Everett

Republic of Cameroon

Ministry of Higher Education and Scientific Research
– M E S R E S –

Institute of Agronomic Research
– I R A –

National Cereals Research and Extension Project
– N C R E –

Testing and Liaison Unit
– T L U –

MAIZE–BASED CROPPING SYSTEMS IN THE NDOP PLAIN OF THE NORTH WEST PROVINCE,CAMEROON

– a monitored farm survey, with labor utilization data –

United States Agency for
International Development
USAID

International Institute
of Tropical Agriculture
IITA

Prepared by:
Dermot McHugh

IRA – Bambui
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Mr. Joseph Tiatorh Mofor	VEW	"
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Mr. Dickson Guayama	VEW (ATA)	"
Miss Ngwenifor Anna	VEW	"
Mr. Ngofon Andrew Makaping	CAP	Bangolan
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Miss Zekeng Pauline	agronomist	IRA-Bambui
Mr. Jonathan Tame	economist	MIDENO/PEM
Dr. Animesh Roy	agronomist	IRA-Dschang
Dr. J. Kikafunda-Twine	agronomist	IRA-Bambui
Mr. Ngoko Zachée	pathologist	IRA-Bambui
Mr. Asanga Cletus	entomologist	IRA-Dschang
Dr. Tambi Emmanuel	economist	IRZ-Bambui
Mr. Njoh Chrysanthus	entomologist	doctoral candidate
Mr. Samatana Marc	economist	IRA-Bambui
Mr. Meppe François	agronomist	IRA-Bambui

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Mr. Che Godlove Nji	Kedjom-Ketinguh
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Dermot McHugh
Bambui, 1988

Table of Contents

Preface

The Testing and Liaison Unit (TLU) is the farming systems research and pre-extension component of the National Cereals Research and Extension (NCRE) Project, responsible for carrying out farmer surveys and on-farm experiments; and ultimately generating farmer recommendations. Four TLU's have thus far been established in Cameroon, with regional responsibilities for the northern savannah, central-south forest, coastal forest and mid-altitude zones, respectively.

The original TLU at Bambui has been working in the western highlands since 1981. By the end of the first phase of the NCRE project, the TLU had tested and identified new maize varieties adapted to farming systems in many of the sub-zones (recommendation domains) in the region, and defined fertilizer recommendations suitable for the commonly found maize-groundnuts and maize/beans intercrops.

In the terms of reference (Project Paper/Contract), the TLU economist was made responsible for completing economic analyses of existing farming systems and of potential technology interventions, including the collection of data on labor utilization. In 1987, the TLU initiated a year-long farm monitoring survey of maize-based cropping systems in the Ndop Plain, for the express purpose of obtaining labor use data.

The following is a report of the results of that study.

Chapter 1

Introduction

Maize (Zea mays, L.) is the most important cereal crop in Cameroon and the staple food crop in the western highlands (North West and West Provinces), where more than 70% of the maize in Cameroon (total annual production = 500,000 tonnes) is grown [Ayuk-Takem, 1981]. The most common use of maize is in "corn fufu", a starchy paste eaten with vegetables or a sauce. Other uses include "corn chaff" (fried maize & beans), corn beer, "corn korky" (a type of maize pudding, often made with dried fish) and limited use as animal feed.

Almost without exception, maize is intercropped with other food crops (including grain legumes and root crops), and not infrequently with cash crops (coffee). It is typically grown in scattered small fields (under 1 hectare), on ridges, and using intensive manual labor. In a yield-cut survey in 1983, MIDENO[1] estimated mean maize grain yields for the North West Province at 1.8 tonnes per hectare.

Originally a subsistence crop, maize has assumed an increasingly important role as a supplementary cash crop, with excess production sold piece-meal over the course of the year to meet small cash expenditure needs such as school fees and health care costs. With this latter development, men are showing more interest in maize cultivation, which traditionally had been strictly a woman's occupation.

At present, there are a number of improved (open pollinated)

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[1] North West Development Authority, an integrated rural development project, funded in part by IFAD.

maize varieties developed by IRA[@] and made available to farmers by MIDENO in the North West Province (since 1983) and UCCAO[@] in the West Province (since the 1970's). Nevertheless, the majority of farmers still use "local" varieties. Time will certainly increase the percentage of farmers using improved varieties. However, there are still significant problems to be resolved by researchers in the areas of varietal improvement (e.g., developing varieties with flintier grain for better storage and shorter cycle varieties) and agronomy (soil erosion control, long term soil fertility management and management of problem soils).

Objