory level of statistical rigor in the analysis. A sample size of eight farmers (effectively seven farmers since the one draft farmer is excluded from the analysis in Chapter 5) allows too few degrees of freedom to arrive at strong statistical results. This problem is exacerbated by the fact that a high degree of variance was observed among farmers in the sample with regards to the agro-economic variables studied. A serious attempt was made to avoid inaccurate conclusions, but the nature of the sample design was such that the analysis was open to subjective bias.

The second major problem was that much of the input-output data had to be disregarded because of the unreliable manner in which it was collected. The Zaria over time study was not a major project on the list of RERU's projects and due to poor supervision the data were suspected to have errors (with the exception of certain stock variables and the labor data). The end result was that the analysis phase of the study had to be restricted primarily to labor aspects. Aggravating this situation, however, was the lack of information -- i.e. income data, yields, purchased inputs, etc. -- which help explain labor activity on the farm.

Finally, the amount of time spent on off-farm employment was not available for analysis. The information was requested, but for various reasons it didn't arrive. Consequently, the study is seriously weakened by not being able to examine the substitution effects between farm and off-farm work. In addition, an analysis of the total work intensity by family male adult's is precluded by not being able to examine the other uses to which time is put.

CHAPTER 2

THE SIGNIFICANCE, VARIABILITY AND DETERMINANTS OF LABOR IN WEST-AFRICAN SMALL FARM SYSTEMS: A LITERATURE REVIEW

Section 2.1 Introduction

In West African farming systems, labor rather than land appears to be the major constraint to agricultural activity. Land has generally been considered to be relatively plentiful compared to many developing regions in the world, although increasing population densities are severely affecting land availability in certain areas. Very little capital has traditionally been used in peasant agriculture, as compared to either land or labor.

Given the proper incentives, agriculture is replete with possibilities to increase production simply through the application of increased labor input. Labor may be used to directly intensify production, from the existing land and capital resources, by more liberal use in land preparation, cultivation and harvesting. Indirectly, labor may be used to increase production by direct capital formation through such activities as land clearing, digging of wells and irrigation ditches and the formation of terraces. Labor becomes of critical importance in the shift from a traditional agriculture to a dynamic agriculture, since many technological innovations require added labor input.

The sources of information used in writing this chapter have been drawn primarily from studies performed in West Africa, although some results from other parts of Africa and Asia are included as well. A large portion

of the West African information consists of studies performed in Nigeria, especially the Hausa area of northern Nigeria. The reason for this emphasis is twofold. One, much of the literature that has been written on labor use in West Africa comes from studies performed in Nigeria. Secondly, it is the author's intention to tie this chapter as closely as possible to the survey results of eight Nigerian farmers presented in later chapters.

Section 2.2 The Family Farm's Special Work Equilibrium

No other characteristic places the family's economic decisions in a better perspective than the view of the family farm as both a consumption and a production unit. Its special content defines both the extent of the family's consumption demands as well as the size and productive capacity of its work force.

The degree to which the family's consumption demands are satisfied and the extent to which its workers expend effort depends on a special equilibrium between two basic and opposing forces. On one side of the equilibrium rests the family's satisfaction gained from the return of an increment of labor. On the opposite side is the producers disutility of that increment of labor derived from the leisure that must be sacrificed, 'other' activities that must be given up and the greater burden that additional labor incurs. Both the family's utility for material goods and services and for leisure is thought to be subject to diminishing marginal utility.

The quantity of goods and services which a farmer may obtain by giving up a given quantity of leisure depends on the farm's physical production function between labor and physical output, the prices of farm output and the prices of consumer goods and services. The physical relationship

between labor and output further depends on the physical quantities and qualities of the farm's land and capital resources and by its state of technology. The productivity of labor is also subject to diminishing returns and varies from area to area and from farm to farm within an area.

Each household strikes a balance between its net utility of the fruits of employment and the disutility of that employment in determining the specific volume of its labor activity (Chayanov, 1966, p. 81). If in the family's estimation the basic equilibrium has not been reached, then unsatisfied consumption demands are still strong and the family is under a very strong stimulus to expand its work activity (Chayanov, 1966, p. 87). Once the basic equilibrium is completly met, however, further labor input would be pointless since the drudgery of extra labor would be greater than what the peasant farmer wishes to endure. Only a very high return to labor and a higher family utility for the product of that labor will stimulate household producers to new work (Chayanov, 1966, p.87).

The relationship between the family's utility for the output of labor and the disutility of that labor can be usefully explained in terms of a standard utility maximizing model (Levi and Bellamy, 1975, pp. 81,82; Mellor, 1966, pp. 163-167). Utility is maximized subject to the constraint of the diminishing returns curve relating agricultural output to labor time. Figure 2.1 represents a hypothetical utility surface for the family farm demonstrating how total man time on the farm is determined.

The horizontal axis OT denotes the total man time available to be divided between farm labor and other activities. A sacrifice of leisure to provide more labor is represented by a movement to the right, from T to O. Arbitrarily, the axis has been divided into three sectors. In

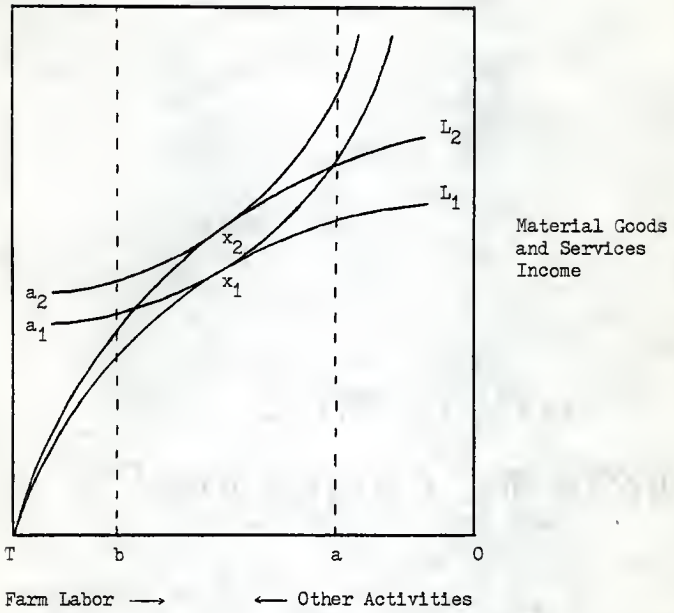

Figure 2.1: Hypothetical Utility Surface and the Determination of Farm Labor Input from Several Production Possibilities

sector Tb, additional leisure provides little utility. For biological and social reasons, segement 0a must be reserved for certain non-work activities such as rest or essential social activities. Segement ab represents the area of normal freedom in decision making. The vertical axis measures goods and services income using market prices as a common denominator.

The iso-utility curves (a_1, a_2) are logically concave to the origin. Each point on the iso-utility curve represents a different combination of

the family's relative utility for 'other activities' and for material goods and services. As we cross successive indifference curves, from a_1 to a_2, higher and higher levels of satisfaction are reached.

The production possibility curves (L_1, L_2) are logically convex to the origen. Two production possibility curves are shown, each representing a different level of labor productivity for the same quantity of labor input by the family farm. Within a traditional agriculture such differences in productivity would most likely be due to different quantities of land. Thus, L_1 might represent a situation where the farmer has a very small acreage, while L_2 might represent the situation of a farmer with substantial acreage. The different production possibility curves could also represent situations of varying qualities of soils, different power sources, different levels of production inputs or different value crops grown.

The equilibrium level of labor usage is determined at the point where the production possibility curve just touches the highest possible indifference curve (x_1, x_2). At this point, the combination of farm labor, value of output and the amount of 'other activities' are all determined.

The equilibrium combination clearly depends on the underlying factors that define the shape of the farm's indifference map, the height of its production possibility curve and the productivity of labor input. The factors determining these relationships are what we are primarily concerned with in the rest of this chapter.

Section 2.3 Family Composition

The special composition of the family in terms of size, age and sex characteristics provides in a general way the first set of underlying deter-

minants to the family's internal work equilibrium. Every household has a distinct number of consumers and producers as governed by family composition and the interrelations between these two greatly influence the labor intensity of family workers.

Section 2.3.1 Definition of Consumers and Producers

The consumption demands of the family are primarily defined by its subsistence needs and the desire for income over and beyond its subsistence requirements. This is basically a function of the size, age and sex composition of the family, the family's income level, personal tastes and social institutions. Due to different age-sex profiles, however, it is very difficult to make comparisons across households in regards to the relative size of the consumption force. Several individuals have tried to weight the consumption habits of different members of the family in terms of the consumption requirements for a male adult (Chayanov, 1966, p. 58).[1/] Although this is only a crude attempt at standardizing consumption measurements it does allow a means to assess and compare the variability between households.

The number of producers available for farm work again depends on the size, age and sex composition of the family, the physical condition of its members and social institutions. Problems are encountered though, when comparisons are made between households because different types of labor

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[1] Matlon (1977, pp. 59-61) assigned .2 man-equivalent units to all children under 4 years of age; .5 units to children between 5 and 9 years of age; .75 and .7 units for males and females, respectively, between 10 and 15 years of age; and 1.0 and .75 units for males and females, respectively, over 16 years of age. These coefficients closely reflect the relative standard calorie requirements of each age and sex group suggested by the FAO.

have varying degrees of productivity.[1] The problem is further complicated because relative work productivities vary depending on the type of task being performed, the nutritional level of the family's work force, the season of the year, etc. Various weighting systems have been designed which attempt to translate the heterogenous work force and its labor activity into more standard units for comparison (i.e. man-equivalent units -- see section 3.2 for further discussion).

Section 2.3.2 A Theory of Consumers and Producers in the Household

One of the first thorough evaluations of peasant economic activity was performed by A.V. Chayanov in his study of the Russian Peasant Economy of the early 1900's. Through the use of consumer/worker coefficients, Chayanov studied the effects of family consumption pressures on workers in the household. Chayanov (1966, p. 78) observed that: [2]

> "...other things being equal, the peasant worker stimulated to work by the demands of his family, develops greater energy as the pressure of these demands becomes stronger. The measure of self-exploitation depends to the highest degree on how heavily the worker is burdened by the consumer demands of his family."

Since the family's age-sex composition is the primary determinant of consumption demands, then other things being equal, producers will work harder as the ratio of consumers to workers increases. It is implicit in Chayanov's definition, though, that some final level of work intensity (and

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[1] This point is very much in question. Some authors argue that no differences in productivity exist and the differences that do occur between age-sex groups are due to endurance and expressed by fewer hours worked per day. For further explanations see section 3.2.

[2] Chayanov observed, in Table 2.8, that the number of work days per worker per year was 99 days for households with a 1.01-1.20 consumer/worker ratio, 102 days for the 1.21-1.40 consumer/worker ratio, 157 days for the 1.41-1.60 consumer/worker ratio and 161 days for a consumer/worker ratio greater than 1.61.

production) is associated with each distinct ratio of consumers to producers. The theory can be restated in a manner that doesn't assume any limits to work intensity; that is, that labor intensity will vary inversely with the relative working capacity of the producing unit (Sahlins, 1972, p. 76).

Several researchers have found evidence to support Chayanov's theory. Norman (1972, p. 65) found in his Nigerian studies that the time worked per male adult on the family farm was negatively related to the number of male adults in the family. Sahlins (1972, pp. 107-123) has tested his hypotheses in East Africa and New Guinea and found that 'Chayanov's rule' does hold in a general way, though not in specific.[1/] Raynaut (1976) has observed, in Niger, that the production of cereals per actif decreased with an increasing number of actifs in the family.[2/]

Section 2.3.3 Family Composition as a Source of Variation

The composition of the family in relation to the consumer-producer mix offers the first source of variability between households in the intensity of labor input. As the ratio of consumers to producers differs

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1 Sahlins mentions that the real Chayanov slope between labor intensity and the consumer/producer ratio is subject to violations at the extremes in society. Due to kin and political relations and the interest in other's welfare that these relationships entail, some farmers (who are in a position to do so) are compelled to produce above the norms implied by Chaynov's rule. At the other extreme, are households weak in manpower and inflicted by malchance who work below the norm's implied by Chayanov's slope. These household economic failures are attributable to illness, death, European influence or the fact that they could depend on others to take care of them. Underproduction is as acceptable in some societies as is surplus intensity.

2 'Actifs' is a French term used in the Francophone areas of Africa. It is generally defined as those individuals between the ages of 15 and 59. There is often no differentiation between sex groups.

between households so can differences be expected in the labor intensity per worker. Several explanations account for the variability in family composition. For the most part they are random in nature and revolve around the biological and social factors governing size and sex characteristics. A more systematic explanation is offered, however, by the 'life cycle' of the family.

The family's progression through life can be described in its most simplest form as a series of overlapping stages, beginning with the marriage of two adults; expanding and maturing with the birth and rearing of children; dissolving with the marriage of the children; and, ending with the death of the parents and replacement by the childrens families. Early in its life the family bearing children will face rapidly increasing consumption pressures as the family becomes burdened with non-productive children. The combination of a higher consumer/worker ratio, a younger age of the family head and the relatively weak social and economic position associated with a young, just starting family, suggest a higher work intensity for family workers.

Later in life, the productive capacity of the work unit increases as children reach adult age. Under ceteris paribus conditions, this should permit a larger volume of work activity by the family, though the work activity per worker may possibly decline. The social and economic means of the family may also increase with age, enabling better abilities to recruit outside labor.

However, Hill (1972, pp. 165-170) contends, in her study of economic inequality in Batagarawa village, in northern Nigeria, that several standard 'life cycles' can be statistically differentiated in the community.

One model would certainly correspond to the case of the successful farmer described above, but other models can be formed for the young farmer whose father has died prematurely, the impoverished farmer who has either never had children or lost them or elderly parents who have children born to them.

Every family depending on its age and structure, is in a different phase of development. The special nature of its development will result in a distinct ratio of consumers and producers that on average is likely to grow more favorable with age (Chayanov, 1966, pp. 56-58). These changes in a general way offer some predictability to the family's labor activity per worker throughout its life.

Section 2.3.4 Family Organization and Structure

Families, in northern Nigeria, can be organized into two types of units: a simple (nuclear) family or iyali unit and a complex family or gandu unit.[1/] The iyali unit consists of a single married man with his wives and dependent children while the gandu unit consists of two or more male adults, their wives and children. Hill (1972, p. 38) observes that most gandaye are paternal with sons remaining in gandu with their fathers after marriage while the fraternal gandu is relatively uncommon and fragile in nature.

The gandu family unit is larger than the iyali family unit in size. Norman, Ouedraogo and Newman (1979, p. 58) mention that the gandu structure possesses an average family size half again as large as the iyali structure with more than twice the number of male adults. This difference in size resulted in nearly twice as many hours input per annum on farms controlled

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1 The terms underlined here and in the remaining chapters are terms used in the Hausa language.

by gandu type families compared to that of farms controlled by iyali type families.[1] An important source of variation then, can be found in the size of the family, in general, and the structure of the family in specific.

In general, simple family units are more common than complex family units. Norman, Pryor and Gibbs (1979, p. 31) observed in their northern Nigerian studies that 62 percent of the farming families were organized under the iyali system. Traditionally, the complex unit was thought to be the preferred type, but it is now declining in significance for various reasons. These reasons focus on the increasing individualization of society that is resulting from increased contact with the outside world and greater monetization of the economy (Norman, Ouedraogo and Newman, 1979, p. 59).[2]

The breakdown that is occurring in the complex family structure is resulting in a number of important implications. The shift toward the simple family unit is resulting in a smaller family size and smaller farms although the land per resident ratios are similiar. The nuclear family unit also has higher dependent per worker ratios, poorer net worth and lower cash liquidity levels (Norman, Ouedraogo and Newman, 1979 p. 58). This

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1 A total of 2075 hours were worked by gandu families compared to 1222 hours worked by iyali families (Norman, unpublished information)

2 Norman, Ouedraogo and Newman suggest that the disintegration of the complex family system and the rate at which this change takes place are due to the introduction of cash crops, secular education, the influence of the Islamic land inheritance rule, increased off-farm employment opportunities, desire for freedom of action and the extent of new settlements and migration. However, the speed of disintegration may be restrained by the strength of the traditional hierarchical structure, the ethnic origin of the people concerned, ownership of cattle and the specific farming systems and its labor requirements.

would imply that individuals who work on the farm are likely to work more time than they would if the traditional structure had been maintained. The increasing dependent per worker ratios often mean as well that other family members, especially women, have to work harder (Guissou, 1977).

Section 2.3.5 The Size and Capacity of the Family's Work Force

The importance of male adult labor on the family farm is evident from studies across Africa (Cleave, 1974, p. 32). As Table 2.1 and 2.2 indicate, male adults contributed about 72 percent of total labor input in Norman's Nigerian studies and 34 percent in studies conducted by Delgado in Upper Volta. The significance of female adult labor, however, is less evident from the studies reviewed. While females contributed 49 percent of total labor in Upper Volta, their contribution in northern Nigeria was less than 2 percent.[1/]

The contribution of different family members to farm labor depends on a number of factors. One is the extent to which work on the farm is differentiated by age and sex. Certain tasks are performed mainly by male adults in the family, while other tasks are performed primarily by females. In certain areas of West Africa, for instance, men are responsible for work on the cash crops and much of the heavy field work that needs to be done, while women are responsible for the food crops, compound plots, food processing and domestic chores (Anthony et al., 1979, pp. 117,118; Cleave, 1974, p. 170). The nature of task differentiation, though, varies greatly from society to society.

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[1] This comparison is not completely accurate. Delgado's statistics include a number of domestic activities that are performed primarily by women that are not included in Norman's statistics.

Table 2.1: Contribution of Different Labor Types to Work on the Family Farm, Northern Nigeria

Variable		Sokoto	Zaria	Bauchi
Annual man-hours on the family farm[a]		1566	1800	1317
Source of farm work (% of total man-hours):				
Family:	Male adults	72.4	72.2	75.2
	Female adults	1.1	0.3	3.3
	Large children	8.5	8.9	9.9
Hired:	Hourly	7.7	8.6	3.1
	Contract	3.0	9.1	1.5
	Communal	7.3	0.9	7.0

Source: Norman, Pryor and Gibbs, Technological Change and the Small Farmer in Hausaland, p. 31.

[a] A female adult hour is equal to 0.75 man-hours and one hour by a large child (7-14 years old) is equal to 0.50 man-hours

Table 2.2: Contribution of Family Members by Age-Sex Group, Upper Volta

Variable	Family						Total	Non-family
	Males			Females				
	8-14 years	15-60 years	61+ years	8-14 years	15-60 years	61+ years		
Number of Persons	0.6	1.7	0.2	0.5	2.0	0.2	5.2	
All tasks[a]:								
Hours	1073	3653	262	569	5238	350	11,145	246
Percent	9.4	32.1	2.3	5.0	46.0	3.1	97.9	2.1

Source: Christopher L. Delgado, Livestock Versus Food Grain Production in South-Eastern Upper Volta, p. 82.

[a] The activities include labor hours for all activities except those of a purely social nature. Hours worked by individuals of different age and sex were not differentiated.

In his Upper Volta studies, however, Delgado (1978, p. 86) observed that considerable flexibility existed between men and women on farm activities and that task differentiation varied according to the season. During certain times of the year, certain tasks are predominantly performed by males or females while at other times considerable substitutability exists, especially during the critical labor periods. Table 2.3 and 2.4 indicate, for instance, that while Mossi women performed no weeding during the dry season, they performed about 40 percent of the weeding during the wet season. Thus, women weed with the men when the demand for labor is high, while men weed alone during the slack season. Delgado also observed that the division of labor varied according to ethnic groups, noting the differences between Mossi and Bisa households (Delgado, 1978, p. 86).

Crop production can also be differentiated by sex. One of the better known studies concerning the division of labor was performed by Haswell in Genieri, Gambia. Women were observed to take sole responsibility for the major food crop, rain-fed and swamp rice, while the men concentrated on the cash crop, groundnuts, and minor crops of millet and sorghum. As a consequence, when women were working 7 hours per day for 22 days a month in August and September, performing the arduous hoeing and transplanting tasks, men were working ten shorter days per month, on hoeing and bird scaring. At no time during the year were the two groups equally engaged (Haswell, 1953, pp. 8,36,42). Maymard (1974) observed a similiar situation in Senegal where women were also responsible for the cultivation of swamp rice.

The division of labor between sex groups may result in available labor being unutilized during important agricultural periods. Also, the changing nature of cropping patterns would seen to increase the burdens of one sex

Table 2.3: Task Differentiation by Sex, Age and Ethnic Group During the Rainy Season, Upper Volta

Task expressed[a] in percent of total hours	Mossi			Bisa		
	Children	Male	Female	Children	Male	Female
Agricultural activities:						
Land preparation	6	49	43	11	35	52
Sowing	4	39	54	5	46	47
Weeding	5	52	40	10	48	40
Harvesting	5	45	47	8	38	50
Non-agricultural act.:						
Livestock work:						
Small	68	15	12	47	46	5
Large	14	71	14	26	64	8
Domestic:						
Fetch water	6	4	89	7	19	71
Meal preparation	0	0	98	4	1	92
Other domestic	11	0	73	24	3	70

Source: Christopher L. Delgado, Livestock Versus Food Grain Production in South-Eastern Upper Volta, pp. 88-91.

[a] The breakdown may not add up to 100 percent because of rounding errors. Hours are not adjusted to man-equivalent terms.

Table 2.4: Task Differentiation by Sex, Age and Ethnic Group During the Dry Season, Upper Volta

Task expressed[a] in percent of total hours	Mossi			Bisa		
	Children	Male	Female	Children	Male	Female
Agricultural activities:						
Land Preparation	3	74	21	12	60	25
Water Crops	5	92	0	14	82	1
Weeding	2	96	0	-	-	-
Harvesting	4	52	41	10	43	45
Non-agricultural act.:						
Livestock work:						
Small	86	12	0	16	80	2
Large	31	68	0	6	87	5
Domestic:						
Fetch water	8	9	80	11	3	83
Fetch wood	4	14	80	5	26	67
Meal preparation	1	0	98	10	1	87
Other domestic	8	0	90	7	62	30

Source: Christopher L. Delgado, Livestock Versus Food Grain Production in South-Eastern Upper Volta, pp. 92-95.

[a] The breakdown may not add up to 100 percent because of rounding errors. Hours are not adjusted to man-equivalent terms.

group compared to the other. One example of this is the increasing significance of swamp land rice in the Gambia and the increasing problem this poses for women (Haswell, 1953).

However, evidence is available to indicate that the traditional division of labor tends to break down when sufficient incentive arises. Haswell (1953, p. 35), for instance, describes how men have begun to help women transplant the expanded acreage of swamp rice that replaced the abandoned late millet fields. They are also beginning to help in harvesting the crop by transporting the grain back to the compound. Cleave (1974, pp. 172,173) cites evidence from various studies conducted in Nigeria which indicate that women will assist men or vica versa in periods of emergency or in agricultural periods of critical importance.

A more rigid division of labor is found in the Hausa areas of northern Nigeria where Islam prevails (Hill, 1972, p. 279).[1/] The practice of auren kulle and auren tsare keeps Moslem wives in partial or complete seclusion and precludes them from participating in farm work.[2/] However, even though work is almost exclusively carried out by men, women in poorer families will still take part in farming at the time of planting and harvesting (Luning, 1967, p. 74).

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[1] Hausa is a linguistic and not an ethnic term and refers to those who speak the Hausa language by birth.

[2] Hill (1972, p. 279) explains that the practice of seclusion of women is more strict in Hausa Nigeria than in other parts of Moslem West Africa.

Section 2.4 The Farm's Physical Resources and Productivity of Labor

Throughout much of West Africa, land is less of a constraint to agricultural activities than is labor. In general, land is relatively abundant as is demonstrated by the high land per capita ratios, the prevalence of shifting cultivation systems (as opposed to permanent cultivation) and the low level of landlord-tenant institutional constraints. However, with the increasing population pressures that are occurring, land is becoming a more critical factor in certain areas. With reference to capital, very little has traditionally been used in agriculture. In most instances, it is relatively scarce compared to either land or labor.

The special characteristics of the farm's land and capital resources greatly influence the family's labor activities. Each household can be distinguished by the specific quantity and quality of land it uses or has available for use and the amount of capital it is able to and wishes to employ. The special combination of these resources (in relation to the farm's work equilibrium) greatly influences the return of a given unit of labor, the drudgery of applying it and -- with consideration of the family's utility preferences -- the volume of labor activity. The special nature of the farm's resources also determine's the degree to which the family's work force can be utilized on the farm throughout the year and to some extent the crop and livestock enterprises it can engage in.

2.4.1 Individual Versus Common Fields

The land farmed by the family can be divided into two types of fields: common and individual fields. Traditionally, the family head supervised farming activities on the common fields and instructed family members as to what and how much they should do. In turn, the family head was responsible

for at least a part of the family's food needs and payment of the household's taxes. However, with the increasing individualization that is occurring, an increasing proportion of fields are now coming under the control of other members in the family including that of stranger farmers (for a discussion of stranger farmers see section 2.7).

Although family members are given control over their own fields, they still must perform certain duties for the family head on the family's common fields. These obligations vary by season, region and ethnic group, but one type of arrangement discussed by Hopkins (1975, p. 37) is for individuals to work four mornings of the week for the household head with the remaining time spent on their own plots or working for others.

A number of important implications have arisen as a result of these changes in land management. Venema (1978) observed in his Senegal studies, for example, that the average sowing date and the date of first weeding were later and yields lower for fields under the control of other individuals in the family. The problem is attributed to the shortage of labor that results from family head's ensuring that labor requirements on common fields are given priority. As a result, lower labor inputs and poorer timing of operations occurred on individual fields.

Another complicating factor is the seasonality of agriculture (Norman, Ouedraogo and Newman, 1979, p. 74). The time when labor is most critical on the common fields is also the time when the return from working on the individual fields is highest. Thus, the problems of labor priorities on common fields are accentuated by the effects of seasonality. Although little information has been collected that has differentiated between the two types of fields, it is hypothesized that the labor inputs on common fields are likely to be higher for the above reasons.

Section 2.4.2 Land Quality

Two main types of land quality can be differentiated on the family farm in Hausaland. Gona land (upland soils) is the more prevalent type and, since it is rainfed, is suitable for crop cultivation only during the wet season of the year. Fadama land (lowland soils) occurs where the water table is near the surface and is suitable for crop cultivation throughout the year. The difference in land quality is reflected in the type of crops they normally support. The high quality fadama is generally used for growing the high-value, labor intensive crops such as sugar-cane, rice, onions and yams. On gona land are grown the crops that have a lower value per acre and are less labor intensive such as millet, guinea corn, cotton and groundnuts.[1/]

However, a number of constraints may prevent the intensive cultivation of fadama and in certain instances preclude its cultivation entirely. These include: 1) the lack of labor during the dry season due to non-farm work and social obligations; 2) the shortage of financial resources to provide the inputs necessary for the higher value crops; 3) a greater utility preference for leisure following the wet season's agricultural activities;

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[1] Norman (1972, pp. 74-77) observed that the average labor input per acre of cultivated fadama was 526 man-hours compared with an average of 219 man-hours per cultivated acre on gona land. In regards to specific crops, 526 man-hours were put in per acre of sugar cane, while 134, 217 and 138 man-hours were devoted to an acre of guinea corn, groundnuts and cotton, respectively.

4) the farmer's unwillingness to grow fadama crops because of the high level of labor inputs that they require; 5) the problem of flooding during the rainy season; and, 6) the problems of accessibility of markets. In regards to the last point, many of the crops grown on fadama are primarily cash crops and due to the low value per unit weight are more expensive to transport.

Section 2.4.3 Inputs Improving the Productivity of Land

The use of new and traditional technologies on the farm has an important influence on farm labor activity. Some technologies can be classified primarily as those which improve the productivity of land, while others can be classified primarily as those which improve the productivity of labor. The effect on labor activity will depend on the specific type of technology used on the farm.

The use of biological and chemical types of technology (i.e. improved seeds, fertilizers and insecticides) directly increase the productivity of land. Such land-improving technologies generally result in greater use being made of labor on the farm. The use of biological and chemical inputs are likely to result in increased weeding activity as well as increased harvesting activity due to higher yields (Norman, Pryor and Gibbs, 1979, pp. 88,97). The productivity of labor may indirectly increase as well if weeding can be performed in a timely and effective manner.

Labor-saving technologies primarily refer to the use of herbicides and to the use of mechanized or draft power. Such technologies directly increase the productivity of labor at planting (draft power) and weeding (herbicides) times and generally are considered to be labor-saving in nature.

However, the expanded acreage that draft power can encourage at planting time can indirectly result in an increase in total weeding and harvesting labor activity.

The type of improved inputs used and the extent to which farmers are able to use them depend on a number of factors. Mainly, they focus on the farmers ability to gain access to such inputs. This is a function of the farm's financial resources, the social and political position of the household head, the location of the farm, the nature of the input distributional system and the availability of credit.

Several studies have examined the relationship between the level of land-improving inputs and labor allocation. Matlon (1977, pp. 121-133) found that the highest levels of all variable inputs used per acre were recorded for the highest income class (with the exception of one very densely populated village).[1/] It was found that the highest income household's applied 37 percent more inorganic fertilizer, 27 percent more organic fertilizer and employed 28 percent more hired labor per cultivated hectare than low income households. These differences in resource use were reflected in a positive relationship between total hours worked per hectare and income status. Matlon (1977, p. 180) observed, for instance, that low, middle and high income households worked a total of 587, 694 and 712 hours per hectare, respectively.

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1 For both high and low income households alike, Matlon found that the most significant determinant of income per consumer was the productivity of land and labor. One factor found to significantly influence productivity was the difference in crop mix (food crops versus cash crops) and the corresponding higher costs associated with the higher value crops. More importantly, however, were the differences in technique and management between income classes (note: differences in management refers to differences in resource allocation, enterprise mix and farm organization rather than that of managerial ability).

Similiar results were observed by Mellor (1966, p. 160) in his comparisons between similiar rice growing areas in India and Japan. Mellor notes that, both as a cause and an effect of greater fertilizer use (ten times as great) and higher levels of output (eight times as great), the labor input on Japanese fields was nearly four times as great (with the inclusion of double cropping) as on Indian fields. Norman, Pryor and Gibbs (1979, pp. 95,96) observed a positive effect on total labor per hectare that resulted from introducing improved technology in Daudawa village in northern Nigeria. Labor inputs on sorghum and cotton fields using improved technology were substantially higher than on fields using traditional methods.

Section 2.4.4 The Availability of Land

It is postulated, ceteris paribus, that farmers with small amounts of land per resident will input greater amounts of labor per hectare than more favorably endowed farmers. This was observed by Norman (1972, pp.58,59) in his Zaria studies where a strong negative relationship was found between family labor and total labor per cultivated hectare and the land per resident ratio. Matlon (1977, p. 180) observed a similiar relationship in one densely populated Nigerian village. Total labor was observed to decline with increasing income status (an exceptional relationship compared to other less densely populated villages in the study) due to the very high land pressures existing among the low income strata in the village. These relationships are consistent with economic theory which prescribes, ceteris paribus, maximizing use of the relatively scarce input (i.e. land).

The lower family labor contribution per hectare associated with greater land availability is due to several factors. First of all, the potential family labor input per unit of land becomes progressively less as the land

per resident ratio increases. Also, a higher utility preference for leisure is likely as the greater marginal productivity of labor (associated with greater land availability) enables both a higher level of income per resident and a greater hired labor contribution on the farm. Matlon (1977, p. 186) mentions that the rate of substitution of hired labor for family labor increases during the peak labor season (for higher income farmers) due to the higher utility preference for leisure held by the family at this time.

A positive association was found by Matlon (1977, p. 187) between income status and the amount of land per resident. As has been demonstrated though, labor intensity per hectare increased with income status but declined with the greater availability of land per resident. This situation can be explained by the fact that not all households with high income status have large quantities of land and not all households with high land availability have high income status. The continued introduction of land-improving technologies is likely to even further separate income status from the control of land.

In a traditional agriculture, for instance, high income status is likely to be strongly associated with high land availability. Similiarly, the amount of total labor input per hectare is likely to decline with an increase in the land per resident ratio. This conclusion is supported by Norman's finding of a strong negative relationship between labor intensity per hectare and land availability discussed above. With the introduction of land improving technology though, high income status is likely to become less strongly associated with land availability and higher levels of labor input per hectare are likely to be made by the larger farms. Matlon (1977, pp.191,194), for

instance, found only a weak negative relationship between total labor and hectares per consumer, though a negative relationship was found for all income classes. A more important finding, by Matlon though, was that the negative relationship between total labor per hectare and hectares per consumer was stronger for low income farmers than for the group of high income farmers. Thus the greater use of land-improving technologies by all households in Matlon's sample and especially by the high income households tended to weaken the negative relationship between total labor per hectare and land availability.

Population pressures are a major force influencing the availability of land. The decrease in land availability that is implied in increasing population densities suggest a greater land use intensity in regards to labor. Under severe land pressures, however, greater labor inputs alone amounts to no more than 'treading water' (Geertz, 1963, pp. 77-79).[1/] Without greater use of inputs complementary to labor, the farming system inevitably results in low levels of marginal productivity and a low-level state of equilibrium (Ruthenberg, 1976, pp. 149-151). A state of agricultural 'involution' occurs with the attainment of higher total income per acre in

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1 Geertz, in his study of several highly populated areas in Java, discusses how population pressures and the expansion of sugar cultivation placed severe demands on the Javanese peasantry to maintain caloric sufficiency. There was no industrial sector into which to move, the Javanese were not a part of the existing coffee estate economy and extensive systems could not be adopted because of inadequate capital. Without any variation in capital inputs, yields were increased and per-capita output of rice kept pace with the island as a whole by more intensive use of labor. Wet rice cultivation complemented labor intensity due to its extraordinary ability to maintain levels of marginal labor productivity. However, this system offers very little scope for increasing, not to mention maintaining per-capita levels of output. After 1900, rice production could not keep pace with the rising population.

the area but accompanied by lower income per head because of the increasing population (Lagemann, 1977, pp. 77-79).

However, some of the evidence that is available indicates that farmers do engage in more land improving practices as land becomes a more critical constraint to the farm. It has been found, for instance, that greater emphasis has been given to cash crops and higher value food crops as land pressures increased (Matlon, 1977, p. 80). Matlon (1977, p. 172) has found that the applications of organic and inorganic fertilizer was greatest in the village facing the highest land pressures. The use of such land-improving technologies generally complements labor by improving labor productivity. This would be indicated by a rightward shift in the marginal value product of labor curve. Under ceteris paribus conditions, the higher incentive of returns encourage greater labor inputs per unit of land.

Section 2.4.5 Low Labor Inputs by Smaller Farmers

As land pressures become greater, farmers appear, ceteris paribus, to maximize the limited quantity of land by applying more labor per hectare. However, this does not imply that workers in low land per resident households work harder. To the contrary, evidence is available to indicate that a positive relationship exists between the amount of farm labor per worker and land availability. It has been found that the amount of family labor per man-equivalent and the amount of male adult hours per male adult both increased with an increasing land per resident ratio (Norman, 1972, pp. 19, 20,23).[1/] Matlon (1977, p. 296) also observed that the lowest number of

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[1] Based on computations made from Table 12 and 13 (in Norman, 1972) it was found that family hours per man-equivalent declined from 324 hours in the high land per resident households to 311 and 264 hours in the middle and low land per resident households (for Norman's definition of a man-

hours worked per day on the farm, were worked by the low income farmers (low income status is significantly associated with small farm size).

The low level of family labor input, on the farm, by farmers in the low land per resident strata and the low-income households can be attributed to several interrelated factors:

1) Because of different opportunity structures or greater constraints, the poorer farmer (as opposed to the wealthier farmer), may be unable to gain access to land improving inputs which facilitate greater labor intensity. Thus, the marginal productivity of labor is low and falls rapidly.

2) The indifference curve is likely to be strongly in favor of material goods and services income, but due to very low levels of marginal productivity, too little incentive may exist for further labor inputs.

3) Family labor may be reallocated to non-farm jobs, as the marginal return to labor falls below the off-farm opportunity cost. Even if this is not the case, off-farm employment may still be sought in order to meet farm and household expenses. Off-farm employment has been observed to be higher among those farmers with low amounts of available land (Norman, 1972, p. 23). Still this higher off-farm component does not entirely explain the difference between high and low land per resident strata (due in part to inadequate opportunities).[1/]

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equivalent see section 3.2). The figures for male adult hours per male adult on the farm are 570, 607 and 669 hours for the low, middle and high land per resident ratios, respectively.

[1] Including off-farm employment, Norman (1972, p. 23) found that male adults, on average, each worked a total of 1197, 1054 and 1230 hours per year, in the low, middle and high land per resident strata, respectively.

4) A calorie shortage, particularly during the hungry season (see section 2.9.2.3), may constrain the potential energy expenditure of farmers.

5) The income-leisure indifference curve, could possibly be biased toward leisure or 'other' activities.

Further consideration will be given to these points in subsequent sections, especially in reference to the effect of seasonality on labor activities.

Section 2.5 Time Worked by the Family

The major input of labor on the family farm tends to be provided by family workers. Reasons given for the dominance of family labor include the fact that agriculture has traditionally been largely subsistence in nature and that the nature of the land tenure system and relatively low population densities have prevented the development of a landless laboring class (Raynaut, 1976).

Section 2.5.1 Time Worked by Male Adults

The amount of time worked by male adults on agricultural activities has been studied by a number of research workers. Cleave (1974, p. 32) indicates that male adults typically work about 1000 hours per year on the farm's fields. This represents some 4 to 6 hours worked per day for under 200 days of the year. Table 2.5 indicates that male adults in three areas in northern Nigeria worked between 700 to 900 hours per year, including time spent walking to and from the fields. This consists of about 130 to 160 days worked per year with 5.1 to 5.8 hours per day worked. Haswell (1953, p. 60) observes that male adults in the Gambia worked a somewhat lower number of days per year.

Table 2.5: Time Worked by Family Male Adults, Northern Nigeria

Variable	Sokoto	Zaria	Bauchi	Overall
Days worked per year:				
Family farm	159	140	134	145
Off-farm: In village	78	89	97	88
Outside village	35	-	-	11.8
Total	273	229	231	244
Hours worked:				
Hours per day worked:				
Farm[a]	5.8(5.0)	5.1(4.4)	5.6(4.7)	5.5(4.7)
Off-farm	4.8	5.1	4.2	4.7
Total hours worked	1484	1166	1159	1270
Distribution of time worked in days[b]:				
20% worked less than	196(670)	154(687)	159(671)	170(676)
20% worked more than	340(1607)	319(1544)	334(1468)	331(1540)

Source: Norman, Pryor and Gibbs, Technological Change and the Small Farmer in Hausaland, p. 27.

[a] Figures in parentheses exclude time spent walking to and from fields.

[b] Figures in parentheses are hours.

The total amount of time devoted to work (i.e. farm and off-farm employment) is rarely available. Monnier et al. (1974) indicate that a male adult, in Senegal, works a total of 1250 hours per year while Haswell (1953, p. 58) observed a total of 193 to 201 days worked by male adult's in the Gambia. Results from Table 2.5 indicate that male adults worked an average of 1270 hours. This amount of time was spread over a period of 244 days at an average of 5.1 hours per day worked.[1/]

Section 2.5.2 Time Worked by Female Adults

It is very difficult to draw firm conclusions regarding the contribution of women in agriculture. Due to different forms of work organization and varying customs concerning the women's role in farm work, different studies show widely different contributions of women in farm activities. The problem is further complicated by the different systems used to weight the productivity of female labor, making it difficult to compare across studies. The studies that are available, however, indicate that women can provide anywhere from an insignificant to a substantial contribution to farm work.

In northern Nigeria, for instance, the contribution of women in agriculture is generally less than 2 percent of total farm time worked (Norman,

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[1] Two different measurements of labor intensity per day can be found in the literature. The number of hours per day worked refers to the average number of hours worked per given unit of time divided by the actual number of days worked during that time period. For example, if 15 hours were worked in a given week and 3 days were worked in that week, the hours per day worked would be 5 hours. A different measurement, though, is the number of hours worked per day. This measurement is calculated by dividing the number of hours worked in a given time period by the number of days comprising that time period. For example, 15 hours worked per week would amount to 2.1 hours (15/7) worked per day. The specific method used can greatly affect the complexion of the results.

Pryor and Gibbs, 1979, p. 31). However, Monnier (in Reboul, 1972) observed in Senegal that female adults worked between 460 to 600 hours per year on farm activities and Haswell (1953, pp. 25,37,38) found a female contribution of 1081 hours, in the Gambia. When domestic chores are included, Cleave (1974, p. 163) suggests that an additional 2 to 3 hours are worked per day. Indeed, Delgado (1978, pp. 78,82) observed that with the inclusion of domestic activities, female adults work in excess of 2000 hours per year.[1/] In addition, women many times become engaged in income earning activities that may not be included in data collection (Simmons, 1976).

Section 2.5.3 Time Worked by Children

Children can also make an important contribution to farm activities. Norman observed that children contributed about 9 percent of the total man-hour input on the family farm. This amounted to about 80 days worked per year with just under 5 hours per day worked (or 2.5 man-hours)(Norman, 1972, p. 30). Similiar contributions were found by Haswell while Delgado observes a much higher contribution with the inclusion of domestic tasks (see Table 2.2).

Some caution is warranted, though, in evaluating the significance of children labor. Children are typically involved in such activities as livestock herding, bird scaring and general domestic activities. Such jobs may absorb large residuals of labor at insignificant levels of productivity. When work is performed on cropping activities, the problem again arises as to how productive such work is in relation to adult labor.

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[1] In Table 4.1, Delgado shows an average of 2.32 female adults per household for the overall sample. The total female contribution (for age class 15 to 60) for all females in the average household was 5238 hours (Table 4.2). Thus, a contribution of 2256 hours is calculated for each female adult in the family.

Section 2.6 Non-Family Labor

Non-family labor, in general, represents a smaller fraction of total farm labor in comparison with family labor. The estimates vary from 2 percent to 16 percent by Delgado (1978, p. 82) and by Norman, Pryor and Gibbs (1979, p. 31), respectively, while Matlon (1977, p. 180) observed a non-family contribution of 42 percent.[1/] The importance of hired labor is even further demonstrated by studies in Hausaland which indicate that 57 percent of total cash expenses was spent on hired labor (Norman, Pryor and Gibbs, 1979, p. 52).

When sample distributions are studied instead of whole-sample averages, substantial inter-farm variations were observed in regards to the amount of non-family labor that was used. Matlon (1977, p. 180) observed, for instance, that 51 percent of total farm labor, among high income farmers, was provided by non-family members, compared with just 38 percent and 31 percent for middle and low-income households, respectively. Norman (1972, p. 20) found a similiar relationship among his high, middle and low land per resident strata, while Hill (1972, p. 105) discovered that a small number of richer farmers provided a high proportion of all employment.

The inter-farm and inter-regional variations that occur in the amount of non-family labor input depends on a number of interdependent factors. Of principal importance are the: 1) marginal productivity associated with a given quantity of labor; 2) the size and productive capacity of the family's work force; 3) the availability of financial resources to pay for hired labor; 4) the differences in political and socio-economic position, which enable

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[1] The very low contribution observed by Delgado is due in part to the inclusion of domestic tasks which are performed almost entirely by family members.

more advantaged groups to obtain labor during critical periods; and 5) the strength of traditional institutions.

Several trends are encouraging an even greater non-family labor contribution over time. The trend toward greater individualization and monetization of the economy and the development of increasing inequalities in land and income distribution are facilitating greater hired labor use. Hopkins (1975, p. 427) mentions that changing relationships between the household head and farm laborers may result in the emergence of a class of landless laborers as land becomes more scarce and as inequalities between households increase.[1/]

There are many types of arrangements under which non-family labor is obtained, but four main classes can generally be distinguished. In Hausaland, these can be referred to as labor hired by the day (kwadago), contract labor paid by the job or task (jinga), communal labor (gayya) and reciprocal types of labor.

Important changes are occurring in the relative importance of the different labor classes over time. More traditional types of labor, as exemplified by the reciprocal and communal types, appear to be diminishing in significance, while individually hired labor is gaining in importance. Also, traditional systems of remuneration (i.e. voluntary labor or payment with food and drink) are being replaced by more formal systems of payment (i.e. wages).

The reasons for the decline in reciprocal and communal labor can be attributed to the general breakdown in community structures, increasing

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1 Large male children and stranger farmers (see section 2.7.1) are requesting to be paid in cash for the work they do rather than simply receiving food and a plot of land to cultivate.

individualization and the greater productive potential for labor hired on a contract or daily basis. Indeed, Cleave (1974, p. 174) feels that as the opportunity cost of these traditional practices rises, the less efficient work organizations may be expected to disappear. However, Norman, Ouedraogo and Newman (1979, p. 70) mention four reasons for the continued presence of these traditional systems.

1) Mutual responsibility in times of stress.
2) Hired or contract labor (remunerated in cash) tends to be associated with cash crops.
3) Reciprocal labor is more commonly found on food crops which do not enter the market place.
4) Reciprocal and communal labor may still be called forward by influential individuals within the village.

A special variation on the use of non-family labor is that of the stranger farmers (navetanes) in the Gambia and Senegal. Stranger farmers are temporary seasonal migrants from outside the groundnut growing areas. They came traditionally in response to the relatively high land to labor ratios and the seasonal labor bottlenecks that occur. A complementary relationship exists between farmers and stranger farmers. In exchange for a piece of land on which to grow groundnuts and payments of food and lodging, the stranger farmer works three or four days a week on the fields of the farmer (Haswell, 1975, pp. 17,18). The labor advantages to the farmer are obvious from this relationship. The household's work force is expanded at a time when hired labor may be difficult to obtain.

However, these arrangements are changing over time. An increased food shortage is causing the farmer to require the stranger farmer to

supply some food for the family of the farmer. Also, increased monetization and increasing shortages of land are encouraging cash rent to replace work requirements on the farmer's fields.

Section 2.7 Underemployment of Family Labor

African farmers, in general, appear to work nearly as many days per year as employees in temperate climates (i.e. around 240 days), although a big difference does emerge in the length of time worked per day. Male adults, for instance, appear to work only 60 percent of the hours considered normal for an average employee in temperate areas. Even during the peak agricultural periods the amount of time worked per day appears to be less than full-time employment.

However, the fact that some surplus time remains during the day and year that isn't spent on farm activities does not imply that farmers in West Africa are underemployed. Before such an assumption can be made, a more careful accounting is needed of the underlying forces that determine the underemployment of labor. Specifically these refer to 1) the uses to which non-labor time is put; 2) the extent to which 'leisure' time can be diverted to farm and outside employment; 3) the restraints reducing the potential for further labor inputs (health, nutritional level, etc.); and 4) the farmer's opportunity structures for productive work. One additional factor that affects the whole character of African farming in general and the influence of each of the above factors in specific is the seasonality of agriculture.

Very few labor studies have attempted to determine the significance of non-work activities on the family farm. The studies that have been done

generally record only the time spent on specific tasks, rather than establishing their value to the farmer. Very little is known of the extent to which non-work activities compete with farm and off-farm work for the family's labor supply.

From the fragmentary data available, it is clear that the time devoted to the wide range of non-work activities is considerable. Such activities vary from household chores and crafts through a range of activities that have various political and social significance in society. Some of these activities such as firewood collection and fetching water can be valued rather easily. However, the time spent on religious observance or ceremonial activities is less readily evaluated and requires a knowledge of the workings of the specific social system.

The amount of information available regarding non-work activivies is indeed scanty. Cleave (1974, pp. 163-168) cites various estimates for such household chores as firewood and water collection (0.5 to 2.5 hours per day), domestic chores (2 to 4 hours per day), food processing (0.75 to 1 hour per day) and marketing (4 to 6 hours per week). It is difficult to ascertain to what extent these activities are undertaken solely for their functional use since certain of these activities, such as marketing, have "social" significance as well. Also, the division of work by age and sex will clearly influence the work loads for different members in the family. Indirectly, this will influence the amount of time that is available to each family member in relation to farm and off-farm work.

The amount of time spent on social activities is very difficult to ascertain. Not only is limited information available, but the diversity of definitions and the varying techniques used make it very difficult for

the sake of comparison. One thing that is clear from these studies is that many social activities are put off till the off-season when total work activities are at a lower level of intensity (see section 2.9.3).

The importance of non-work activities is likely to raise the opportunity cost of agricultural work and reduce the readiness with which the flow of labor into agriculture can be increased. Hypothetically, the farmer will need ever greater returns from his labor inputs if he is to shift his time away from the non-work activities that have economic and social significance.

The value of leisure is less clearly understood. Usually leisure is viewed as the residual of labor activity such that labor can always substitute for leisure, given the incentive to do so. This assumption, however, can easily underestimate the value of leisure to the farmer. During the time period immediatly following the wet season, for instance, farmers may be so reluctant to take on work that few incentives are sufficiently attractive. In light of the significance of 'other activities' that the farmer engages in, the time available for rest is likely to be reduced and the marginal value of pure leisure time raised. Thus, a greater incentive is required to encourage the farmer to sacrifice leisure for more work. Also, nutritional deficiencies or illness may raise the farmer's utility for leisure.

Section 2.8 The Seasonal Nature of Agriculture

Seasonality refers to an annual cycle of distinct climatic changes. Primarily, this cycle is defined by rainfall distribution which in West Africa is characterized by a wet and dry season. Many local variations occur

in the amount of precipitation received, though a decrease in rainfall occurs as one moves north through the region (Norman, Ouedraogo and Newman, 1979, p. 1). The amount and timing in which this precipitation is received greatly defines the character of agricultural activity. The control of irrigated land or fadama allows more year around cultivation, but these are limited in traditional African farming systems and pose additional problems for the farmer (see section 2.4.2).

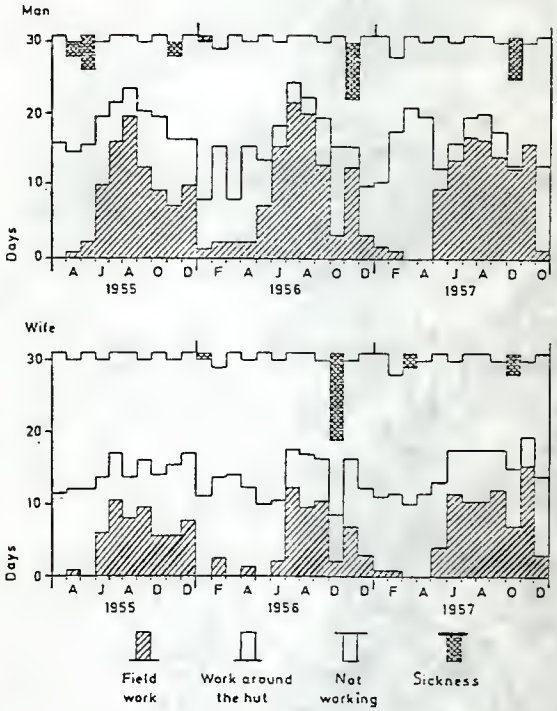
Crop cultivation closely follows the distribution of rainfall. Most of the farm's agricultural activities take place during the wet season while during the dry season only minimal agricultural activity takes place. Clearly, the seasonality of agriculture will influence the distribution of farm labor input throughout the year.

Section 2.8.1 The Seasonal Nature of Farm-Labor

Figures 2.2 and 2.3 show that the total amount of labor input varies widely throughout the year. Agricultural activities tend to concentrate in the May to November period with relatively little activity occurring during the remaining months. Also noticeable is the extreme variability that occurs within the main agricultural season. A distinct peak in labor activity appears to occur during the June to August period, associated with the time consuming activities of weeding, ridging and thinning.

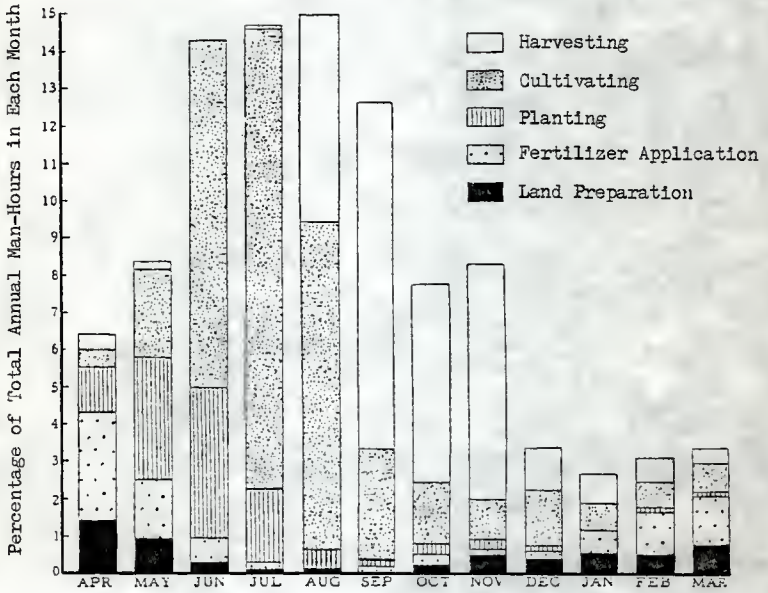
Several researchers have studied the seasonal distribution of labor activity. Norman, Pryor and Gibbs (Table 2.5) demonstrate, for instance, that an average of 241 man-hours per month were spent on the family farm during the peak month. This was 89 percent more than the average annual monthly input of 130 man-hours. The labor input during the lowest month was only 28 man-hours which was 79 percent lower than the average annual monthly

Figure 2.2: Seasonal Distribution of Work, Northern Cameroon



Source: Guillard, Golonpoui: Analyse des Conditions de Modernisation

Figure 2.3: Composition of Work on the Family Farm by Month and Operation, Sokoto, Nigeria



Source: Norman et al., Samaru Miscellaneous Paper, No. 64, p. 31.

Table 2.6: Indicators of the Seasonality of Work, Northern Nigeria

Rainfall (mms)[a]	752 (137)	1115 (115)	1102 (127)
Busy period:			
Four busiest months:			
Name	June-Sept	May-Aug	June-Sept
% of annual man-hours on farm	57	50	53
Peak month:			
Name	July	June	July
Man-hours on the farm	258	256	210
Percent non-family labor	21	19	12
Days per male adult on farm	20	17	19
Days per male adult off farm	7	7	7
Total days	27	24	26
Hours per day worked by male adults on the farm:	6.1	5.0	5.3
Slack Period:			
Four slackest months:			
Name	Dec-Mar	Jan-Apr	Dec-Mar
% of annual man-hours on farm	13	16	10
Slackest month:			
Name	Jan	Mar	Feb
Man-hours on the farm	32	35	17
Percent non-family labor	8	19	0
Days per male adult on farm	6	4	3
Days per male adult off farm	13	9	9
Total days	19	13	12
Hours per day worked by male adults on the farm:	3.5	2.7	4.2

Source: Norman, Pryor and Gibbs, Technological Change and the Small Farmer in Hausaland, p. 42.

[a] Figures in parantheses represent the coefficient of variation in monthly rainfall.

input. Delgado (1978, p. 82) observed a similiar distribution, though the amount of family labor was substantially higher. The seasonal nature of labor activities is location specific, but it has been found that the coefficient of variation for monthly labor inputs on the family farm increases as one moves north through the region (Norman, Ouedraogo and Newman, 1979, p. 78). This is due to a shorter growing season and a concomitant decrease in rainfall as one moves northward through West Africa.

The seasonal nature of farming highlights two of the main problems for farmers in West African agriculture. These are the problems of the peak labor period (or bottleneck) in farming associated with the expanded use of labor during certain periods and the prospect of considerable labor underemployment during other periods of the year. Conversely, the seasonal pattern of labor use may reflect adjustments that have occurred in the organization of the farm in response to labor shortages (during bottleneck periods) and the attempt to substitute another occupation during the off-season.

Section 2.8.2 The Peak Labor Season

Most studies seem to agree that seasonal bottlenecks are one of the major constraints in rainfed agriculture in West Africa. The timing and amount of weeding is often considered to be the most limiting factor, but bottlenecks are stated to occur as well in land preparation and planting. Harvesting activities do not generally create a serious bottleneck, even-though the amount of labor input per month may be as high or higher than the weeding period. The possible explanation is that harvesting work is less arduous than weeding work and the presence of the dry season creates a less urgent atmosphere for completing the task. The significance of the weeding

bottleneck period has been illustrated by linear programming models, where estimates of the marginal productivity of labor put in during this period were several times higher than the going wage rate (Norman, 1970).

Section 2.8.2.1 Labor Intensity During the Peak Labor Period

The farmers perception of the importance of weeding and planting is reflected in a higher level of work intensity during peak periods. Norman (1972, p. 26) found, for instance, that farmers on average worked 5.6 hours per day worked during the peak month of June compared with just over 3 hours per day worked in March. Similiar results were observed in other study areas in northern Nigeria (Table 2.5), while Matlon (1977, p. 295) found a somewhat lower overall contribution.[1/] Delgado (1978, p. 84) observed, on the other hand, that adult men and women, in Upper Volta, worked an average of 9 to 10 hours per day, seven days a week during the peak season. This compares with an average of 4 to 5 hours for adult males and 0.7 hours for adult females in the slackest month.[2/] Farmers also appear to work more days on the farm during peak periods as compared to the slack season (Jones, 1970; Table 2.5).

Section 2.8.2.2 Variation in the Length of Working Day

The amount of time worked per day varies between different periods of

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1 The number of hours per day worked among three study areas in northern Nigeria was found to be between 5.0 and 6.1 hours during the peak season compared with 2.7 to 4.2 hours per day worked in the slack season. Matlon, on the other hand, found that farmers worked an average of only 2.8 to 3.8 hours worked per day during the peak month of June compared with 1.7 to 2.2 hours worked per day for the year as a whole. The lower work intensity observed by Matlon can be contributed in part to his use of the measure 'hours worked per day' rather than 'hours per day worked' (see footnote in section 2.5.1).

2 The higher contribution observed by Delgado is probably due to a large extent to the inclusion of household chores and domestic activities. Such activities are not included in the comparative studies conducted by Norman and Matlon.

the year, between sex groups and among different areas. It is also related to the type of crops grown and to the type of tasks performed on these crops.

One would expect that the amount of work put in per day will vary according to the arduous character (i.e. monotony and degree of discomfort) of the task (Levi and Bellamy, 1975, p. 82). Cleave (1974, pp. 54,55) cites certain evidence that would seem to support this, but explains that the arduousness of the task is insufficient in itself to fully explain the variations in the length of work day that occur.

A contrary view is expressed by Haswell (1953) and Luning (1967, p. 29) who explain that the length of the work day is determined to a considerable extent by the urgency of operations. Collinson (1964, p. 18) showed that farmers in Geita district, Tanzania, worked a 20 percent longer day on cultivation than harvesting, even though cultivation is considerably more exacting. The urgency attached to planting and weeding operations is supported by a number of researchers. Ruthenberg (1976, pp. 80,99,100) explains, for instance, that crop yields are highly sensitive to timely and effective weed control, while both Ruthenberg and Haswell (1953, pp. 48,49) explain the importance of timely planting to crop yields.

However, the length of time worked is not necessarily a true indication of either productivity or the importance of the operation. Haswell (1953) is one of the few people who have attempted to measure the time actually spent resting while undertaking different tasks. The time spent resting on planting and weeding, for instance, was 11 percent and 17 percent of the time spent on the job compared with 30 to 33 percent on certain harvesting operations. Thus, a shorter amount of time worked per day on weeding may, in fact, represent greater productivity and more actual time worked than a

longer day spent on harvesting work. The picture is further complicated by the changes in the composition of the tasks that occur during the year, the multiple tasks that may be performed per day and the extent to which the urgency and arduousness of the task influences the amount of time worked per day.

Section 2.8.2.3 Traditional Techniques for Alleviating Labor Bottlenecks

Farmers have traditionally adopted a number of strategies to alleviate the adverse affects of seasonal bottlenecks in rainfed agriculture. These include both changes is the allocation of labor during peak seasons as well as changes in the organization of the enterprise mix. Some of the more important adjustments are the following.

1) Greater Use of Family Labor: Farmers, in general, work more time in the peak season as is indicated by the greater number of hours worked per day and more days worked per month. The traditional division of labor also seems to become more flexible during seasonal peak periods as family members participate more fully in the farm's critical work activities.

However, a number of factors may restrain the potential use of family labor on the farm as well as explain the low levels of daily work intensity, often observed in small farm systems. An insufficient caloric intake, for instance, may physically preclude greater work intensity during the peak period. The peak labor season usually parallels the 'hungry-gap' when food availability (either home-grown or purchased) is at its lowest ebb during the year. The 'hungry season' occurs during the pre-harvest period when food reserves following the dry season are normally low; when alternative sources of employment are reduced to compensate for peaked farm demands; and the need to purchase production inputs can strain the family's financial resources.

In one village in the Gambia, for instance, Haswell (1975, p. 196) found that only 20 percent of the villagers (surveyed on July 1, 1974) had sufficient food grains to last until the next harvest. Matlon observed that the poorest households in his Nigerian studies (i.e. in the lowest two deciles of his sample) did not have sufficient food production or even the purchasing power (due to the emphasis on cash crops) to obtain the minimum daily caloric requirements (Matlon, 1977, p. 285).

Several other factors to be considered revolve around the fact that family members have other activities to perform during the day besides just field work. These may include essential household and domestic chores or other activities of various political and socio-economic significance (see section 2.8).

Also important is the time spent on off-farm occupations. It would seem to be natural that non-farm work would be kept at a minimum during the peak season in order to emphasize work on the farm. However, such a strategy is not always feasible. One condition for keeping employment in the off season may be that time must be put in year around to ensure continuity. Such may be the case for individuals employed by public and private institutions, by private entrepreneurs or in self-employed occupations that derive considerable value from regular clientels (i.e. trading and crafts). Another example, is the ownership of livestock which requires supervision throughout the year. In fact, Delgado (1978, pp. 125-127) found that livestock may require even closer supervision during the rainy season in order to protect the fields from livestock damage. As a result, adults rather than children may have to supervise the herd at this time.

Various social obligations may also detract from time spent on farm activities. Such obligations may be of a social or reciprocal nature or the result of exploitive relationships. For example, work obligations appear to be emerging between families owning draft animals and those who don't. Draft owning farmers provide plough services at the beginning of the year in exchange for labor supplied during the bottleneck period (Jones, 1976; Ernst, 1976).

A poor cash liquidity position may also encourage farmers to seek off-farm employment. The household's cash flow often becomes most critical in the pre-harvest period as little income is received from farm activities and cash reserves become short. The presence of the hungry season, in regards to the need for food purchases, and the farm's production expenses tend to exacerbate this problem.

2) Use of Non-Family Labor: Another way farmers attempt to overcome labor bottlenecks is to obtain the services of non-family labor. Indeed, the evidence that is available indicates that the use of non-family labor does increase during the peak season (Table 2.5). However, two major constraints prevent further use of hired labor and help explain the low levels of hired labor use that is often observed in traditional farming systems.

i) A class of landless laborers has not yet emerged, in most areas of West Africa. Thus, the period when hired labor is most in demand is also the period when individuals are busiest on their own farms.

ii) The relatively low cash position that exists during this period imposes a restriction on the amount of labor that can be hired by farm families.

Some caution is needed though in interpreting these statements. Polly Hill (1972, p. 123), for instance, adamantly explains that no shortage of labor exists in the Nigerian village she studied. Those farmers who have the financial resources can recruit all the daily laborers they desire. This occurs without detriment to other farmers who wish to hire labor and the hired laborers themselves seldom undertake daily work at the expense of 'own farming' (Hill, 1972, p. 106). Thus, the work force of the richer farmers is expanded without a corresponding reduction in the laborers own farming activities.

3) Reorganization of the Farm's Cropping Patterns: There is evidence to indicate that farmers attempt to smooth out the flow of labor through adjustments in the type and timing of crops grown. Cleave (1974, pp. 131-136) cites evidence of farmers staggering the planting dates of a single crop in order to avoid concentrations of labor during planting, weeding and harvesting. Farmers have also been found to phase the cultivation of different crops so as to avoid simultaneous peaks in labor demand (Jones, 1976). Similiarly, the cultivation of crops in mixtures helps to stabilize the flow of labor during the wet season (Norman, Ouedraogo and Newman, 1979, p. 161).

These changes in cropping patterns reflect the adaptation of the farming system to the constraints of peak labor periods. More profitable cropping patterns have often been reccomended by agricultural scientists, but farmers many times ignore them because of the resulting labor bottlenecks that would occur. Norman, Hayward and Hallam (1974) suggest, for instance, that farmers do not plant cotton according to recomendations in northern Nigeria because of the concentrated demand for labor and the conflict with food crops that would ensue.

Section 2.8.2.4 Influence of Improved Technologies on Seasonal Bottlenecks

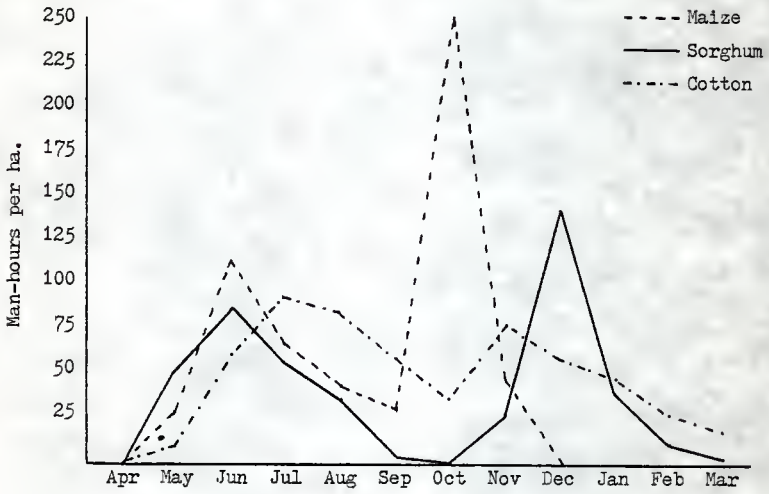
The effect of new technology inputs on the farm's labor flow has by no means been thoroughly studied. Numerous and diverse types of technologies have been introduced, but most research has focused on input-output relationships and cost-benefit studies. Still a few studies have been conducted which have studied the impact of new technology on labor flows throughout the year. Some of the more significant relationships that have emerged are mentioned below.

1) Improved Land Intensive Technology Using Only Hand Labor: The amount of land cultivated by the family farm is fundamentally determined by the amount of weeding and ridging that can be effectively performed during the peak labor period. The use of biological-chemical technologies on the farm can aggravate the weeding burdens that exist at this time. The use of labor improving technologies (i.e. herbicides) can help alleviate this problem but additional problems are encountered (see point 2 of this section). If weeding can be controlled successfully, the productivity of labor can be improved from increased yields on the farm.

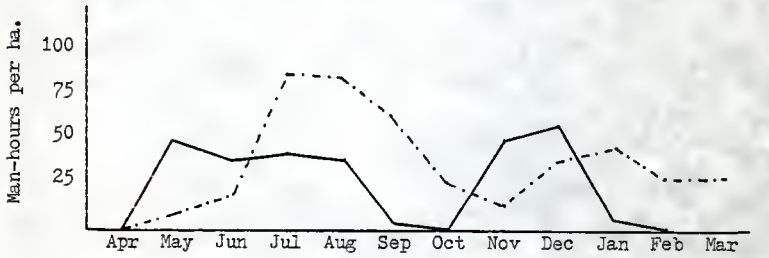
In accordance with the above, the introduction of new land-improving technologies, without changing the power source, will normally shift the peak labor period to the harvesting months of the year (see Figure 2.4). Whether this creates a critical bottleneck in labor flows will depend on the urgency of harvesting operations. Usually, a greater amount of time can be spent on harvesting because of its less arduous character and its being performed after the rainy season is over. However, the prospect of pest or rodent damage or the possibility of late rainfall may create considerable urgency to remove the crops from the fields.

Figure 2.4: Seasonal Labor Requirements of Specific Crops Using Hand Labor, Northern Nigeria

a) Improved practices



b) Indigenous practices



Source: Norman, Ouedraogo amd Newman, The Farmer in the Semi-Arid Tropics of West Africa, p. 88.

2) Effect of Labor Improving Technologies: The introduction of animal traction can help increase the productivity of labor at seasonal bottleneck periods. The constraining labor peaks that often occur during the planting period can be greatly reduced by the use of draft power and suitable land preparation equipment. However, the greater productivity of labor, when combined with draft power often results in larger areas of land being prepared (Tiffen, 1971; Jones, 1976). Due to inadequate weeding equipment and the difficulties of managing draft animals during weeding operations, the necessity of performing the operation by hand can aggravate the labor bottleneck. Also, the labor input during the harvesting period may be accentuated because of the expanded acreage carried out at planting.

The use of oxen on the farm have an opportunity cost in terms of the time requirements for supervising and caring for the animals. Delgado (1978, p. 253) found, for instance, that the ownership of two steers necessitated a reduction of 1.2 hectares of millet production. Farmers may be unwilling to make this sacrifice in order to alleviate the planting bottleneck. In addition, Norman, Ouedraogo and Newman (1979, pp. 190-199) mention a number of technical constraints to the ownership and use of draft power (i.e. lack of resources to pay for the animals and equipment, the difficulties in training the animals, increasing fractionization of fields, etc.).

Herbicides have often been considered an important means for overcoming weeding bottlenecks. However, their use is limited because of their crop specificity and the dominance of crop mixtures throughout the region. Herbicides may also destroy the critical balance of organic matter in the soil, especially in areas where the rainy season is short.

Section 2.8.3 Underemployment in the Dry Season

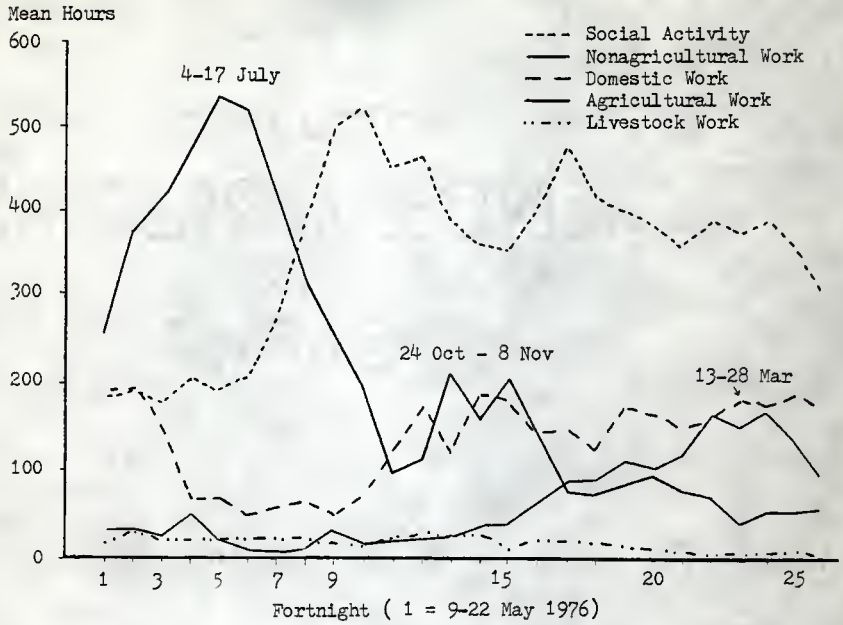
Farmers have generally attempted to compensate for the seasonal nature of farm employment by engaging in substantial off-farm occupations during the dry season. As Figure 2.5 indicates, an inverse relationship was found to exist between monthly inputs of labor on the family farm and off-farm employment. This relationship suggests that farmers attempt to salvage labor that has low opportunity cost, by seeking off-farm work.

However, the increase in off-farm employment does not seem to fully compensate for the slack in farm activities during the dry season. The seasonal indices in Figure 2.6 indicates, for instance, that although male adult days on off-farm work increased during the dry season, this was not sufficient to prevent an overall decline in total male adult days worked (Also see Table 2.5).

One of the major problems is the availability of off-farm employment opportunities. Jobs which require a year round commitment (i.e. trading or work in the city) conflict with farm activities and aggravate labor bottlenecks in the wet season. Part time jobs picked up just during the dry season (i.e. cutting and selling firewood and migration to other areas to do farm work) are insufficient to make up the decline in farm activities. This problem could be especially severe for the poorest farmers. Both Hill (1972, p. 105) and Matlon (1977, p. 297) have observed that a large proportion of the lower income groups off-farm employment consisted of work as farm laborers -- the very work that declines during the dry season.

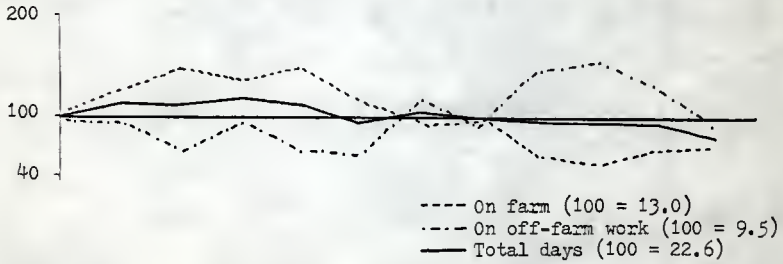
The opportinity costs of labor, in terms of the value placed on leisure and social activities, must also be considered in evaluating off-farm employment. It is very difficult to determine the extent to which leisure

Figure 2.5: Mean Total Household Labor Hours Each Fortnight by Category of Work, Upper Volta



Source: Christopher L. Delgado, Livestock Versus Food Grain Production in South-Eastern Upper Volta, p. 103.

Figure 2.6: Seasonal Indices of Male Adult Labor (Days) for the Sokoto Area, Northern Nigeria



Source: Norman, Pryor and Gibbs, Technological Change and the Small Farmer in Hausaland, p. 41.

time results from the lack of sufficient work opportunities and the extent to which it may possess considerable utility and actually compete with remunerative work.

Cleave (1974, p. 168) notes, for instance, that the obligatory element in these social activities can be reduced when there is pressure to do so. Social activities are thought by Cleave to concentrate in the dry season (see Figure 2.5) because of the lower opportunity cost of time and the relative abundance of food, drink and human energy.

However, two basic arguments support the view that the labor supply is not as elastic in the off-season as might be supposed.

i) The value of leisure following 5 to 7 months of arduous work activity in the field is bound to be high.

ii) People put off certain social tasks and obligations till the slack times of the year, but the activities must be performed all the same. Galletti et al. (1956, pp.269,272) indicate that ceremonies accompanied by feasting and dancing must occur at the time when money is plentiful (i.e. after harvest in the dry season). Haswell (1953, p. 27) and Luning (1967, pp. 80,81) observed a concentration of traveling, visiting relation, marriage payments and ceremonies during the slack period when little work occurs on the land.

Section 2.9 Conclusion

The misconception often arises that the use of labor in traditional systems is limited by low levels of labor productivity. Because of the apparent under-employment of family labor, too few incentives are said to exist for further labor applications. However, this conclusion is drawn

from too narrow a perspective of the farmer's labor activities. When viewed in a more complete perspective of the incentives available to the farmer, the opportunity structures he faces and the constraints that limit his labor activity, a better understanding is reached for the labor decisions he makes. Viewed in this manner, the traditional system reveals that considerable possibilities remain for increasing production through a minimization of the constraints he faces. Labor on the farm can be further encouraged through the design of appropriate incentives and through the creation of opportunities for fuller employment. This involves the recognition that all farmers do not parrallel the action of an 'average' farmer in society but rather that different economic and social groups exist, possessing different opportunities and constraints. The implication is that a more holistic approach needs to be used in the evaluation of the farming system in order to gain a more complete understanding of the complex enviroment the farmer operates in.

CHAPTER 3

PROBLEMS ENCOUNTERED IN MEASURING LABOR

Section 3.1 Introduction

This chapter discusses some of the major problems encountered in defining and measuring labor activity on the small farm. The variation that occurs with respect to family composition and the differences, in productivity, that are believed to exist among family members, make inter-farm comparisons of labor activity a problem. The decision of what to include under the heading of 'labor' also creates problems because of the subsistence nature of the small farm enterprise. Consequently, the amount of time worked in the field cannot be viewed independently of other demands placed on labor time. However, the line between labor and non-labor activities becomes increasingly vague as other activities (i.e. domestic tasks, farm chores or even consumption activities) on the small farm are studied. Finally, certain problems are associated with the specific aggregation periods used in which to analyze annual and intra-annual variations in labor activity.

Section 3.2 Definition of Labor Stock and Labor Flow

The term 'labor' is both a stock and a flow variable. Labor stock refers to a measure of the potential of productive effort and is normally thought of in terms of the number of workers that comprise the family's work force. The flow of labor, on the other hand, is the actual productive effort put forth by the particular work force.

The two concepts, however, are not entirely separable since the stock of labor influences labor flow. During the periods of critical labor demand on the farm, the family's stock of labor is an important determinant of how effective farm operations are performed (Levi and Bellamy, 1975, p. 82). The timely completion of planting, for instance, is probably more dependent on the number of workers than on the number of hours, because hours worked per head are limited by the potential time available.

Labor stock will also influence the productivity of labor flow. In general, an x number of hours worked by two workers is likely to be more productive than x hours worked by one because the workers would be less tired, they could share in burdensome tasks or through cooperation, complement the other's work activity. Similiarly, the efficiency of labor may be improved by working in a group due to the economies of labor associated with certain tasks and by lessening the monotony of the work.

Section 3.2.1 The Problems of Measuring the Stock of Labor

As was stressed earlier in Chapter 2, certain problems are incurred in defining and measuring the potential productive effort that is available from family members. Work on the farm, for instance, can be differentiated by age and sex causing the potential productive effort to vary according to the time of the year, type of task performed and the specific crop being worked on. The social institutions which govern the division of labor vary greatly from society to society and between different ethnic, social and economic groups in a society.

The productivity of a family's work force also depends on the size, age and sex composition of the family. It is generally assumed that male adults are more productive than either female adults or children. But,

quantifying these differences in order to reflect the productive potential between different farms is a difficult procedure at best. The problem is further aggravated by the large variations that occur with respect to family composition. Indeed, when viewed at an aggregate level it is easy to visualize the problems that occur when making inter-farm comparisons in productive work capacity. Section 3.3 discusses a few of the weighting systems that have been used to adjust for the differences in labor productivity among different family members.

Section 3.2.2 The Flow of Labor

The same problems that are encountered in measuring labor stock, with respect to the differences in productivity of different labor types, are also incurred when measuring labor flow. The labor activity on the farm can be overstated or understated in comparison with other farms, due to productivity differences implicit in the hours worked by different age-sex groups. For example, 1000 hours worked by children in the family, on an annual basis, may not be equivalent to 1000 hours worked by male adults, in terms of productivity. The problem is further complicated when comparing across studies due to different weighting systems used to adjust for these productivity differences (see section 3.3).

It is also difficult to decide whether certain activities on the farm should be classified as labor or not (i.e. whether they are productive). Little doubt arises concerning such farm operations as planting, weeding, harvesting or remunerative off-farm employment. However, a number of household activities do not directly increase farm production or earn income, but are nontheless necessary for the success of the subsistence enterprise. These activities would include time spent on collecting firewood, carrying

water, processing food and other farm chores and domestic tasks. Other activities are indirectly productive in nature such as the time spent on walking to and from the fields; arranging for the purchase of inputs or sale of output; supervision of workers in the field; and, time spent nuturing human relationships to ensure the availability of hired labor at critical times. The time spent on communal and reciprocal labor is sometimes neglected in studies because of their unremunerative nature, though, at least in the latter case, a reciprocal return of labor to the farm is implied.

It is apparent then, that there are many other activities that are just as important to the livelihood of the African household as the more productive types of employment. Several researchers have attempted to measure the complete utilization of time by the household, but it could be argued that this too is unrealistic. A detailed breakdown of labor time by the household does not reflect the value of these activities to the small farmer or the extent of substitutability between farm and off-farm work and 'other' activities. Similiarly, the importance and value of these other activities is likely to vary greatly between households. The fine line between what is considered to be labor and what isn't has resulted in a diverse range of activities to be included and analyzed in labor studies.

Section 3.3 Measuring and Weighting the Productivity of Labor

A number of systems have been developed which attempt to convert the heterogenous work force and the labor activity of different family members into more equivalent units for comparison. Most labor studies assume that male adults per unit of time are more productive than other family members. Consequently, the work-time of different labor types are generally converted

into some measure of man-equivalent units. However, no method can account for the wide variances in productivity that occur, although some systems are better than others.

One general system used, to account for the differences in productivity, is to assign productivity weights to different age-sex strata, in the family, regardless of the type of work performed on the farm. Chayanov (1966, p. 58), for instance, developed a fairly arbitrary set of weights in which male adults were assumed to be the most productive laborers on the farm and the labor-time of women and children were converted into man-equivalent units. A similiar system of weights was used by Norman (1972, p.17) in his Zaria studies.[1/]

Several researchers have tried to quantify the differences in productivity between age-sex groups and develop weighting systems based on these measurements. Haswell (1953), for instance, used a weighting system in proportion to the average calorie consumption of different family members. A different approach used by Spencer and Byerlee (1977) assumed that wage differences between men and women reflect different degrees of productivity and a weighting system was formulated based on these differences.

The above systems, however, implicitly assume that male adult labor is more productive than female labor and both are more productive than that of children for all tasks performed on the farm. However, several researchers have observed that at least for certain operations, on the farm, the work

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[1] Norman assigned a male adult, 15 to 64 years of age, as one man-equivalent unit; female adults, 15 to 64 years of age, as 0.75 man-equivalent units; large children, ages 7 to 14, and the elderly as 0.5 man-equivalent units; and small children, under 7 years of age, as 0 man-equivalent units.

of women and children are just as productive as that of male adults. Table 3.1 demonstrates, for instance, that the productivity of labor varies not only by age and sex, but also by the specific task being performed. Matlon (1977, p. 171) feels that the productivity of women, children and male adults is nearly the same for such activities as planting, transplanting and picking, while the productivity of male adults is believed to be superior on weeding and ridging operations. Hopkins used actual farm management data (see Table 3.2) to calculate a set of conversion weights based on the mean time required per hectare to perform various operations. The productivity of females was observed to vary between different tasks, on the farm, although they were found to be less productive than males for all tasks studied.

However, as Collinson (1972, p. 201) points out, no one has completely demonstrated that women, children and old people are less productive than prime age male adults. Several other researchers have also avoided the weighting of labor and have studied the actual (unweighted) amount of time spent by family members on the farm (Guillard, 1965; Delgado, 1978). The justification is that women give the same output per unit of time as men and many tasks are differentiated by sex and are therefore not comparable anyway. Delgado (1978, p. 97) suggests that any differences in strength that occur show up primarily in endurance, rather than in the efficiency which a given task is performed. Thus, females are assumed to be as equally productive as males, but fewer hours may be worked per day because of lesser endurance.

It is obvious that this is one area that deserves further attention in research studies. Assuming that differences in productivity do exist, certain advantages may be gained from weighting labor when making inter-farm

Table 3.1: Conversion Weights Used in Computing Man-Equivalent Labor Hours by Age, Sex and Farm Task.

Activity	Child	Male			Female		
	0-9	10-15	16-49	50+	10-15	16-49	50+
Clearing	.5	1.0	1.0	1.0	a	.8	a
Early ridging	a	.75	1.0	.8	a	a	a
Carrying manure	.5	.8	1.0	1.0	a	.75	a
Spreading manure	.5	1.0	1.0	1.0	a	a	a
Spreading inorg. fert.	a	1.0	1.0	1.0	a	a	a
Planting	.75	1.0	1.0	1.0	.8	1.0	.8
Supplying	a	1.0	1.0	1.0	a	1.0	a
Transplanting	.5	1.0	1.0	1.0	a	1.0	a
Weeding	.25	.8	1.0	.8	a	.6	a
Late ridging	a	.75	1.0	.8	a	.5	a
Irrigating	.5	.75	1.0	1.0	a	a	a
Fencing	.5	1.0	1.0	1.0	a	a	a
Cutting stalks	.25	.8	1.0	1.0	a	.75	a
Lifting groundnut	.25	.75	1.0	.8	.5	.75	a
Cutting heads	.5	1.0	1.0	1.0	.8	.8	.8
Picking	.5	1.0	1.0	1.0	1.0	1.0	.75
Trans. crop	.5	.8	1.0	1.0	.5	.75	.5
Trans. crop residues	a	.8	1.0	1.0	.5	.75	a

Source: Matlon, "The Size Distribution, Structure and Determinants of Personal Income", p. 171.

[a] No observations were made.

Table 3.2: Conversion Weights Used in Computing Man-Equivalent Labor Hours by Sex, Crop, Operation, and Type of Draft and Equipment

Crops and Specific Crop Operations		Weights					
				Males			
		Males	Females	Bullocks + light equip.	Bullocks + heavy equip.	Horses	Donkeys
Groundnuts	sowing	1.0	0.7	1.4	2.8	2.5	1.4
	1st hoeing	1.0	0.5	2.5	5.0	5.0	1.0
	2nd hoeing	1.0	0.5	2.5	5.0	5.0	1.0
	3rd hoeing	1.0	0.5	2.5	5.0	5.0	1.0
	harvesting	1.0	0.7	1.4	-	-	-
	threshing	1.0	0.7	-	-	-	-
Grain	sowing	1.0	0.7	1.4	2.8	2.5	1.4
	1st hoeing	1.0	0.5	2.5	5.0	5.0	1.0
	2nd hoeing	1.0	0.5	2.5	2.5	5.0	1.0
	harvesting	1.0	0.7	-	-	-	-

Source: Hopkins, "Wolof Farmers in Senegal", p. 97.

comparisons in labor activity. However, if the objective is to view the utilization of time, the weighting of labor will underestimate the actual amount of time worked on the farm by other family members and overestimate the potential amount of time that can be diverted to work. This can be especially important in areas where women and children make a substantial contribution to work on the farm. Furthermore, this may affect the success of certain development strategies (i.e. the shift to cash cropping) that may require the greater participation of family members.

Similiar problems are incurred in studying the labor input by non-family labor, although few researchers have differentiated between different age-sex groups. In addition, several researchers have emphasized the inefficient nature of communal labor types in comparison to labor paid by the day or contract (Cleave, 1974, p. 174; Norman, 1972, p. 33; Luning, 1963, pp.62-63). None of the studies reviewed, however, have attempted to adjust for these productivity differences. Matlon (1977, p. 170) distinguished between the productivities of different age-sex groups within non-family labor, but did not differentiate across the various non-family labor types. The approach used by Spencer and Byerlee (i.e. weights assigned according to wage-rate differences) could be used, but oftentimes the wage for communal labor is held artificially low due to institutional and societal factors.

A further problem arises concerning the efficiency with which certain operations are performed. Some activities such as bird scaring or livestock herding may absorb large residuals of labor stock at very low levels of productivity. An emphasis on such activities can exaggerate the farm's labor flow in comparison with the actual productive effort implied in that

labor time. Thus, knowing the composition of labor time is just as important as knowing the total amount of time worked on the farm. Similiarly, Haswell (see section 2.8.2.2) observed that the amount of time spent resting varied according to the task performed, reflecting differences in the actual amount of time worked (per unit of time) on different operations.

Section 3.4 Analytical Problems Associated with Labor

Most of the labor surveys conducted in West Africa have been annual and intra-annual in nature. Data collection generally extends over a twelve month period or less and the labor data are typically aggregated into monthly and yearly totals. The amount of work performed has been measured in terms of hours and days and the time spent working per day on various farm and off-farm activities.

The African farmer, however, does not necessarily function according to any western notion of time. It has been suggested that he has his own time framework which he uses to gauge his daily work activities. The concept of the 'half-day' used by Guillard (1965) and Hopkins (1975) perhaps most closely approximates the unit of time envisaged by the farmers themselves. The half-day does not refer to any strict unit of time but is associated instead with the period of work activity most closely followed by the farmers. A similiar situation is implied in Hill's (1972, p. 105) study of hired labor use in Nigeria. Laborer's are paid a standard wage for a mornings work (which normally consists of 5 to 6 hours of work) while the wage for an afternoon or evening's work is always half the morning rate (which generally consists of 2 to 3 hours of work).

When labor activity is aggregated into calendar months, within the year,

the labor constraints of the peak labor period can be underestimated. Critical labor peaks of short duration may not show up because labor time is spread over a month, while an extended labor peak may not be as apparent because it is divided between months. Thus, an aggregation period of less than a month may be necessary to accurately depict the labor peaks that occur. Delgado (1978, pp. 11-12), for instance, used a fortnightly study period to analyze labor constraints. However, for certain operations such as weeding and planting, even a week's delay can result in a substantial decrease in yields. A weekly aggregation period may be necessary then to reflect the labor bottleneck's that occur during these periods.

Labor profiles represented by annual studies implicitly assume that the profiles will be the same year after year. However, due to changes in weather conditions, resource availability or enterprise combination, certain changes might be expected in the farm's overall labor activity and in the seasonal composition of labor. Inter-annual studies would be instrumental then in pointing out the variations in labor usage that can occur from year to year as well as express any trends that might be occurring in labor activity. Unfortunately, very few studies have been conducted which have attempted to study inter-annual variations in labor usage.

CHAPTER 4

LARGE SAMPLE AND SMALL SAMPLE SURVEY COMPARISONS

Section 4.1 Introduction and Methodology

This chapter includes the first part of the analysis of the Zaria 'over time' study that was conducted between the years 1969 to 1974. The analysis includes the study of overall averages (defined below) computed from the time series data and the results are compared with earlier large sample and small sample surveys conducted in the Zaria area. Part two will be covered in Chapter 5 and will include the actual analysis of the computed overall averages. Factor-factor relationships are studied for the small sample of farmers in aggregate and individually as well as an analysis of the intra-year variations that occur with respect to labor activity. The last chapter (Chapter 6) will deal with the inter-year variations that occur with respect to labor activity as opposed to the study of overall averages presented in Chapters 4 and 5. The chapter includes the analysis of the variations that occur in labor activity from year to year, trends in labor activity that occurred between the years 1969 to 1974 and the major determinants of total labor activity.

All the results of the Zaria 'over time' survey presented in this and the following chapter are overall averages computed from the time series data. The overall average is calculated by summing across the five years of time series data, computing the mean average and arriving at what can

be considered an 'average year' of agro-economic data.[1/] The concept of the overall average is used to satisfy two main objectives. First of all, land, labor and agronomic characteristics for farmers in the Zaria 'over time' study can be viewed for a more representative year, without the complications of year to year changes. Organizing the data in this manner simplifies the analysis and accentuates relationships that possibly would be unclear when studied in a time series framework. Secondly, the overall average is used, in this chapter, to make comparisons between an average year of a multi-year study and the results of a single year study. Some question arises in present literature as to whether or not the results of a single year study are representative of what occurs in other years. The differences in the results between the single year study and the overall average (of a multi-year study) should reflect to some degree the representativeness of a single year survey's results.

Two general survey comparisons are made in this chapter with specifics of each of the survey's described below. The first comparison is made between what is called the "overall small sample study" and the "Zaria 1966 large sample survey" in order to determine how representative the small sample of farmers are to the population of farmers in the Zaria area. The second comparison mentioned above is that of the "overall small sample study" and the "Zaria 1966 small sample study" to determine how representative a single year survey is of the overall average of a number of years. Details concerning each of these studies are as follows:

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[1] Five years of time series data are used to calculate the overall average instead of six years because of missing data for the year 1972 (see section 1.3).

1) Overall small sample study: refers to the sample of seven hand farmers who were included in the Zaria over time survey. All results of the agro-economic data studied for the farmers are overall averages calculated from the time series data. The average of the overall small sample study refers to the mean of the overall averages for the farmers in aggregate.
2) Zaria 1966 small sample study: includes the same sample of seven hand farmers as was included in the overall small sample study. The data analyzed, however, are records for the year 1966, only.
3) Zaria 1966 large sample study: is an agro-economic survey of 124 farmers in the Zaria region of Nigeria. The data included in the survey were collected for the year 1966, only.

One additional farmer was included in the Zaria over time survey that was not included in the analysis of the overall small sample of seven hand farmers. The farmer is an oxen farmer whose activities will be compared with that of the overall small sample (in Chapter 5) in order to examine the effects of draft technology on the seasonal distribution of labor.

Section 4.2 Large Sample Versus Small Sample Comparisons

It was pointed out in Chapter 1 that the sample of farmers included in the Zaria over time survey were not likely to be representative of the entire population of farmers in the Zaria area. Indeed, the results indicate that the sample in aggregate appears to represent the larger, more prosperous farmers in society. Table 4.1 indicates, for instance, that total farm size and the amount of land cultivated was nearly twice as great in the case of the overall small sample as for the large Zaria sample. Total family size,

Table 4.1: Details Concerning Land Characteristics for the Aggregate of Farmers in the Various Large Sample and Small Sample Studies

Item	Large Sample Zaria 1966	Small Sample Zaria 1966	Small Sample Overall Average
Total hectares	3.95	7.64	6.79
Total Gona hectares	3.57	6.49	5.83
Total Fadama hectares	0.37	1.16	0.97
Total Cultivated hectares	3.20	7.32	6.03
Total Fallowed hectares	0.75	0.33	0.76
Cultivated Gona hectares	2.91	6.27	5.17
Cultivated Fadama hectares	0.29	1.05	0.86

Table 4.2: Details Concerning Family Characteristics and Income Status for the Aggregate of Farmers in the Various Large Sample and Small Sample Studies

Item	Large Sample Zaria 1966	Small Sample Zaria 1966	Small Sample Overall Average
Total Family Size	8.49	11.71	12.40
Male adults	2.15	3.00	2.69
Female adults	2.62	3.57	4.09
Large Children	1.54	2.29	2.63
Small Children	2.18	2.86	3.00
Family Income[a] (in shillings)	2057.1	4247.0	-

[a] Family Income refers to the amount (shillings per household) of net farm income and off-farm income earned by the household. Income derived from cattle operations is excluded. No income data was available for the Overall Small Sample of Farmers.

in the overall small sample, was also observed to be greater as was the number of male adults, female adults and large children in the family (Table 4.2).

In regards to labor activity, the aggregate of farmers in the overall small sample worked more than twice as many total hours on the family farm as farmers in the large sample (Table 4.3). Part of the higher labor activity was due to the higher labor contribution by family members, although this was the result of a greater number of workers implied in the overall small sample. This is evident by the fact that the hours input per male adult was nearly the same for the large sample as it was for the overall small sample. However, a substantial difference exists in regard to the non-family labor contribution. As indicated in Table 4.3, the non-family labor contribution for the overall small sample was nearly seven times greater than that for the large sample.

As was pointed out in section 2.6, a positive association was found to exist between income status (financial well-being) and the ability to hire labor. The results in Table 4.2 would seem to support this finding. Average household income for the small sample of farmers in 1966 was more than twice as great as that for farmers in the large sample survey.[1/] This helps explain the larger non-family contribution experienced by farmers

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[1] No income data was available for the overall small sample of farmers so income comparisons were made between the 1966 small sample study and the Zaria 1966 large sample study instead. It is felt, though, that income status in the overall small sample is likely to be as great or greater than that of the 1966 small sample survey. In fact, the higher non-family labor contribution of the overall small sample may suggest that household incomes, on average, are higher in the overall small sample.

Table 4.3: Details Concerning Annual Labor Input by All Labor Types on the Farm for the Aggregate of Farmers in the Various Large Sample and Small Sample Studies

Item	Large Sample Zaria 1966	Small Sample Zaria 1966	Small Sample Overall Average
Total Farm Labor[a]	1782.9	3344.7	3884.0
Total Family Labor[ab]	1455.0 (81.6)	2225.5 (66.5)	1761.5 (45.4)
Male Adult Hours	1291.4	1862.2	1534.4
Hours per Male Adult	600.7	622.4	604.4
Days per Male Adult	138.6	135.3	134.6
Female Adult Hours[c]	7.0	10.3	28.5
Children Hours[c]	156.6	353.0	198.6
Total Non-Family Labor[a]	327.9	1119.1	2121.1
Kwadago	150.3	493.6	797.4
Jinga	158.6	592.8	1211.6
Gayya	19.0	32.7	112.1

[a] All figures are in hourly units unless otherwise specified.

[b] The figures in parenthesis are average total family hours on the farm as a percentage of average total farm man-hours.

[c] Both female and children hours on the farm were converted to man-equivalent hours (i.e. man-hours) by using Norman's system of conversion weights (see section 3.3).

in the overall small sample as was mentioned above.

Large differences appear to exist then between the overall small sample study and the large sample survey with respect to farm size, family size and income status. Indeed, the results indicate that the overall small sample of farmers, on average, have higher economic or social standing relative to the average farmer in the Zaria area.

Section 4.3 Small Sample Comparisons

A comparison between the overall small sample and the 1966 small survey indicates that certain differences exist regarding the amount of land controlled and cultivated. The average farm size for the aggregate of farmers in the overall small sample was nearly a hectare lower than that for the same farmers in 1966 (Table 4.1). Similiarly, the amount of gona land and fadama land owned and cultivated were also observed to be lower in the overall small sample.

In regards to family characteristics, the average total family size for the aggregate of farmers in the overall small sample was slightly larger than that found in the 1966 survey (Table 4.2). However, the greater family size was due to a larger average number of female adults and children in the family. The number of male adults, though, which comprise the bulk of the family's work force was actually lower. The average number of male adults in the overall small sample was 2.7 compared to 3.0 male adults for the same sample of farmers in 1966.

Few differences were observed in relation to cropping patterns and crop characteristics (Table 4.4). In terms of hectarage grown, the amount of land devoted to each of the major crop groups was observed to be lower in

Table 4.4: Comparisons Between the Various Large Sample and Small Sample Studies with Regards to Selected Cropping Patterns and Cropping Characteristics

Item	Large Sample Zaria 1966	Small Sample Zaria 1966	Small Sample Overall Average
Percent Cash Crops[c]	29.70	26.31	28.26
Inter-Cropping Index[d]	2.43	2.49	2.19
Major Crop Groups (Adjusted hectares):[b]			
Cereal Crops[ae]	1.64 (51.3)	3.77 (51.6)	3.09 (51.2)
Grain Legumes[ae]	0.70 (21.9)	1.78 (24.4)	1.07 (17.7)
Starchy Crops[ae]	0.22 (6.9)	0.43 (5.9)	0.54 (9.0)
Vegetables[ae]	0.14 (4.4)	0.19 (2.6)	0.36 (6.0)
Sugar Crops[ae]	0.19 (5.9)	0.47 (6.4)	0.31 (5.1)
Non-Food Crops[ae]	0.31 (9.7)	0.67 (9.2)	0.66 (10.9)

[a] Figures in parenthesis are the adjusted hectares of each major crop group as a percentage of total cultivated hectares

[b] In calculating the total adjusted hectares of specific crops and crop groups, each crop in a crop mixture is assigned the area in hectares calculated by dividing the hectares of the crop mixture by the number of crops in the mixture. For example, a 2 hectare millet/guineacorn mixture is assumed to consist of 1 hectare of millet and 1 hectare of guineacorn.

[c] Cash crops are defined as those crops of which more than 50 percent of total production was sold for cash and food crops as those of which less than 50 percent was marketed. In Norman's (1972, Appendix G, p. 11) survey, nine major crops grown in the Zaria area satisfied this definition of cash crops. These were Sugar-cane, Cotton, Tobacco, Groundnuts, Onions, Irish Potatoes, Peppers, Rice and Tomatoes. The percentage of cash crops grown was calculated by dividing the total adjusted hectares of cash crops by the total cultivated hectares.

(continued)

(Continuation of Table 4.4)

[d] The inter-cropping index measures the extent to which crop mixtures are grown on the farm. The index increases with a greater hectarage of crop mixtures grown and a greater number of crops grown in the mixture and decreases with the prevalence of sole cropping. Norman (1972, p. 88) calculated the index as:

$$I_f = \sum_{n=1}^{6} n \cdot A_{nf} \Big/ \sum_{n=1}^{6} A_{nf}$$

where; I_f = inter-cropping index of household f

n = number of crops in the crop stand

A_{nf} = total area of sole crops or crop mixtures consisting of n crops grown by household f

[e] The crops grown in the Zaria area were grouped into six major crop groups: 1) Cereals: Millet, Guineacorn, Maize, Rice, Ibaru; 2) Grain Legumes: Groundnuts, Bambara Nuts, Cowpeas; 3) Starchy Roots and Tubers: Cassava, Irish Potatoes, Sweet Potatoes, Yams, Cocoyams; 4) Vegetables: Okra, Onions, Pumpkin, Pepper, Tomatoes; 5) Sugar Crops: Sugar-cane; and 6) Non-food crops: Henna, Cotton, Deccan Hemp and Tobacco.

the overall small sample, but this was a consequence of the smaller amount of land owned and cultivated. In percentage terms, the relative emphasis on cash crops and each of the major crop groups was similiar between the two small sample surveys. A slightly lower percentage of grain legumes and a higher percentage of starchy crops and vegetables was observed in the overall small sample, but this could easily be contributed to the errors incurred in calculating the adjusted hectarages of each major crop group (see footnote b in Table 4.4). A lower inter-cropping index was also observed for the overall small sample (Table 4.4). This would seem to indicate that the aggregate of farmers in the overall small sample placed less significance on crop mixtures and more on sole crops than they had done in the Zaria 1966 small sample survey.

In regards to labor activity, the average total labor input used on the farm, in the overall small sample survey, was 16 percent higher than that in the 1966 survey (Table 4.3). However, the amount of family labor input was some 21 percent lower, due to the lower work activity of children and male adults (due primarily to the smaller average number of male adults in the family). The reason for the higher total labor input was due to the higher amount of non-family labor used. The number of non-family hours used by the average farm, in the overall small sample study, was 90 percent higher than that of the average farm in the 1966 survey. Similarly, the respective contributions of kwadago, jinga and gayya labor in the overall small sample was approximately 62, 104 and 243 percent higher than that recorded in 1966.

A 't' test was used to test the significance of the differences between the two small sample studies with regards to the agro-economic variables

studied in Tables 4.1 to 4.4. Due to the small number of farmers included in the samples and high inter-farm variation, all tests were found to be insignificant at the 10 percent level. Nevertheless, the results of the two studies indicate that the single year study was not entirely representative of the overall average of a multi-year study, especially with regards to the non-family labor contribution. In addition, it remains unknown as to how variant the results of the study year 1966 are in regards to the results of other 'single' years. It could be possible that the year 1966 is in fact a fairly representative year in relation to the overall average year examined, yet be quite different compared to other years. It is necessary then to examine the actual inter-annual variations that occur, with respect to land, labor and cropping characteristics, before drawing conclusions on the representativeness of single year survey's in general (see Chapter 6).

Section 4.4 Conclusions

Two major conclusions can be drawn from this chapter. First of all, the sample of farmers included in the Zaria over time survey are atypical of the average farmer in the Zaria area. On average, they control larger areas of land, have larger family sizes and higher household incomes than that of the average small farmer. This point is important when analyzing the results of the Zaria over time survey in Chapters 5 and 6. The results are more representative of the larger farmer in society, hence generalizations to the population of farmers as a whole should be made with caution. Secondly, differences were observed between the results of the single year small sample survey and the results of the overall average of the multi-year survey. The differences that exist raise some doubt as to the accuracy of

only using one year's results to project what goes on in other years. Furthermore, the use of the overall average smooths out the extremes in inter-annual variation. Thus, the results in Chapter 6 need to be reviewed in order to examine the magnitude of the deviations that occur from the overall average over the years. This should provide a better indication of how representative or non-representative any single year is compared to other years in the study.

CHATPER 5

ANALYSIS OF THE ZARIA OVER TIME SURVEY: THE STUDY OF OVERALL AVERAGES

Section 5.1 Introduction

The overall average was used in Chapter 4 to compare the results of the overall small sample study with other large sample and small sample single year studies. In this chapter, the results of the overall small sample study is used to analyze the annual flows of different types of labor on the farm. In addition, the seasonal distribution of labor is analyzed with annual labor flows disaggregated into both monthly and weekly periods.

The analysis is performed at two basic observational levels. Firstly, an analysis is made of the overall average for the group of farmers as an aggregate (i.e. the mean average of the overall small sample). Secondly, an analysis is made of the overall average for individual farmers in the overall small sample. The disaggregation of the overall small sample into inter-farm comparisons was done for several reasons. First of all, due to large within sample variation, the mean of the overall small sample was often a poor reflection of what individual farmers were doing. Secondly, the mean of the sample as a whole often masked important underlying relationships among farmers. Using a case study approach enabled direct associations to be made between the specific characteristics of individual farms and the special nature of their labor profiles.

In order that the results of the Zaria over time survey be presented in a meaningful manner, it was thought best to separate the analysis from the

main body of the literature review. Subsequently, some overlap resulted between the results of this chapter and the review of literature in Chapter two. A serious attempt was made to minimize the repetition as much as possible, but for the sake of clarity some repitition had to be made.

Section 5.2 Annual Labor Activity for Farmers in the Overall Small Sample

A mean total of 3884 hours were input on the family farm by farmers in the overall small sample (Table 5.1). This value is unrepresentative of individual farmers in the sample, however, due to large within sample variation. Total labor input ranged from 1036 hours for the farmer with the smallest farm size to 8133 hours for the farmer with the largest farm (Tables 5.1 and 5.4). Total labor activity for the remaining farmers in the sample varied greatly between these two extremes.

Section 5.2.1 Family Labor

A total of 1762 hours on average were input by family members on the family farm, contributing 45.4 percent to total labor activity. In terms of hours, this figure is in agreement with other studies conducted in northern Nigeria (see the large sample Zaria results in Table 4.3). However, the percentage of total labor contributed by family members is substantially lower than that generally found in traditional small farm systems. The reason is due to the significantly higher use of non-family labor on the farm (Table 4.3 and 5.1).

The largest proportion of total family labor on the farm was contributed by male adults in the family. On average, male adults worked a total of 1534 hours on the farm representing 87.1 percent of total family labor. A substantial amount of variation was observed between farmers due in part to

Table 5.1: Total Labor, Family Labor and Non-Family Labor Activity On the Family Farm for Individual Farmers in the Overall Small Sample

Farmer (Code Name)	Total[a] Hours	Family[a] Hours	Non-Family[a] Hours
TF	8133	2136 (26.3)	5996 (73.7)
NJ	5107	2795 (54.8)	2304 (45.2)
MS	2842	362 (12.7)	2480 (87.3)
DN	3371	2385 (70.8)	985 (29.2)
SH	1036	790 (76.3)	245 (23.7)
YR	2679	402 (15.0)	2277 (85.0)
BL	4020	3460 (86.1)	560 (13.9)
mean labor	3884	1762 (45.4)	2121 (54.6)

[a] Figures in parenthesis are percentages of total annual labor.

Table 5.2: Labor Activity of Family Members On the Family Farm for Individual Farmers in the Overall Small Sample

Farmer (Code Name)	Male Adult[a] Hours	Time Per Male Adult		Female[ab] Adults	Large[ab] Children
		Hours	Days		
TF	1808 (22.2)	687	189	20 (0.2)	308 (3.8)
NJ	2247 (44.0)	727	208	26 (0.5)	522 (10.2)
MS	347 (12.2)	252	62	3 (0.1)	12 (0.4)
DN	2033 (60.3)	1380	213	133 (3.9)	219 (6.5)
SH	496 (47.9)	248	64	14 (1.4)	280 (27.0)
YR	354 (13.2)	97	26	2 (0.0)	46 (1.7)
BL	3456 (86.1)	841	180	2 (0.0)	3 (0.0)
mean labor	1534 (39.5)	604	135	29 (0.7)	199 (5.1)

[a] Figures in parenthesis are percentages of total annual labor.

[b] Female hours and Children Hours are converted into man-hour equivalents. Female adult's are assumed to be equal to .75 man-equivalents and large children equal to .50 man-equivalents

Table 5.3: Work Activity of Non-Family Labor Types On the Family Farm for Individual Farmers in the Overall Small Sample

Farmer (Code Name)	Kwadago[a] Hours	Jinga[a] Hours	Gayya[a] Hours
TF	2187 (26.9)	3775 (46.4)	34 (0.4)
NJ	982 (19.2)	1316 (25.8)	6 (0.0)
MS	949 (33.4)	1332 (46.9)	200 (7.0)
DN	662 (19.6)	249 (7.4)	74 (2.2)
SH	157 (15.2)	88 (8.5)	0 (0.0)
YR	439 (16.4)	1373 (51.3)	465 (17.4)
BL	206 (5.1)	349 (8.7)	6 (0.1)
mean labor	797 (20.5)	1212 (31.2)	112 (2.9)

[a] Figures in parenthesis are percentages of total annual labor.

Table 5.4: Land Characteristics for Individual Farmers in the Overall Small Sample

Farmer (Code Name)	Total Hectares	Cultivated Gona	Cultivated Fadama	L/R[a]	CF/CG[b]
TF	15.39	10.89	2.12	0.76	.195
NJ	8.87	6.82	0.27	0.55	.040
MS	6.10	5.05	0.89	0.78	.176
DN	4.38	3.07	1.31	0.41	.427
SH	1.18	0.93	0.24	0.16	.258
YR	5.62	4.88	0.00	0.27	.000
BL	5.99	4.58	1.17	0.45	.255
mean average	6.79	5.17	0.86	0.49	.193

[a] Refers to cultivated hectares per number of residents in the family.

[b] The ratio is cultivated fadama to cultivated gona.

the differences in the number of family male adults (Table 5.5). A more meaningful figure of work intensity is the amount of time worked per male adult in the family. In this regard, a male adult in the study worked an average of 604 hours per annum on the farm spread over a period of 135 days (Table 5.2). A great deal of variability was still observed, however, within the overall small sample. The highest work intensity was observed for the farmer DN, in which male adult's worked an average of 1380 hours per annum. Several reasons help account for this higher level of work intensity. First of all, very little non-family labor was used on the farm, resulting in a greater contribution by family members (Table 5.1). Secondly, the farmer DN had the highest ratio of cultivated fadama to cultivated gona land in the sample (Table 5.4). The cultivation of fadama not only circumvents the problems of seasonality, by enabling year round cultivation, but the crops grown on fadama are generally more labor intensive in nature (see section 2.4.2). A high inter-cropping index was also observed reflecting a greater emphasis on crop mixtures (Table 5.6). As Norman (1972, pp. 74,79) explains, crop mixtures generally incur greater labor inputs per hectare than sole crops. Finally, it is hypothesized that the farmer DN is a full time farmer and thus spends less time on off-farm employment. However, this hypothesis could not be tested due to the lack of off-farm data.

The reasons for the low work intensity per male adult on the farm by the farmers MS, SH and YR (Table 5.2) are less easily explained. Some of the reasons offered come from certain biographical details known of the farmers, but the results cannot be substantiated from the data collected (i.e. because no off-farm data was available for analysis). In the case of the farmer MS, the overall average number of male adults in the family was only 1.2 and

Table 5.5: Family Characteristics for Individual Farmers in the Overall Small Sample

Farmers (Code Name)	Total Family Size	Male[a] Adults	Female[a] Adults	Large[b] Children	Small[c] Children
TF	17.2	2.6	5.2	4.2	5.2
NJ	12.8	3.0	4.0	3.0	2.8
MS	7.6	1.2	2.2	2.2	2.0
DN	10.8	2.2	4.0	2.4	2.2
SH	7.2	2.0	2.0	1.4	1.8
YR	18.4	3.6	6.0	3.6	5.2
BL	12.8	4.2	5.2	1.6	1.8
mean average	12.4	2.7	4.1	2.6	3.0

[a] Male and Female Adults are 15 years old or older.

[b] Large Children are Males and Females 7 to 14 years of age.

[c] Small Children are less than 7 years of age.

Table 5.6: Relative Emphasis on Cash Crops, Crop Mixtures and Crop Groups for Individual Farmers in the Overall Small Sample

Farmers (Code Name)	Percent[a] Cash Crops	Inter-Cropping Index	Cereals[ab]	Grain[ab] Legumes	Starchy[ab] Roots	Vegetables[ab]	Sugar[ab] Crops	Non[ab] Food
TF	36.51	1.90	53.46	16.51	6.45	3.92	7.37	12.14
NJ	35.88	2.43	42.74	26.09	10.58	6.35	3.95	10.44
MS	44.57	1.82	39.06	15.66	3.20	8.42	10.61	23.06
DN	25.56	2.36	49.54	18.49	18.26	6.62	4.57	2.51
SH	9.70	2.62	64.96	27.35	5.13	0.00	0.00	1.71
YR	17.60	2.06	72.95	10.45	1.02	5.74	0.00	10.04
BL	28.03	2.12	49.13	16.20	18.99	8.71	2.09	5.23
mean average	28.26	2.19	51.24	17.74	8.96	5.97	5.14	10.95

[a] Definitions for Cash crops, Inter-cropping index and major crop groups are given in the footnotes under Table 4.4.

[b] The figures are percentages of total cultivated hectares.

the household head became a village leader mid-way through the time series study. As a consequence, little time was devoted to farm work because of the political position he filled. The farmer YR, on the other hand, was a large cattle owner. Thus, a great deal of time was probably spent by male adults in caring for and supervising the animals. In addition, at least one male adult member in YR's household was involved in full time work at a nearby school. Likewise, the farmer SH became a full-time employee at an electric company midway through the time series study.

The contribution of female adults to farm labor was virtually non-significant. Female adults on average worked 28.5 man-hours per year, representing 0.7 percent of total farm labor activity (Table 5.2). The contribution of female adults appears to be even less significant when farmers are studied individually. Only one farmer (i.e. DN) had what could be considered an important female labor input, but it was still only 4 percent of total farm labor.

Children on average worked 198.6 man-hours per year on the farm, representing 5.1 percent of total farm labor activity. The work of children on the farm, however, can be very important as demonstrated in Table 5.2. The large children on one farm worked 522 man-hours per year while large children on another farm performed 27 percent of total farm work.

Section 5.2.2 Non-Family Labor

The contribution of non-family labor to total work on the farm is substantially higher than that found in other West African studies (see section 2.6). Non-family labor, on average, worked 2121 hours on the family farm representing 54.6 percent of total farm labor activity (Table 5.1). The highest amount of non-family labor time was input by those farmers (i.e. TF,

NJ and MS) with the highest cultivated land per resident ratios in the sample (Table 5.1 and 5.4). In addition, the higher incomes of these farmers are likely to improve their ability to hire labor (Table 5.7). This is consistent with the results in Chapter 2 which show a positive association between non-family labor use and the size of farm and income status (see sections 2.4.3, 2.4.4 and 2.6).

Table 5.7: Net Family Incomes (shillings/Household) of Individual Farmers[1/] in the Small Sample for the Year 1966.

Farmer (Code Name)	Family Income	Farmer (Code Name)	Family Income
TF	8884.9	SH	1116.6
NJ	3603.7	YR	4439.2
MS	4650.3	BL	4569.2
DN	2465.1		

An exceptional case was the farmer YR who had a high non-family labor contribution eventhough his cultivated land per resident ratio was small. This was probably a result of the low level of family labor input due to his cattle operations (thus the need to acquire non-family labor) and the availability of financial resources (Table 5.7) from his cattle operations to hire labor.

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1 No income data were available in the overall small sample study, thus the figures for 1966 were used to estimate income status. Net family income refers to the amount of farm and off-farm income received by the household, excluding income derived from cattle sources.

Jinga labor was the most popular type of non-family labor used on the farm followed closely by kwadago labor. The average jinga labor input on the farm by the aggregate of farmers was 1212 hours compared to 797 hours by kwadago labor (Table 5.3). This represents 31.2 and 20.5 percent of total farm labor by jinga and kwadago labor, respectively. The popularity of jinga over kwadago was demonstrated by almost all farmers in the sample, although a great deal of variability existed between farmers in the magnitude of their respective contributions. The preference for jinga labor can be explained, in large part, by its greater productivity and due to fewer problems associated with the management and supervision of workers in the field (see sections 2.6 and 3.2).

Gayya labor, on average, had very little significance in regards to farm labor activity, which is consistent with the results found in section 2.6. The average gayya labor input by the aggregate of farmers in the sample was 112 hours, representing 2.9 percent of total labor activity. However, for two farmers in the sample, gayya labor made an important contribution to total farm work. One was the cattle farmer YR, in which gayya labor contributed 17.4 percent of total farm labor. This is in agreement with the study by Norman, Pryor and Gibbs (1979, p. 33) which closely links gayya labor to traditional settings and cattle ownership. The other farmer (i.e. MS) was probably able to recruit higher levels of gayya labor because of the political clout he held in the village (due to his position as village head).

Section 5.3 The Seasonal Distribution of Labor

The effect of the seasonal nature of rainfall on the distribution of

labor throughout the year was discussed earlier in Chapter 2 (see section 2.8). Unless the small farmer has access to sufficient quantities of fadama land, he faces the prospect of a seasonal flow of labor on the farm during the year.

Section 5.3.1 The Seasonal Nature of Total Labor Activity

The total amount of time worked per month on the farm varies greatly during the year, as is demonstrated by the histogram of labor operations in Figure 5.1. For the overall sample of farmers, on average, the peak month of labor activity occurred in July. During the peak month, 76 percent of the man-hours worked on the farm were devoted to weeding and ridging operations. The ebb in labor activity occurred during the dry months of February and March where time was spent preparing fields for cultivation in the wet season and some crops are cultivated on fadama land.

The extent to which labor is influenced by the seasonal nature of agriculture is indicated in Table 5.8. During the four-month peak labor period, from May to August, 44 percent of annual total man-hours were worked on the farm. This compares with a figure of only 20 percent of total man-hours for the slack labor period, January to April. In reference to the peak labor month, 478 man-hours were worked on the farm in July. This figure was 48 percent higher than the average monthly input of 324 hours. The amount of time worked during the slack month (i.e. March) was 145 man-hours, which was 123 percent lower than the average monthly labor input. The seasonal nature of labor distribution is further demonstrated by the median seasonal indices of total man-hours worked per month on the farm in Figure 5.2 and time spent by different types of labor in Figure 5.3.

The intra-year variation in regards to total man-hours worked on the family farm is not as great as that found in other north Nigerian studies.

Figure 5.1: Relative Time Spent on Different Farm Activities During the Year for the Average of the Overall Small Sample of Farmers

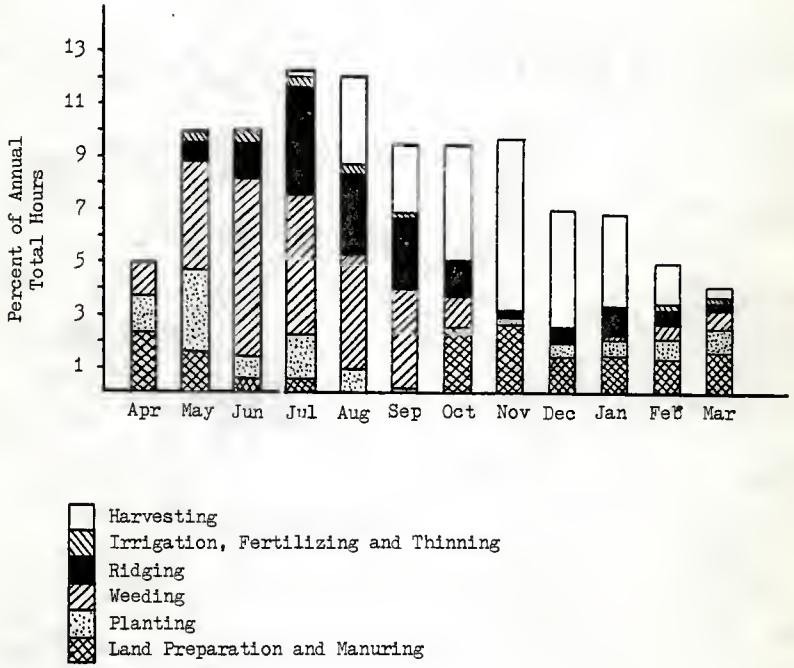


Table 5.8: Details Concerning the Seasonality of Labor on the Family Farm for the Overall Sample of Small Farmers

Details	Peak Season	Slack Season
Four Month Period:	May to August	January to April
Percent of total man-hours	44.1	20.4
Percent of male adult hours	49.0	16.7
Percent of total non-family hours	40.8	23.3
Peak or Slack Month:	July	March
Total man-hours on the farm	477.7	144.8
Percent of total man-hours contributed by the family	45.0	35.9
Family Male Adults:		
Days per Male Adult	16.7	4.5
Hours worked per day	3.6	2.8
Total Non-Family Hours	262.8	92.8

Figure 5.2: Median Seasonal Indices of Different Types of Labor on the Farm for the Overall Sample of Small Farmers

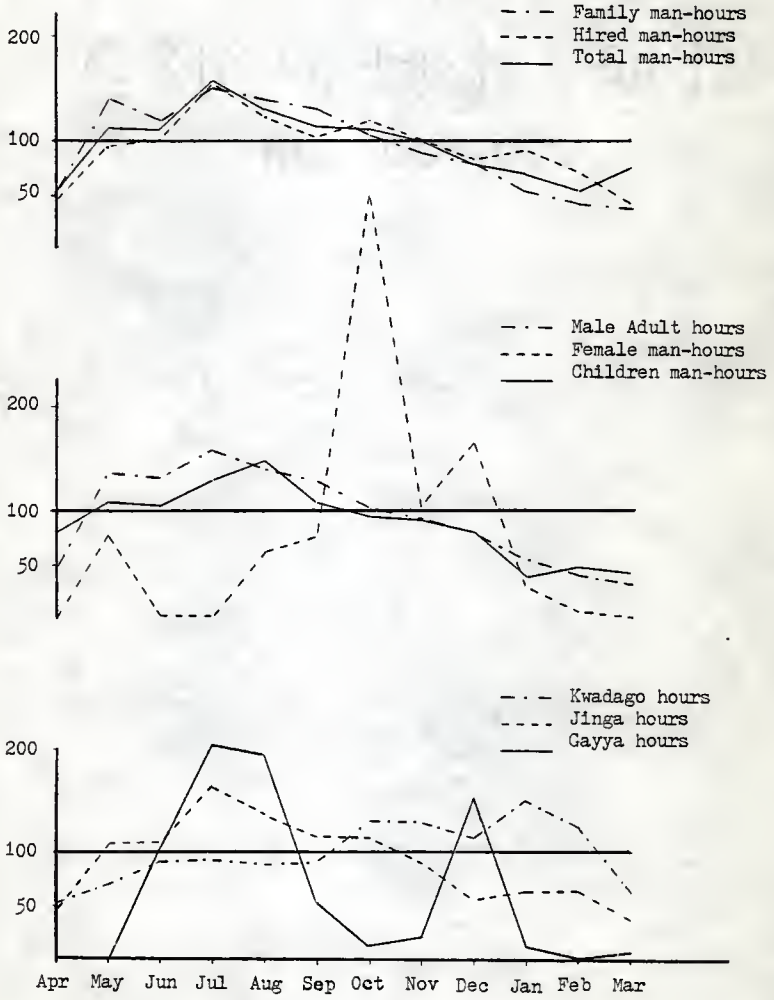
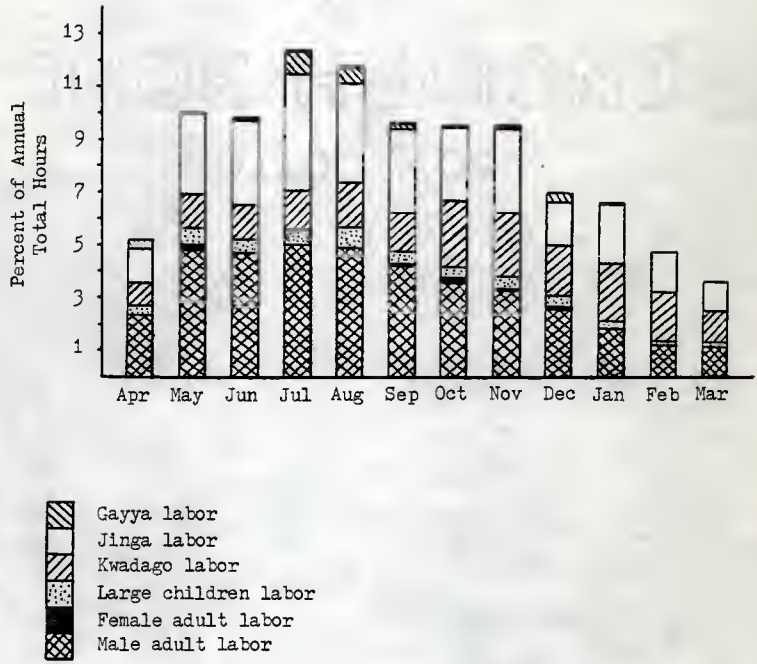


Figure 5.3: Relative Time Spent by Different Labor Types on the Farm for the Overall Small Sample of Farmers



The coefficient of variation in respect to total man-hours worked per month by the small sample of farmers (using overall averages) was 33.6 percent. The values calculated by Norman, Pryor and Gibbs (1979, Appendix A2) for three villages in the Zaria area, however, ranged from 42.4 to 54.9 percent. The lower intra-year variation observed for the overall small sample of farmers was due in large part to the use of overall averaging and the effect this has on smoothing out the inter-annual variations in the seasonal distribution of labor. Another contributing factor is the greater contribution of non-family labor on the farm. The flow of non-family labor for the overall small sample is relatively more constant than that of family labor. This would bias the results compared to other Nigerian studies which show a predominance of family labor on the farm. Finally, the fact that a greater quantity of fadama land is cultivated by the overall small sample of farmers enables more work to be performed during the dry season.[1/]

Section 5.3.2 The Seasonal Nature of Family Labor

The amount of time devoted to farm work by family members is seasonally concentrated in the wet months of the year (Table 5.8). During the dry months, male adults are usually involved in off-farm employment and the greater financial status of the family, following the harvests, enables a greater substitution of non-family labor for family labor at this time (see section 2.8.2.3). Indeed, the contribution of family labor declined from 55 percent of the total man-hours in May to 30.6 percent of the total man-hours in February.

The coefficients of variation for different types of family man-hours

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[1] The overall average quantity of fadama land owned by the small sample of farmers was three times greater than that observed by Norman, Pryor and Gibbs (1979).

worked per month, on the farm, ranged from 36.9 to 124.2 percent. The smallest amount of intra-year variation was observed for children in the family, who worked a fairly constant number of hours on the farm throughout the year. Still, a distinct peak in children labor activity occurred during the months of intense planting, weeding and ridging activity.

The greatest intra-year variation was shown for female adult labor in the family. Although the work of females on the farm (for the farm activities studied) was insignificant for most farmers in the study, the results of two farmers showed a distinct concentration of female hours during the early planting and the harvesting months of the year. Indeed, the results of one farmer (i.e. DN) indicated that 10 percent of the total hours spent on the farm, during May, was contributed by female adults. This not only explains the nature of task differentiation among women in the Zaria area, but it also points out that women in some instances can be an important source of labor during critical operations. Why the remaining farmers did not use female adults as a source of labor during critical periods is not clearly understood from the data collected (some possible explanations were mentioned in section 2.3.5.1).

With reference to male adult labor, the coefficient of variation for male adult hours worked per month on the family farm was 43.5 percent. Male adults, on average, worked the greatest amount of time during the wettest months of the year while very little time was worked, on the farm, during the dry months. As indicated in Table 5.8, 49 percent of total male adult hours were worked during the four-month period, May to August. This figure compares with less than 17 percent of total male adult hours worked during the period, January to April. The seasonal nature of male adult hours is

further demonstrated by the diagram of median seasonal indices in Figure 5.2. The overall average peak month of family male adult labor, for the aggregate of farmers, was July, although the peak month was found to vary from May to August for farmers studied individually.

The greatest number of days worked, on the farm, by male adults in the family was observed in the month of May, apparently in response to the urgency of planting and weeding operations. More than 18 days were worked, on average, by male adults on the family farm with slightly less than an average of 3.7 hours per day worked (excluding travelling time). This is similiar to the amount of time spent on weeding and ridging operations, during the peak month of July, as is indicated in Table 5.8. However, the number of hours worked per day in the peak months of labor activity is not greatly different from that of the harvesting months. This may seem surprising in view of the critical nature of timely planting and effective weed control on the farm, but work intensity per day is restrained by the arduous character of these tasks (see section 2.8.2.2). The timeliness of harvesting activities is not as critical (or urgent) as planting or weeding, but the work is less difficult to perform, encouraging more time to be worked per day. Also, fewer days were worked per month, on average, in the harvesting months compared to the peak months of labor activity. Following the completion of harvesting operations, the amount of time worked by male adults on the farm declines dramatically, as indicated by the low amount of work activity in the slack month, March (Table 5.8).

For the peak month of July, the overall average amount of time spent per day worked on the farm, for individual farmers in the sample, ranged from 1.8 to 5.3 hours. The greatest rates of work intensity were observed for those

individuals (i.e. DN, BL) who, it is hypothesized, are the full-time farmers in the study. The lowest rates were observed for those individuals who had other off-farm obligations to perform. One of these farmers was the cattle farmer (i.e. YR) while the other was the farmer (i.e. MS) who was elected to village head.

However, for no farmer and in no month did the work intensity exceed an average of 5.3 hours per day worked (excluding travelling time). If labor bottlenecks do occur during this period, they must be due to the other uses that labor must be put (for which no data are available) or due to the length of aggregation period used to study labor. The results of the weekly analysis are discussed in section 5.3.4.

Section 5.3.3 The Seasonal Nature of Non-Family Labor

The coefficient of variation with respect to non-family man-hours worked on the farm per month was 33.6 percent. Non-family labor reached its peak contribution in the month of July with 263 man-hours worked on the farm, while the slackest month was March with 93 man-hours worked.

While family labor made up the major portion of total monthly labor during the planting months of the year, non-family labor was dominant during the weeding, harvesting and off-season months. The contribution of non-family labor, for instance, ranged from 44 to 48 percent of monthly total man-hours during the three month period, April to June. However, the contribution of non-family labor increased to 55 percent of monthly total hours in July and ranged from 55 to 69 percent during the period, October to March.

Non-family labor tended to supplement the work of family members during the peak labor periods. Although family man-hours increased in absolute terms during the peak months, non-family labor increased at a proportionally

greater rate. Thus, the use of non-family labor or the financial ability to hire labor is an important means of alleviating seasonal bottlenecks. The increased significance of non-family labor during the harvesting and dry months is likely to be due to male adults devoting more of their time to off-farm employment.

The coefficients of variation for man-hours worked per month on the farm by different types of non-family labor ranged from 29.6 and 39.9 percent for kwadago and jinga labor, respectively, to 121.9 percent for gayya labor. Both kwadago and jinga labor were used heavily throughout the year, but the peak periods of concentration differed between the two. The peak four-month period of kwadago labor activity occurred from October to January, where 44.7 percent of total kwadago labor was used on the farm. The peak four-month period of jinga labor activity, on the other hand, was June to September, where the figure was 46.7 percent of total jinga labor activity. Similiarly the ratio of kwadago hours to jinga hours worked on the farm increased from .346 in July to .807 in November. These differences in kwadago and jinga labor are further demonstrated by the diagram of median seasonal indices in Figure 5.2.

The greater importance placed on jinga labor during the planting, weeding and ridging season can possibly be attributed to several factors. First of all, the crucial importance of timely planting and weed control may encourage the use of jinga labor due to its greater productivity per given unit of time (Norman, 1972, p. 33). Secondly, the higher wage rate of jinga labor may be necessary to attract laborers at this critical period. Hired laborers generally have their own fields to attend to, thus higher wage rates may have to be paid to attract the quantity of hired labor that

is desired. Finally, jinga labor (contract labor) requires less supervision in the field than kwadago labor. Hence, fewer demands are placed on family male adults, enabling them to devote more of their own time to weeding and ridging operations. The reasons for the peak in kwadago labor during the harvesting season and off-season is less easily explained. One likely factor is that the lower level of labor activity at this time creates less need for more highly productive and higher wage-cost types of labor. It may also be possible that the type of operations performed during this period are more ameniable to work by the day rather than by the job or task.

In reference to gayya labor, only two farmers in the small sample had what could be considered a significant gayya contribution. In both cases, a distinct peak in gayya labor usage occurred during the critical months of July and August. The critical demand for labor during this time period resulted in greater gayya labor usage, but for different reasons between the two farmers. In one case (i.e. MS), the political power of the farmer certainly strengthened his position to call upon communal labor to help out on the farm. In the other case (i.e. YR), the traditional nature of the cattle owning enterprise likely contributed to the greater participation in communal type work.

Section 5.3.4 Peak Period Analysis by Weekly Aggregation Period

As was indicated in section 4.3.2, the labor bottleneck that is oftentimes associated with peak labor periods was not strongly represented in the monthly analysis. However, the importance of timely planting and weed control is so critical that even a week's delay in these operations can result in a substantial loss of yields (section 2.8.2.2). Thus, it is often thought that a bottleneck can be incurred with respect to a week's or

fortnight's labor activity, but be disguised when labor activities are aggregated into monthly time periods.

The peak weeks of total man-hours, on the farm, were observed during the same time period as the monthly peak labor periods (Table 5.9). The peak week of labor activity occurred during the latter part of July where 127 total hours were worked per week on the farm. This was nearly 30 hours greater than the average total man-hours worked in each of the first two weeks of the month. However, the increase came about due to a greater non-family labor contribution, while little change occurred with respect to the average amount of family male adult hours worked on the farm (Table 5.9). The amount of time worked, on average, per male adult in the family was approxamately 16 hours. This represents some 4 days worked per week with nearly 4 hours spent per day worked. When farmers are studied individually, the amount of time worked per male adult ranged form 0.5 hours to 30.2 hours per week.

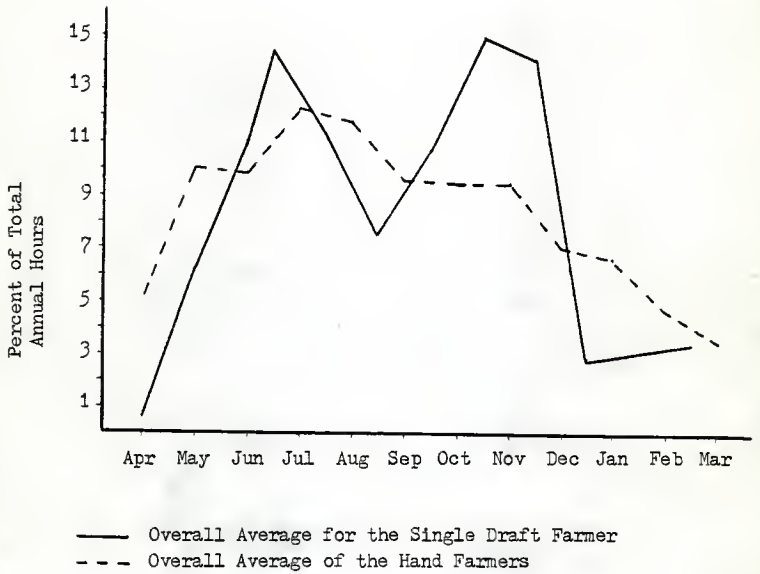
The results would seem to indicate that no significant peak in male adult labor arises (within the peak month), when the data are disaggregated into weekly periods. This conclusion requires some reservation, however. The farmers included in the small sample study use a substantial amount of non-family labor, on average. It is uncertain what the case would be if most of farm labor was performed by family members (which is the usual case in traditional small farm systems).

Assuming that the results of the weekly analysis are representative of farmers in general than other explanations must be sought for the labor bottlenecks that exist. The average work activity of 16 hours per week needs to be assessed in view of the other uses to which time is put (i.e. off-farm

Table 5.9 Details of Peak Period Labor Use by Week

Month	Week Number	Total Hours	Male Adult Hours	Family Male Adults		Other Family Hours	Non-Family Hours
				Days	Hours Per Day		
May	6	90.8	42.4	3.8	4.2	6.6	41.6
	7	105.2	49.5	4.8	3.8	10.1	45.3
	8	95.1	46.7	4.8	3.7	5.3	42.8
July	14	93.7	45.7	4.0	3.9	4.5	43.3
	15	98.6	45.6	3.8	4.2	4.1	48.7
	16	122.0	44.7	4.2	3.6	4.2	72.7
	17	127.0	43.4	3.6	3.9	4.6	79.0
August	18	102.3	45.0	4.0	4.2	6.7	50.6
	19	114.1	41.9	3.9	4.0	5.0	67.1
	20	100.9	44.5	4.2	4.0	6.1	50.2

Figure 5.4: The Influence of Draft Power on the Seasonal Distribution of Labor Throughout the Year



employment, farm chores, domestic tasks, etc.). or to nutritional deficiencies which influence the family's potential for work (see sections 2.7, 2.8.2.3 and 3.1.2). Unfortunately, information of this nature was not available for analysis.

Another possible factor might be the relationship between rainfall distribution and seasonal labor activity. The timing and amount of rainfall can strongly influence weed growth and subsequently weeding labor activity on the farm. Thus, inter-annual variations in the seasonal distribution of labor can alter the severity of labor bottlenecks from year to year. The overall average figures used in this chapter would imply that greater and lesser levels of work intensity exist in the other years of the study. The extent of these variations and their relationship with the inter-annual variations in the timing and amount of rainfall distribution are discussed in Chapter 6 (see sections 6.3.2 and 6.3.5).

Section 5.3.5 Draft Power Versus Hand Power Technology

Oxen and oxen-drawn equipment, in the Hausa areas of northern Nigeria, are primarily used for land preparation and for some inter-row cultivation. The improvement in labor productivity, in regard to land preparation, results in less time being spent in the field relative to hand farming, as indicated in Figure 5.4. A feasible weeding technology has not successfully accompanied the introduction of draft power, however, thus the use of oxen does not appear to diminish the peak weeding period. In fact, the greater productivity of labor during land preparation can result in greater acreages being cultivated, further aggravating the weeding bottlenecks that occur. Figure 5.4 also indicates that the use of draft power accentuates the labor peak during harvesting operations, relative to the labor demands

of the average hand farmer. This results from the greater productivity of labor and the greater physical output that results from using oxen on the farm (Norman, Pryor and Gibbs, 1979, p. 99).

CHAPTER 6

INTER-ANNUAL VARIATIONS AND DETERMINANTS OF LABOR ACTIVITY

Section 6.1 Introduction

Very little information is available, in the existing literature, concerning the variability of the small farm's labor profile over the years. Labor studies in Africa are generally of a twelve calendar month duration and time-series studies are virtually non-existant. The importance of the Zaria over time survey then, stems from the fact that it includes data for the same sample of eight farmers for a number of consecutive years.

An analysis was made of the overall average of the time-series data, in Chapter 5, and large sample and small sample survey comparisons were made in Chapter 4. The emphasis in this chapter is on the inter-annual variations that occur with respect to annual labor activity, on the farm, as well as the intra-year variations that occur from year to year. In addition, multiple regression analysis is used to analyze the major determinants of total labor activity on the farm.

Section 6.2 Inter-Annual Variations in Land and Annual Labor Characteristics

This section discusses the inter-annual variations that were observed with respect to various agro-economic variables. Table 6.1 includes the values for various types of labor on the farm, representing the mean average of the sample of seven hand farmers. Table 6.2 demonstrates the inter-annual variations in the mean averages of various land and family characteristics.

Table 6.1: Inter-Annual Variations in Labor for Different Labor Types for the Sample of Seven Hand Farmers

Details	1969	1970	1971	1973	1974
Total hours	4758	3750	4039	3427	3446
Family hours:[ab]	2440 (51.3)	1717 (45.8)	1740 (43.1)	1412 (41.2)	1497 (43.4)
Total male adult hours:	2336 (49.1)	1590 (42.4)	1558 (38.6)	1037 (30.3)	1151 (33.4)
Hours per male adult	702	612	651	531	525
Days per male adult	164	155	134	109	112
Female adult man-hours	10 (0.2)	9 (0.2)	58 (1.4)	30 (0.9)	35 (1.0)
Large children man-hours	94 (2.0)	118 (3.2)	124 (3.1)	346 (10.0)	311 (9.0)
Non-family hours:[ab]	2316 (48.7)	2031 (54.2)	2296 (56.9)	2014 (58.8)	1947 (56.6)
Kwadago hours	857 (18.0)	696 (18.6)	891 (22.1)	791 (23.1)	752 (21.8)
Jinga hours	1297 (27.3)	1235 (32.9)	1203 (29.8)	1159 (33.8)	1166 (33.9)
Gayya hours	162 (3.4)	100 (2.7)	203 (5.0)	65 (1.9)	30 (0.9)
Hours per cultivated hectare[b]	719	584	678	704	721
Family hours per cult. hct.[b]	440	295	352	347	379
Non-family hours per cultivated hectare[b]	279	289	326	357	342

[a] Figures in parenthesis are percentages of total annual hours worked on the farm

[b] All figures are in man-equivalent terms.

Table 6.2: Inter-Annual Variations in Land Characteristics and Family Characteristics for the Sample of Seven Hand Farmers

Stratum	Characteristics	1969	1970	1971	1973	1974
Land Characteristics	Total hectares	8.3	7.3	7.5	5.4	5.4
	Gona hectares	7.1	6.2	6.5	4.6	4.6
	Fadama hectares	1.1	1.1	1.0	0.8	0.8
	Cultivated gona[a]	6.3 (87.6)	5.4 (87.1)	5.5 (84.4)	4.2 (90.1)	4.6 (98.1)
	Cultivated fadama[a]	0.9 (75.4)	1.0 (91.9)	0.9 (85.1)	0.8 (97.4)	0.8 (100.0)
	Fallowed hectares	1.2	0.9	1.2	0.5	0.1
	Cult. hcts./resident	.60	.57	.53	.40	.41
	Cult. hcts./ male adult	2.32	2.63	2.76	2.48	2.62
Family Characteristics	Total residents	12.7	11.9	12.4	12.3	12.7
	Male adults	3.1	2.7	2.7	2.4	2.4
	Female adults	4.0	3.9	4.4	4.1	4.0
	Large children	2.9	2.6	2.4	2.7	2.6
	Small children	2.7	2.7	2.9	3.0	3.7
	Consumer/Worker ratio[c]	1.22	1.24	1.23	1.26	1.31

[a] Figures in parenthesis are percentages of total gona hectares

[b] Figures in parenthesis are percentages of total fadama hectares

[c] The terms used in calculating the consumer/worker ratio are defined as follows:

- Consumer = Male adult's are equivalent to 1 consumer unit; female adult's as 0.73 units; large children as 0.71 units; and, small children as 0.43 units (see footnote on page 15).
- Worker = Male adult's are equivalent to 1 worker unit; female adults as 0.75 work units; and, large children as 0.50 worker units (see section 3.3 for measures of the work force).

As indicated in Tables 6.1 and 6.2, substantial differences were observed between years, especially in regards to land and labor characteristics. Analysis of variance was used to test the significance of these changes in order to determine whether significant differences exist between years. The 5 years of agro-economic data were treated separately as 'treatments' and the sample of hand farmers provided 7 observations per treatment (i.e. year). An Anova table was set up and F-values studied for the agro-economic variables in Tables 6.1 and 6.2. The following null hypothesis was tested for each of the variables studied:

$$Ho: \quad u_1 = u_2 = u_3 = u_4 = u_5 = u$$

where; u_1 to u_5 represent the mean average for the five treatments or years;

and, u equals the overall average of the years.

The calculated F-values were insufficient, in all cases, to reject the null hypothesis at the 10 percent significance level. The conclusion, then, is that the mean value of any one year is not statistically different from the mean values of other years. However, this situation is not entirely unexpected. The large within sample variation, that was demonstrated in Chapter 5, combined with a small sample size, greatly increases the within sum of squares variation relative to the between sum of squares variation. An examination of the minumum and maximum values for two agro-economic variables -- i.e. total hours and total hectares -- can help demonstrate the extent of the within sample variation that exists. Taking the year 1969 as an example, total annual hours on the farm ranged from 867 to 8606

hours while total farm size ranged from 1.0 to 18.7 hectares. This hetereogeniety within the small sample of farmers was displayed in all the 5 years of data studied.

Section 6.2.1 Land Characteristics

As indicated in Table 6.2, a downward trend was observed over time, with respect to total farm size, cultivated gona land, cultivated fadama land and the amount of total hectares fallowed. Average total hectares, for instance, was observed to decline from 8.3 hectares in 1969 to 5.4 hectares in 1974. Total cultivated hectares experienced a similiar decline falling from 7.1 hectares in 1969 to 5.3 hectares in 1974. A negative correlation coefficient was found to exist between years and total hectares and between years and total cultivated hectares, but both were insignificant at the 10 percent significance level. However, nearly all farmers in the sample showed at least a one hectare decrease in farm size between the years 1969 and 1974.

The decline in the amount of land available to the family farm is further demonstrated by a decrease in the cultivated land per resident ratio over time (Table 6.2). The family farm, however, appeared to compensate for this decline by making greater use of the existing land resources. The percentage of total gona land that was cultivated, for instance, increased from 87 percent in 1969 to 98 percent in 1974. The percentage of total fadama land that was cultivated increased from 75 percent to 100 percent during this same time period. The greater utilization of available farm land is further indicated by the significant decline in fallowed hectares over time.[1/]

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[1] A correlation coefficient of -.3298 was found between fallowed hectares and years, which is significant at the 5 percent level.

It is not clear what the reasons are for the decline in farm size and cultivated hectares over time. The decline may reflect growing land-use pressures and greater competition for available land in the Zaria area. This could be due to such factors as increasing population pressures or the deterioration of traditional family structures. The greater individualization that seems to be occurring throughout West Africa may be causing a division of farmland into smaller units as family male adults set out to establish their own households. This might explain the decline in the average number of adult males in the family over the years, as is demonstrated in Table 6.2. In any event, the decreasing emphasis on fallowing and the greater utilization of land resources may perhaps lead to declining soil fertility if land improving practices do not follow.

Furthermore, a positive correlation coefficient was found between the total number of male adults in the family and the amount of total hectares, gona hectares and cultivated gona hectares.[1/] This would seem to indicate that the size of the farm (and cultivated hectares) is to some degree influenced by the number of workers (i.e. primarily male adults) in the family. This is further supported by the fact that the average amount of cultivated hectares per male adult remains fairly constant over the years (Table 6.2).

Section 6.2.2 Total Annual Hours

Eventhough, differences between years were found to be statistically insignificant, the results seem to indicate that the particular year studied can influence the character of total labor activity on the farm. The average

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[1] The correlation coefficient between the number of male adults in the family and total hectares was .2257; gona hectares: .2549; and, cultivated gona hectares: .2402. These correlation coefficients, however, were insignif- at the 10 percent level.

total hours worked in 1969, for instance, was nearly 1500 hours greater than that of the year 1973 (Table 6.1). However, excluding the year 1969, very little difference was observed between the remaining years. In regards to individual farmers in the sample, six out of seven farmers showed a negative correlation between total hours and years, though only one correlation coefficient was significant at the 10 percent level.

The decline in cultivated hectares mentioned in section 6.2.1 appears to have been accompanied by an increase in total labor activity per cultvated hectare. From 1970 to 1974, total labor activity increased from 584 hours to 721 hours per cultivated hectare. This conclusion is supported by the fact that a significant negative correlation coefficient was found to exist between the amount of total hours worked per cultivated hectare and the amount of cultivated gona hectares farmed.[1/]

Section 6.2.2.1 Annual Family Labor

As indicated in Table 6.1, substantial changes were observed between years with respect to the average amount of family hours devoted to farm work. Average family hours on the farm declined from 2440 hours in 1969 to less than 1500 hours in 1974. This decline represented a decrease in the family's contribution to total labor over time, falling from 51 percent of total hours in 1969 to roughly 43 percent in 1974.

A similiar decline was observed with respect to male adult hours worked on the farm. The average number of total male adult hours in 1969 was more than twice as great as in the year 1973. During this same time period, the contribution of male adult hours to total hours worked on the farm fell from

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[1] A correlation coefficient of -.3685 was found to exist between total hours per cultivated hectare and the amount of cultivated gona hectares farmed (significant at the 5 percent level).

49 to 33 percent (Table 6.2). Part of this decline could be contributed to the decreasing average number of male adults in the family over the six year period. However, as indicated in Table 6.2, the number of hours worked per male adult on average was found to greatly decline over time. In fact, a significant negative correlation was found to exist between years and the amount of male adult hours and hours per male adult worked on the farm.[1/]

The decline in male adult labor over time is further demonstrated by the results for individual farmers in the sample. A student's 't' test was used to test the significance of the correlation coefficient between male adult hours and years for individual farmers. The null hypothesis tested was that no correlation existed between male hours and years versus the alternative hypothesis that a significant correlation existed. The t statistic was calculated as follows:[2/]

$$t = r\sqrt{\frac{n-2}{1-r^2}}$$

where; r = the correlation coefficient between male adult hours and years for an individual farmer.

n = five, representing five years of observations.

It should be noted that a negative correlation coefficient was found between male adult hours and years for all of the seven hand farmers in the

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[1] A correlation coefficient of -.3264 and -.3027 was found between years and the amount of male adult hours and hours per male adult in the family, respectivelly. Both were significant at the 10 percent level.

[2] W. Mendenhall, L. Ott and R. Larson, Statistics: A Tool for the Social Sciences (North Scituate: Duxbury Press, 1974), p. 414.

sample. With the use of the t statistic to test the strength of the linear relationship, the correlation coefficients for 4 of the farmers were found to be significant at the 10 percent level. When male adult hours are studied as a percentage of total hours, in order to study the relative contribution of male adults to total work on the farm, 5 farmers out of 7 showed a significant decline (at the 10 percent level) in male adult labor over time.

It is not certain what the specific reasons are for this downward trend in male adult labor activity. One possible explanation is that labor time was increasingly devoted to off-farm occupations during this period. But, this could not be substantiated, because off-farm data were not available for analysis. Another explanation is that the shifts that occurred with respect to the seasonal distribution of labor over time (due to variances in rainfall distribution over the years) may have resulted in a lower male adult labor contribution. This hypothesis is examined in section 6.3.3.

In regards to the labor activity of other family members, female adult hours on the farm incurred little change over time. However, the results for large children indicate that the average amount of large children labor increased from 94 hours in 1969 to 311 hours in 1974. A positive correlation coefficient was found between large children hours and years, which was significant at the 5 percent level. However, the results for individual farmers in the sample were mixed, with only 2 farmers showing a significant positive correlation over time.

Section 6.2.2.2 Annual Non-Family Labor

As indicated in Table 6.1, very little change occurred with respect to average non-family hours over the years. However, average non-family hours as a percentage of average total hours over the years tended to

increase, from 48.7 percent in 1969 to 56.5 percent in 1974. This trend is somewhat surprising. The decline in cultivated hectares over the years and the decline in total hours and family hours would be expected to be accompanied by a corresponding decrease in non-family hours. The fact that it doesn't may indicate that non-family hours may be filling the void left by fewer male adult hours on the farm. Indeed, the average amount of non-family hours per cultivated hectare over the years appears to steadily increase (Table 6.1).

In addition, very little change appears to have occurred with respect to the amount of average kwadago, jinga and gayya hours on the farm. However, the mean of the sample as a whole disguises significant inter-farm variations. In regards to jinga labor, for instance, two farmers in the sample showed a significant increase over time, while one farmer showed a significant decrease over time.[1/] When jinga hours are studied as a percentage of total hours, three farmers demonstrated a significant increase in jinga labor over time, while one farmer demonstrated a significant decrease. Similiar variations were observed among farmers for kwadago and gayya types of labor. The above results demonstrate the importance of recognizing inter-farm variations when studying changes over time, rather than relying soley on sample averages.

Section 6.2.3 Summary of Total Annual Changes Over Time

The results of this section appear to indicate that significant changes have occurred over time with respect to certain land and labor characteristics on the small farm. Substantial inter-year variations were observed

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[1] The trends are significant at the 10 percent level.

for individual farmers in the sample and significant trends were observed in certain cases over time. This observation confirms the point that the small farm is a dynamic unit continually responding to changing economic and social forces over time. Combined with this observation though, is the fact that the farmers in aggregate appeared to act in a common manner over the years with respect to certain agro-economic variables. The quantity of land farmed, total hours worked and the amount of male adult hours on the farm generally declined for most farmers in the sample. Male adult hours, in particular, faced a significant decline over time for the farmers in aggregate. The conclusions reached for this particular sample of farmers, then, would seem to place some doubt on the reliability of a single year study to represent the land and labor characteristics of the small farm in other years. In the following section, consideration will be given to the inter-year variations in the seasonal distribution of labor.

Section 6.3 Inter-Annual Variations in the Seasonal Distribution of Labor

It was mentioned in earlier chapters that the seasonal nature of agriculture creates two major problems with respect to labor on small farms in northern Nigeria. One problem is the labor bottlenecks that are believed to occur during the peak labor months of weeding and ridging activity. The other involves the need to find some form of off-farm employment during the slack periods of agricultural activity and the repercussions off-farm employment can have on the family's flow of labor during the peak months.

However, very little information is available on the extent to which labor is seasonally distributed from year to year, especially with regards to inter-annual variations in peak labor activity. Evidence is presented in

this section which demonstrates that the seasonal distribution of labor can vary greatly from one year to the next and that the magnitude of total labor during the peak month experiences large inter-annual variations. More importantly yet, the labor intensity of male adults during the peak month varies greatly, suggesting that the labor bottleneck may be more severe in some years than in others.

Section 6.3.1 The Seasonal Distribution of Total Labor Activity

The monthly seasonal distribution of average total hours, family hours and non-family hours, for three separate years, is illustrated in Figure 6.1. The histograms of labor activity indicate that the distribution of total hours can vary greatly from year to year. In the year 1969, for instance, the distribution of average total hours appears to remain relatively constant, from April through January, with the exception of the extreme peaking of total labor in August. In comparison, average total hours in 1971 were concentrated in the weeding and ridging months of the year, while total hours tailed off in the harvesting months. The greater intra-year variation with respect to average total hours worked, in 1971, is further indicated by the higher coefficient of variation compared to that of 1969 (Table 6.3).

In contrast, the distribution of average total hours, in 1973, shows a distinct peaking of total labor during the harvesting month of November. The critical labor peaks which normally accompany the weeding and ridging periods of agricultural activity appear to be less severe in 1973. This apparent shift in the distribution of labor to the harvesting months of the year is supported by the statistics in Table 6.3. The percentage of average total hours worked during the period, September to December, was 41.2 percent compared to the values of 32.5 percent and 34.6 percent, in 1969 and 1971,

Figure 6.1: Inter-year Variations in Precipitation, Family Hours and Non-Family Hours for the Sample of Seven Hand Farmers

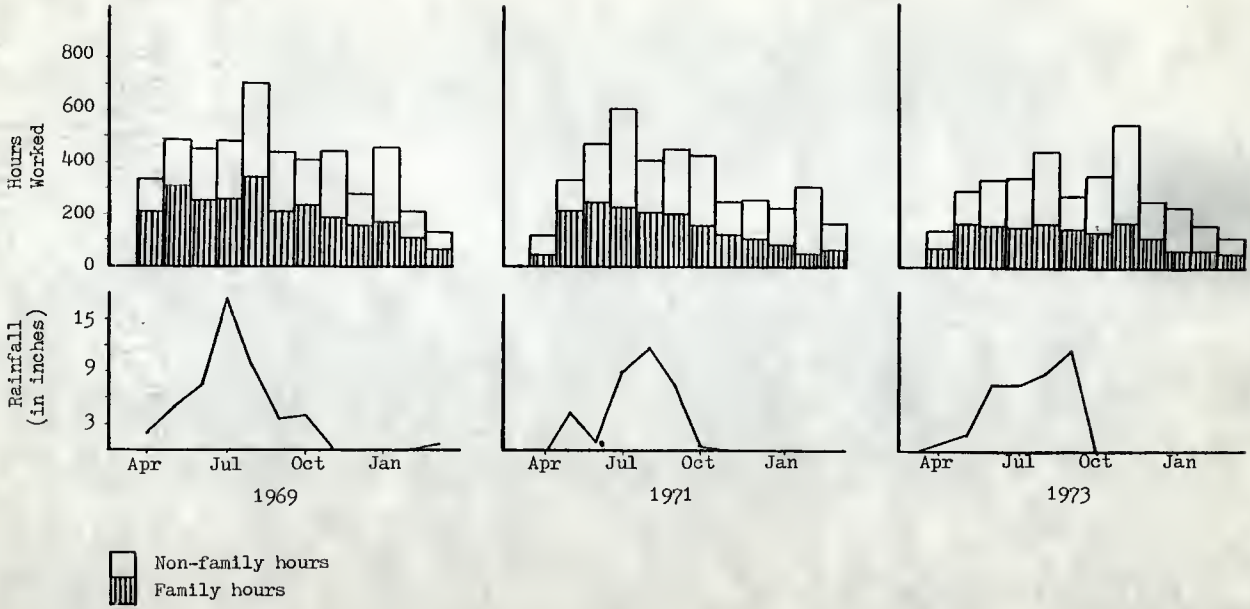

Table 6.3: Inter-Annual Variations in the Seasonal Distribution of Total Hours and Non-Family Hours for the Sample of Seven Hand Farmers

	Labor Characteristics	1969	1970	1971	1973	1974
Total Hours	Coefficient of Variation	37.7%	39.4%	41.7%	43.4%	40.1%
	Seasonal Distribution of Labor:					
	Percent of Total Hours Worked					
	- May to August	44.3%	46.0%	45.1%	40.4%	44.8%
	- January to April	23.2%	19.6%	20.3%	18.4%	19.4%
	- September to December	32.5%	34.4%	34.6%	41.2%	35.8%
	Peak Month (Name)	August	July	July	November	July
	Total Hours worked during the peak month	700	497	600	542	480
	Slackest Month (Name)	March	March	April	March	February
	Total Hours worked during the slackest month	124	131	112	110	63
Non-Family Hours	Coefficient of Variation	44.5%	31.9%	45.1%	51.6%	43.3%
	Seasonal Distribution of Labor:					
	Peak Month (Name)	August	September	July	November	July
	Hours worked during peak month	369	254	374	371	287
	Slackest Month	March	March	April	April	February
	Hours worked during the slackest month	63	84	59	56	28
	Jinga Hours: Peak four months	June-Sept	July-Oct	June-Sept	Aug-Nov	May-Aug
	Percent of Total Jinga Hours	51.6%	46.7%	50.2%	50.6%	57.4%
	Kwadago Hours: Peak four months	Nov-Feb	Dec-Mar	Nov-Feb	Oct-Jan	Oct-Jan
	Percent of Total Kwadago Hours	44.4%	38.5%	41.7%	53.3%	51.1%

respectively. The percentage of average total hours worked during the period, May to August, on the other hand, was less than that of other years examined (Table 6.3).

Section 6.3.2 Influence of Rainfall on Total Annual Labor and on the Seasonal Distribution of Labor

A great deal of variability was associated with the amount of annual rainfall received throughout the time series study (Table 6.4). Total rainfall for the Zaria region ranged from a high of 48.2 inches in 1969 to a low of 34.7 inches in 1971.[1/] Only the year 1969 exceeded the long-term mean annual rainfall figure of 43.6 inches, while the rainfall in 1974 was nearly the same as the long-term average.[2/] In the remaining years of the study (i.e. 1970, 1971 and 1973) annual rainfall fell between 5 to 9 inches below the long-term average.

A positive relationship appears to exist between total annual rainfall and total time worked although the relationship is complicated by a number of interacting factors. As was indicated in Table 6.1, for instance, the highest amount of total man-hours worked on the farm occurred in the year 1969 -- the same year in which the highest amount of annual rainfall was received. Complicating this relationship though, was the larger average farm size and family size that was also associated with the year 1969. However, when farm labor is studied in terms of time worked per male adult and time worked per cultivated hectare (Table 6.1), both figures were found

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[1] The rainfall figures were collected at the Samaru rainfall station and thus do not reflect the local variations in rainfall amounts and distribution that would normally be expected. Given the large distances that exist between the survey villages, these variations could be considerable.

[2] The long-term average rainfall at the Samaru rainfall station was computed by Kowal and Knable (1972, p. 59) and covered a 41 year period from 1928 to 1969.

Table 6.4: Inter-Annual Variations in Total and Monthly Rainfall Figures and Major Cropping Activities for the Sample of Seven Hand Farmers

Details	1969	1970	1971	1973	1974
Total Annual Precipitation[a]	48.2	37.2	34.7	38.8	43.5
Distribution of Rainfall[a] in inches:					
April	1.7	0.1	0.0	0.9	1.2
May	4.6	5.2	4.6	1.9	1.3
June	7.3	4.1	1.2	7.6	5.7
July	17.5	10.2	9.1	7.5	10.0
August	9.2	10.4	11.8	9.0	13.0
September	3.5	6.9	7.7	11.5	9.7
Type of Operation:[bc]					
Land Preparation and Manuring	11.3	14.3	14.2	18.4	15.1
Planting	10.6	12.3	11.8	10.9	9.5
Weeding	33.2	29.4	22.0	23.9	27.9
Ridging	17.0	16.0	19.9	11.8	14.2
Harvesting	25.8	21.4	26.2	31.7	31.7
Other	1.2	3.7	3.6	3.2	1.7

[a] Precipitation figures were collected at the Samaru Agricultural Experiment Station

[b] The figures are percentages of average total hours

[c] The figures may not add up to a full 100 percent due to rounding errors.

to be generally larger in 1969 than in other years. Similiarly, the next to highest year of annual rainfall (i.e. 1974) also showed the next to highest amount of total time worked per cultivated hectare. This tendency was also shown for the second to highest rainfall year, 1973. However, the strength of these relationships is very much in doubt and in fact the results for the two remaining years (i.e. 1970 and 1971) in the study are virtually opposite of what would be expected.

One element that influences the relationship between total annual rainfall and total annual labor flow is the seasonal distribution of rainfall. The specific times and amounts in which rainfall is received, directly influences the seasonal distribution of labor and indirectly influences total annual labor activity.

The distribution of rainfall was found to primarily influence planting and weeding activity on the farm. The amount of total hours devoted to April planting and May planting, for instance, was found to be significantly positively related (at the 1 percent level) to the amount of precipitation received in April and May, respectively. Similiarly, the amount of precipitation received in a given month was found to be significantly positively related to the following month's weeding labor activity.[1/] The amount of weeding performed in May (June, July and September), for instance, was found to be positively correlated with the amount of precipitation received in April (May, June and August), significant at the 5 percent level. In

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[1] This is a rough indication of the lagged effect between the time precipitation is received and the time weeds become a problem. The monthly lag implied in the correlation between April's precipitation and May's weeding is probably too long (a fornightly study would be better) but the results roughly demonstrate the existing relationships between rainfall and weeding activity. No significant correlation was found between monthly precipitation and the same month's weeding activity.

addition, a significant positive correlation coefficient was found between total annual precipitation and annual total weeding hours.

It is not surprising to find, then, that average total weeding hours as a percentage of average total hours declined from 33.2 percent in 1969 to 22.0 percent in 1971 (Table 6.4). The decrease in total annual precipitation and the gradual shift in rainfall distribution to later months of the wet season were probably important factors in the decline of total weeding hours from 1969 to 1973.[1/]

No significant correlation was found between total annual precipitation (or various monthly rainfall figures) and annual total harvesting labor on the farm. This finding is not unexpected, however. The amount of time spent harvesting depends not only on farm yields and it's determinants -- i.e. climatic factors, biological factors, changes in land productivity, etc. -- but also on the type of crops grown and differences in labor productivity (see section 3.3).

Section 6.3.3 Seasonal Distribution of Family Labor

Average family hours are generally concentrated in the peak weeding and ridging months of the year, as is indicated in Table 6.5. However, a large amount of inter-annual variation was associated with the concentration of family labor during this period. The percentage of average family hours worked during the period May to August ranged from 51.6 percent in 1971 to 44.2 percent in 1974. Similiarly, the extent of intra-year variation, as measured by the coefficient of variation, with respect to family man-hours

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[1] Average total weeding hours in 1969 was 1577 hours compared with 888 and 820 hours in 1971 and 1973, respectivelly.

Table 6.5: Inter-Annual Variations in the Seasonal Distribution of Family Hours and Male Adult Hours for the Sample of Seven Hand Farmers

	Labor Characteristics	1969	1970	1971	1973	1974
Family Man-Hours	Coefficient of Variation	39.1	53.1	51.0	41.8	42.8
	Seasonal Distribution of Labor:[a]					
	Percent of Family Hours worked during May to August	46.8% (54.1)	51.5% (51.2)	51.6% (49.2)	45.7% (46.6)	44.2% (47.8)
	Percent of Family Hours worked during January to April	21.5% (47.6)	14.2% (33.2)	14.3% (30.3)	16.1% (36.1)	15.9% (37.7)
	Peak Month (Name)	August	July	June	November	July
	Hours worked during peak month	332	255	256	171	193
	Slackest Month (Name)	March	March	February	March	February
	Hours worked during slackest month	61	47	50	46	35
Male Adult Hours	Coefficient of Variation	39.5	52.7	53.9	45.1	43.8
	Seasonal Distribution of Labor:					
	Peak Month (Name)	August	July	June	August	July
	Hours worked per male adult	98.3	91.9	90.7	48.2	57.9
	Days worked per male adult	23.9	21.8	19.9	11.8	14.5
	Average hours per day worked	4.4	4.1	4.3	3.3	2.9
	Slackest Month (Name)	March	March	February	March	February
	Hours worked per male adult	19.5	18.1	19.8	15.2	12.7
	Days worked per male adult	5.0	4.7	3.7	3.9	3.3
	Average hours per day worked	2.7	3.3	3.2	1.7	2.1

[a] Figures in parenthesis are percentages of total hours for the respective May to August and January to April periods.

on the farm, ranged from 39.1 percent to 53.1 percent over the years.

Family labor appears to make the largest contribution to total monthly labor in the weeding and ridging months of the year. In the year 1970, for instance, average family hours as a percentage of average total hours for the May to August period was 51.2 percent. This compares with a figure of 33.2 percent in the period January to April. This reflects both the critical nature of effective ridging and weed control on the farm as well as the difficulty of acquiring non-family labor during this period. The lower contribution of family labor during the dry season reflects the farmers' involvement in off-farm employment and greater financial resources, following the harvests, to hire labor. In addition, the large disparity consistently shown between average family hours worked in the peak and slack month demonstrates the difficulty of trying to productively employ labor throughout the year (Table 6.5). This problem is exacerbated by the fact that certain years may demand more labor time from family members than other years. The greater the extremes in intra-year variations the more difficult it is to plan for labor activity on the farm (i.e. conflicts between off-farm employment and peak season labor, the need to arrange in advance for hired labor, etc.).

Since family labor is generally concentrated in the wet months of the year, the absence of the peak weeding period in 1973 may have contributed to the lower family labor contribution in that year (Figure 6.1 and Table 6.1). This relationship is accentuated by the large harvesting peak occurring in 1973 of which family labor contributed but a minor part.

Section 6.3.4 Seasonal Distribution of Non-Family Labor

It was mentioned in Chapter 4 that the coefficient of variation with respect to non-family hours was lower than that for family labor (implying

less intra-year variation). However, as indicated in Table 6.3, the coefficient of variation with respect to non-family hours worked on the farm ranged from 31.9 percent in 1970 to 51.6 percent in 1973.

Non-family hours on average were found to generally peak during the July to September period over the years, with very little inter-annual change in the average amount of non-family hours worked during the average peak month. As indicated in Table 6.3, though, a distinct difference arises between the two major types of non-family labor. Jinga labor was found to be consistently concentrated in the wet months of the year (i.e. May to September) while kwadago labor consistently concentrated in the dry months (i.e. October to March). Reasons for this were suggested in section 5.3.3.

Section 6.3.5 Peak Period of Male Adult Labor Use

Male adult labor closely follows the seasonal distribution of family labor with male adult hours and days being concentrated in the wet months of the year (Table 6.5). The peak month of average male adult hours over the years was found to center around the June to August period although a great deal of within sample variation was observed. In the year 1969, for instance, the peak month for individual farmers in the sample ranged from April to August. For all the years studied, though, the peak months for individual farmers tended to center around the peak weeding and ridging months of the year.

The work intensity of male adults during the peak months of male adult labor activity was found to vary greatly over the years. The greatest level of work intensity per male adult in the family was found to occur in the month of August, 1969, while the lowest level was found to occur during August, 1973 (Table 6.5). During the month of August, 1969, a male adult on

average worked 98.3 hours on the farm. This represented about 24 days worked per month with roughly 4.4 hours worked on average per day. This contrasts markedly with the 48 hours worked on the farm by a male adult during the month of August, 1973.

The above results indicate that the severity of the peak bottleneck period can change dramatically over the years. The peak labor month in 1969, for instance, was bound to place greater physical demands on family members than the peak labor month in 1973. Similiarly, an analysis of the peak labor week for individual farmers, in August 1969, indicates that the work intensity per day ranged from 4.3 to 8.0 hours. In view of the other activities that family members must engage in, this level of work intensity (for just field activities) may reflect a severe peak period labor constraint in certain years.

Section 6.4 Determinants of Annual Total Labor Activity

In this section, multiple regression analysis is used to study the influence of different factors on total hours worked on the farm. The analysis attempts to isolate the major determinants of total labor activity by fitting several econometric models to the data.

The sample of farmers used for the regression problem is comprised of seven hand farmers and one oxen farmer. Five years of agro-economic data are available for four farmers in the sample with six years of agro-economic data for the remaining farmers. Data for the oxen farmer and for the year 1972 were included in order to increase the degrees of freedom for the regression problem.[1/]

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[1] A total of 44 degrees of freedom were available for the regression problem.

Section 6.4.1 The Regression Models

Two basic models were used to study the determinants of annual total hours on the farm. The first main model includes the quantity of cultivated gona land and cultivated fadama land to represent land influences. The second main model includes the amount of adjusted hectares devoted to major crop groups in order to account for the variances in cropping practices. For each of the main models, three variant models were fitted to the data. One model examined the influence of years on the variability in annual total hours by including dummy variables for years in the model. The second model includes precipitation in place of dummy variables for years, while the third model includes a dummy variable for cattle owners.

The dependent variable in these regression models is the amount of total man-hours worked on the farm. The independent variables used in the various models are as follows.

Influence of Years

D_1 = A dummy variable for the year 1969.

D_2 = A dummy variable for the year 1970.

D_3 = A dummy variable for the year 1971.

D_4 = A dummy variable for the year 1972.

D_5 = A dummy variable for the year 1973.

or;

X_1 = The total annual precipitation (in inches) received per annum.

Land Characteristics

X_2 = The amount of gona hectares cultivated.

X_3 = The amount of fadama hectares cultivated.

or;

X_4 = The amount of adjusted hectares devoted to Cereal Crops.

X_5 = The amount of adjusted hectares devoted to Grain Legumes.

X_6 = The amount of adjusted hectares devoted to Starchy Crops.

X_7 = The amount of adjusted hectares devoted to Sugar Crops.

X_8 = The amount of adjusted hectares devoted to Non-Food Crops.

Family Characteristics

X_9 = Total number of residents in the family

Cropping Characteristics

X_{10} = Inter-cropping Index reflecting the extent of mixed cropping.

X_{11} = Percentage of cultivated hectares devoted to the adjusted hectares of cash crops

Cattle Ownership

D_6 = A dummy variable for cattle ownership.

An effort was taken to select those independent variables which most fully explained the variation in annual total hours. Separate regressions were run testing the effect of different precipitation values, land characteristics and family characteristics in the equations.

As was indicated in section 6.3.2, the seasonal distribution of rainfall was believed to have a strong effect on certain farming activities. Consequently, various regression models were run using monthly precipitation values and values of different months combined in order to explain that part of total variance contributed to seasonal effects.[1/] However, the conclusion

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1 The monthly values of precipitation for the months of April through August were included in a stepwise fashion in the model. In addition, various combinations of monthly values were included in the model -- i.e. the combination of April-May precipitation, May-June precipitation or May - June-July precipitation -- but none of the arrangements proved superior to total annual precipitation.

reached was that total annual precipitation (in inches) explained as much a part of total variance as did any of the monthly arrangements studied. This does not imply that the seasonal distribution of rainfall has little influence on annual total man-hours worked on the farm. It is believed instead that the relationship between the distribution of rainfall and total labor activity is very complex and none of the monthly arrangements used completely measured the seasonal effects occurring.

In regards to land characteristics, separate regressions were run studying the influence of total hectares, gona hectares, fadama hectares and total cultivated hectares on annual total hours. None of these land characteristics explained as much of the total variance in total hours worked on the farm as did the hectarage of cultivated gona land and cultivated fadama land. In addition, the amount of hectares devoted to vegetable crops had to be excluded from the second regression model. The amount of total variation in total hours explained by the hectares of vegetable crops was insignificant after all other cropping variables were included in the model and its sign was wrong, theoretically. This is due to the fact that vegetable crops are generally grown in crop mixtures with other major food crops. The adjusted hectares of vegetable crops then, is highly correlated with the adjusted hectares of other major crop groups and thus explained very little of the variance in total hours after other crop group variables were included in the model.

In regards to family characteristics, the number of total residents in the household was selected over various other characteristics of the household. Separate regressions were run using the number of family male adults, number of consumers, number of workers, consumer-worker ratio and the number of consumers per male adult. But, all were less superior to the number of residents in the family in explaining the variation in annual total hours.

The two main regression models with their variant forms are specified by the following equations.

First Main Regression Model

$$(1A)\quad T = c + b_1D1 + b_2D2 + b_3D3 + b_4D4 + b_5D5 + b_6X2 + b_7X3 + b_8X9 + b_9X10 + b_{10}X11 + e$$

$$(2A)\quad T = c + b_1X1 + b_2X2 + b_3X3 + b_4X9 + b_5X10 + b_6X11 + e$$

$$(3A)\quad T = c + b_1X1 + b_2X2 + b_3X3 + b_4X9 + b_5X10 + b_6X11 + b_7D6 + e$$

where; T = Annual total hours,
c = constant term, and
e = error term.

Second Main Regression Model

$$(1B)\quad T = c + b_1D1 + b_2D2 + b_3D3 + b_4D4 + b_5D5 + b_6X4 + b_7X5 + b_8X6 + b_9X7 + b_{10}X8 + b_{11}X9 + b_{12}X10 + b_{13}X11 + e$$

$$(2B)\quad T = c + b_1X1 + b_2X4 + \ldots\ldots b_6X8 + b_7X9 + b_8X10 + b_9X11 + e$$

$$(3B)\quad T = c + b_1X1 + b_2X4 + \ldots\ldots b_6X8 + b_7X9 + b_8X10 + b_9X11 + b_{10}D6 + e$$

where; T = Annual total hours,
c = constant term, and
e = error term.

The dummy variables for years were entered as a group into the respective equations in a hierarchical fashion while all other independent variables including precipitation were entered in a stepwise manner. The variable which enters at each step is that which explains the greatest amount of variance unexplained by variables already in the equation (with the exception of the first step in which the variable explaining the greatest amount of variance is entered first).

Section 6.4.2 Results of the Regression Problem

The results of the first main regression model are presented in Table 6.6. The independent variables in model 1A and 2A explain roughly 87 percent (R^2 = .874 and .875, respectively) of the variance in annual total hours, while the independent variables in model 3A explain roughly 91 percent (R^2 = .914) of total variation.

The relative importance of each of the independent variables as a determinant of annual total hours is reflected by the significance of the F-values for individual regression coefficients. Once all the independent variables were included in the models 1A and 2A (Table 6.6), four regression coefficients were found to be significant at the 1 percent level. These were the coefficients for cultivated gona hectares, cultivated fadama hectares, total residents in the household and the inter-cropping index. However, a comparison of the standardized Beta coefficients for selected independent variables (Table 6.7) indicates that cultivated gona hectares explains the largest portion of total variation with respect to annual total hours.[1/] The amount of cultivated fadama hectares is the next most important

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[1] The use of independent variables measured in different units does not allow a comparison of the relative effect of each independent variable on the dependent variable. Standardizing the beta coefficients, however,

Table 6.6: Regression Coefficients and Levels of Significance for Three Variants of the First Main Regression Model Explaining the Influence of Various Factors on Annual Total Hours

Independent Variables	Dependent Variable: Total Hours[ab] 1A		Total Hours[ab] 2A		Total Hours[ab] 3A	
Constant	-3517.1		-4686.9		-3405.4	
Dummy Variables for Years:						
Year 1	175.73	(438.10)				
Year 2	-200.57	(442.72)				
Year 3	-148.54	(434.92)				
Year 4	-129.41	(537.90)				
Year 5	-89.41	(430.64)				
Dummy Variable for Cattle					-2025.26***	(499.00)
Annual Precipitation			26.09	(25.81)	23.47	(21.68)
Cultivated Gona Hectares	444.31***	(70.94)	444.91***	(63.72)	390.27***	(55.17)
Cultivated Fadama Hectares	813.48***	(212.14)	812.32***	(195.69)		
Total Residents	130.51***	(42.21)	130.93***	(38.41)	245.58***	(42.88)
Intercropping Index	1036.13***	(352.91)	1053.42***	(323.13)		
Percentage Cash Crops	20.59*	(11.54)	21.23*	(10.55)	23.95**	(8.88)
R	.9353		.9352		.9560	
R^2	.8748		.8746		.9140	
Syx	856.06		809.01		679.35	

[a] One asterisk denotes that the coefficient is significant at the 10% level; two asterisks at the 5% level; and, three asterisks at the 1% significance level.

[b] Figures in parenthesis are standard errors of the respoctive coefficients.

factor in explaining total variance. These relationships are supported by the fact that a significant positive correlation coefficient of .8758 and .5997 was found to exist between total hours and hectares of cultivated gona land and fadama land, respectively.

Table 6.7: Beta Coefficients Reflecting the Importance of Selected Independent Variables in Explaining Total Variation in Annual Total Hours

Independent Variable	Model 1A	Model 2A
Cult. Gona hectares	.609	.610
Cult. Fadama hectares	.285	.285
Total Residents	.254	.254
Intercropping Index	.247	.251
Percentage Cash Crops	.159	.164

The significance of the regression coefficient for total residents is to be expected because of the hand labor orientation of the small farm enterprise. This relationship is supported by the fact that a significant positive correlation coefficient of .5652 was found between total hours and total residents in the household. In addition, the significance of the inter-cropping index indicates that total hours increases as the degree of mixed cropping increases on the farm. The percentage of cultivated hectares devoted to cash cropping (adjusted hectares of cash crops) was found to have a positive effect on total hours though the coefficient was significant at only the 10 percent level. Neither the dummy variables for years or annual

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such that X and Y have unit variance (i.e. the standard deviations of both X and Y = 1) provides a satisfactory way for the relative effects of different independent variables to be compared. For further discussion see Nie et al. (1975, p. 325).

precipitation explained a significant portion of total variation in annual total hours. It is doubtful, though, that the rainfall figures used accurately reflect the complex rainfall-labor relationships that exist. First of all, the rainfall figures were collected at the Samaru rainfall station and thus fail to account for the local variations in rainfall amount and distribution. Secondly, the use of just monthly or annual precipitation values is not likely to be an accurate proxy for the complex relationships that exist between rainfall and different farming operations.

A rough idea of the importance of each independent variable can be obtained by observing the R^2 values at each step of the regression problem. Comparing the R^2 values after each independent variable is included in the model shows the percentage of the unexplained variation that is attributed to the independent variable added. It should be emphasized that the order in which the variables are entered in the equation will affect the results. However, a crude approximation can be made of the relative importance of different independent variables.

In the regression equation 1A, dummy variables for years were entered in a hierarchical fashion while all other independent variables were entered in a stepwise manner. The dummy variables for years alone explained only about 3 percent of the total variation in annual total hours as indicated by a R^2 value of .0277. The inclusion of cultivated gona hectares in the model added about 75 percent to explained variance, raising the R^2 value to .7755. Adding cultivated fadama land added another 4 percent to explained variation and the number of residents another 2 percent (R^2 = .8421). Finally the inter-cropping index and the percent cash cropping added aproxamately 2 percent and 1 percent to explained variation, raising the R^2 to .8748.

The inclusion of the dummy variable for cattle farmers (Model 3A) indicates that cattle ownership has a significant negative influence on total farm labor activity. This relationship is to be expected since the cattle operations would detract from the family's involvement in farm work. However, the inclusion of the dummy variable for cattle lessened the significance of cultivated fadama hectares and the inter-cropping index. The insignificance of fadama hectares in the model can be attri- to the negative correlation that was found between cattle ownership and fadama land cultivated.[1/] In addition, two of the eight farmers in the sample were involved in cattle operations. The insignificance of the inter-cropping index can be attributed to the inclusion of a draft farmer in the model (the farmer was also a cattle owner). The ownership of draft animals has been linked with cash cropping (Norman, Ouedraogo and Newman, 1979, p. 189) and cash grops are generally planted in sole crops and smaller number-crop mixtures. In fact, a negative correlation was found between cattle ownership (due to the draft farmer) and the inter-cropping index.[2/]

The results of the second main regression model are presented in Table 6.8. The independent variables in model 1B and 2B explain roughly 93 percent and 92 percent of the total variance in annual total hours, while the independent variables in model 3B explain approxamately 94 percent

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[1] A correlation coefficient of -.4829 was found between the dummy variable for cattle ownership and cultivated fadama hectares.

[2] A correlation coefficient of -.4793 was found between the dummy variable for cattle ownership and the inter-cropping index. For a discussion of the intercropping index see footnote d in Table 4.4.

Table 6.8: Regression Coefficients and Levels of Significance for Three Variants of the Second Main Regression Model Explaining the Influence of Various Factors on Annual Total Hours

Independent Variables	Dependent Variables					
	Total Hours[ab] 1B		Total Hours[ab] 2B		Total Hours[ab] 3B	
Constant	-807.13		-2342.03		-2658.65	
Dummy Variables for Years:						
Year 1	43.23	(377.33)				
Year 2	-454.90	(349.45)				
Year 3	-391.58	(325.69)				
Year 4	329.65	(406.83)				
Year 5	-192.80	(328.65)				
Dummy Variable for Cattle					-1271.81***	(411.79)
Annual Precipitation			32.38	(22.25)	25.64	(20.48)
Adj. Hcts. Major Crop Groups:						
Cereal Crops	617.67***	(79.92)	636.85***	(76.08)	482.06***	(85.44)
Grain Legumes	1001.00***	(210.13)	1035.60***	(190.61)	748.30***	(200.02)
Starchy Crops	1404.28***	(260.47)	1267.28***	(240.75)	868.81***	(252.80)
Sugar Crops	-		-		-	
Non-Food Crops	216.25	(261.79)	100.10	(224.77)	283.09	(214.79)
Total Residents	-		-		143.22***	(47.57)
Intercropping Index	311.59	(289.00)	320.87	(286.45)	211.04	(282.16)
Percentage Cash Crops	11.18	(10.83)	14.81	(10.34)	18.92*	(9.46)
R^2	.932		.923		.941	
Syx	639.96		641.11		576.71	

[a] One asterisk denotes that the coefficient is significant at the 10% level; two asterisks at the 5% level; and, three asterisks at the 1% significance level

[b] Figures in parenthesis are standard errors of the respective coefficients.

of total variation. By using cultivated hectares devoted to major crop groups, as opposed to cultivated gona and fadama hectares, the standard error of the estimate is improved greatly. However, the significance of the inter-cropping index and percentage of cash crops decreases due to the high multicollinearity with hectares of major crop groups grown.

As indicated in Table 6.8, the number of adjusted hectares devoted to cereal crops, grain legumes and starchy crops were highly significant factors in explaining the total variation in annual total hours. This is to be expected because of the prevalence of these crops on the small farm. The size of the respective coefficients indicates that starchy crops in general are more labor intensive than grain legumes and both are more labor intensive than cereal crops. Neither non-food crops or sugar cane explained a significant portion of total variation. In fact, the number of adjusted hectares devoted to sugar cane was so insignificant that it failed to meet the criteria (i.e. F = .001) for inclusion into the regression model.

Using the adjusted hectares of major crops grown instead of cultivated gona and fadama hectares, lessened the significance of total residents as an independent variable. This is due to the high multicollinearity existing between the independent variables in the model. However, once the dummy variable for cattle ownership was included, the number of total residents became highly significant. This is due to the fact that a positive correlation coefficient exists between cattle ownership and family size, significant at the 1 percent level.

Section 6.5 Conclusion

In general, the results of this chapter have shown that important changes have taken place on the small farm over the years. The changes in land ownership and management and family characteristics have had an important effect on total labor activity. Similiarly, a great deal of inter-year variation was shown with respect to the labor activity of different labor types and in the seasonal distribution of labor. Obviously, these findings cannot be generalized to the population as a whole due to the small sample size studied and due to the large within sample variation that existed among the farmers. However, the conclusions reached do raise some doubt as to the validity of using one-year survey results to represent the activities in other years.

The results of the regression analysis indicated that land and family characteristics were the major determinants of total labor activity on the farm. The inter-cropping index was also found to be an important determinant of total labor activity indicating that total labor increases with a greater emphasis on mixed cropping. Neither the dummy variables for years or annual precipitation explained a significant portion of total variation in annual total hours over the years. However, at least with regards to the precipitation figures that were used, it is doubtful whether they accurately measured the complex rainfall-labor relationships that exist.

CHAPTER 7

SUMMARY AND CONCLUSIONS

The previous chapters have covered a broad range of topics concerning the labor activities of small farmers in West Africa. The subject matter has been made intentionally broad in order that the labor decisions of the small farmer be placed in perspective of the complex enviroment he operates in. An attempt has been made to tie together in an integral way the numerous theories that have been put forward to explain the labor allocations of the small farmer. Attention was given to those factors which determine the use of labor, the incentives and opportunities which are able to encourage the application of labor as well as the constraints which restrain further labor use.

In accordance with the above, the previous chapters have emphasized the importance of differentiating between different distributions in society. Differences between various economic and social groups have been highlighted and the labor activities of more favored groups were found to be markedly different from that of less fortunate farmers.

An analysis was made of the extent to which labor is seasonally distributed during the year and discussion was devoted to the peak and slack period labor problems that result. Monthly versus weekly comparisons were made of peak period labor flows in order to study the effect of using different aggregation periods to measure peak period labor constraints.

In addition, time series data for a small sample of farmers was used to study the inter-annual variations that occur with respect to the seasonal distribution of labor.

The time-series data for the small sample of farmers were also used to study the inter-annual variations in annual labor flows. The actual variations that occur from year to year and a comparison between an overall average year study and a single year study were used to draw conclusions regarding the representativeness of single year surveys in general. Finally, regression analysis was used to study the major determinants of labor activity on the farm.

A summary of the more important findings of the literature review and the empirical analysis are discussed below.

1) The labor intensity of family workers depends to a considerable extent on the size, age and sex composition of the family. Total labor activity is positively associated with family size, but labor intensity per worker depends on the size and productive capacity of the work force, the extent of consumption demands, the utility preference for goods and services income, the opportunity structures for outside employment and various other factors which influence the productivity of farm labor.
2) Work on the farm is differentiated by the type of task performed and the type of crop worked on for different age-sex groups in the household. The nature of farm work differentiation was found to vary from season to season, from society to society and for different social and economic groups within a society. It was postulated that the divisions of labor between different age-sex groups could restrict the

potential flow of labor during critical labor periods. However, evidence was presented to indicate that the traditional division of labor can break down as the need or incentive arises.

3) Certain problems were encountered in trying to measure the labor flows of different types of labor on the farm. In general, most researchers believe that productivity differences exist between different age-sex groups within the family and these differences in productivity vary according to the type of operation performed. Differences in productivity were also found to exist between different non-family labor types (i.e. daily hired labor, contract labor and communal labor). Subsequently, problems are incurred when making inter-farm comparisons due to productivity differences implicit in each household's labor flow.

4) In a traditional economy, the quantity of land controlled by the household in relation to the size of the work force affects the amount of time worked per unit of land cultivated. Farm labor, in general, is positively associated with the number of hectares cultivated, but the amount of time worked per cultivated hectare generally declines as land availability increases. Conversely, farmers tend to apply more labor per cultivated hectare as land becomes more limiting. This relationship tends to weaken, however, as the transition is made from a traditional agriculture to a more dynamic agriculture.

5) Increasing labor inputs alone to compensate for declining land availability eventually leads to a low marginal value product of labor and a low level state of equilibrium. This equilibrium is characterized by a declining level of income per resident in the household. However,

the use of land-improving inputs can complement labor by raising the marginal value product of labor and thus provide incentive for even greater labor applications.

6) The increase in use of traditional and modern land-improving technologies was found to result in greater applications of labor being made per unit of land. The availability of financial resources to purchase such inputs as organic and inorganic fertilizers resulted in the finding of a positive relationship between income status and labor input per cultivated hectare. Non-family labor per cultivated hectare was also found to be positively associated with income status and high political and social position was found to be an important means for acquiring communal types of labor.

7) The introduction of draft power and suitable land preparation equipment can be important in alleviating planting labor constraints. However, the expanded acreage that can take place at planting and the lack of suitable weeding equipment can aggravate the existing weeding labor bottlenecks. The harvesting labor peak may also increase due to the greater productivity of draft farming.

8) Though the utility preference for goods and services should theoretically be higher for the farmer with lower income status or lower land availability, the labor activity per worker is often observed to be lower. This can be attributed to such factors as the lack of off-farm opportunities, low levels of marginal productivity for farm labor, insufficient cash resources to purchase land improving inputs, nutritional deficiencies, etc.

9) The seasonal nature of labor on the farm creates two of the most

critical problems facing West African agriculture. One is the peak period labor constraints occurring at weeding and ridging time. The other is the prospect of considerable labor underemployment during the off-periods of agricultural activity and the need to supplement farm labor with off-farm employment during the off-season.

10) Farmers were found to work more time during the peak month, but the work intensity per male adult averaged around only 4 to 6 hours per day worked. However, in view of the subsistence nature of the small farm enterprise and the broad range of production and consumption activities the family engages in, this level of work intensity could be quite constraining. This is especially so in view of the arduous character of weeding and ridging activities and due to poor nutritional levels resulting from the presence of the hungry-gap period.

11) The use of weekly aggregation periods showed very little variance in family labor from week to week during the peak month. However, with regards to total labor, the labor activity in certain weeks of the peak month was more than 30 hours greater than in other weeks of the peak month. The difference came about due to the increase in non-family labor contribution.

12) One factor which complicates the peak period labor constraints is the inter-annual variations in labor activity that occur. The amount of time worked during the peak month was found to vary greatly over the years suggesting that the peak period labor constraints are more severe in some years than in other years. Likewise, the seasonal distribution of labor was found to change dramatically over the years.

13) The amount and timing of rainfall distribution was studied in order

to examine its influence on the inter-annual variations in total annual labor and the seasonal distribution of labor. Total annual rainfall was found to have a positive influence on total annual farm labor activity, though the relationship was not a strong one. The amount and timing of rainfall during the year was also found to have a significant influence on the farm's weeding labor activity.

14) Substantial inter-farm variations were observed with respect to land and labor characteristics for the small sample of farmers studied. In the case of male adult hours a significant downward trend was found to have occurred over the years. It was hypothesized that this was due to greater involvement in off-farm occupations, but this could not be substantiated due to the lack of off-farm data. In view of the magnitude of these variations, some doubt arises as to how representative one year's survey results are to the activities of other years. This view is supported by the differences that were found to exist between the overall small sample study and the 1966 small sample study.

The research findings presented in this paper have important implications for the design and implementation of development strategies. Too often the labor component is overlooked or underestimated in experimental work and the introduction of new technologies oftentimes fail to consider the impacts on seasonal labor flows. Relevant technologies need to be developed with cognizance of the labor constraints that exist. The introduction of new crop varieties and recommended changes in cropping patterns need to be evaluated in terms of the adjustments in labor flows that result. If the

labor flow adjustments require greater labor demands from family members during peak labor periods then their acceptance is likely to be less than successful. However, if the labor adjustments result in a more even flow of labor during the wet season then potential family labor can be more productively employed.

Similiarly, the introduction of modern land-improving inputs requires an added labor input on the farm. If such inputs increase the severity of peak labor bottlenecks then important weeding and ridging operations may suffer with a subsequent depressing effect on yields. Appropriate technologies which increase the productivity of labor at weeding and ridging times would be instrumental in alleviating peak period labor constraints as well as improve the acceptance of new cropping patterns and land improving inputs. Greater focus also needs to be given to the constraints that prevent the smallholder from acquiring or using new technologies. This may require the design and implementation of improved input distributional systems, improving access to credit and placing greater emphasis on extension services and farmer education.

Above all, a more holistic approach needs to be taken by researchers and development planners in the study of the small farm system and in the policy decisions that are made. One element of the farming system cannot be viewed separately of other elements or of the operation of the farming system as a whole. This suggests both the need for development strategies which are compatible with the complex workings of the farming system as well as an understanding of the complex enviroment the small farmer operates in.

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THE SIGNIFICANCE, VARIABILITY AND DETERMINANTS OF LABOR IN WEST AFRICAN SMALL FARM SYSTEMS: A CASE STUDY OF EIGHT ZARIA FARMERS

by

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Labor is one of the most important yet one of the least understood components of the traditional small farm system. The hand labor orientation of the small farm enterprise highlights the crucial role that labor plays in farm activities. Given a constant state of technology, agricultural production can be directly increased through more liberal use of labor in planting, cultivation and harvesting and the embodiment of labor in capital improvements can indirectly benefit farm production. In the shift from a traditional agriculture to a dynamic agriculture, labor becomes of critical importance since the use of technological inputs generally reguires added labor input (assuming a constant power base). However, considering labor's importance on the small farm, the nature of smallholder labor activity is far from clearly understood. Too little is known of the specific forces which influence smallholder labor activity or of the reasons for the specific labor allocations that are made on the small farm.

The purpose of this paper is to analyze the labor activities of small farmers in West Africa, particularly the Hausa areas of northern Nigeria. The study consists of a literature review of various labor studies performed throughout West Africa as well as an empirical analysis of the labor activities of a small sample of Zaria farmers over time. The analysis of the small farm's labor flows is a very complicated procedure. Problems arise in trying to measure the flow of labor, adjusting for productivity differences among different types of labor and special analytical problems are associated with analyzing the flow of labor.

The literature review is primarily concerned with the analysis of the complex set of factors which influence labor usage on the small farm. The study includes an analysis of the factor-factor relationships that exist

between labor and other factors of production, the influence of varying incentives and opportunities on the application of labor and a discussion of constraints which restrain the small farmer's labor activity. The results of the analysis indicate that different economic and social groups in society possess markedly different labor profiles. The differences were attributed to varying levels of resource base, social status, opportunities for off-farm employment and special constraints which affect the labor activities of the less fortunate farmers in society. Similiarly, the results of a small sample labor survey indicates that substantial inter-farm variations in land, labor and family characteristics were apparent.

A most serious problem facing West African small farmers is the seasonality of agriculture and the labor problems that result. Labor constraints are incurred during the peak labor periods while farmers face the prospect of considerable underemployment during the off-season of the year. Complicating this problem is the inter-annual variation that occurs with respect to the seasonal distribution of labor. The analysis of the small sample time series study showed substantial inter-annual variations in peak month male adult labor activity. A comparison was made between the use of weekly and monthly aggregation periods to examine peak period labor flows. The results showed that very little variance occurred in male adult labor activity from week to week during the peak month, though substantial variances were observed in non-family labor use.

Substantial inter-annual variations were observed with respect to land and family characteristics and annual labor flows for the small sample of farmers studied. These results shed some doubt on the use of a single year's survey results to represent the activities of other years. This

conclusion is supported by the differences that were found to exist between a small sample single year survey and the overall average of a small sample multi-year study.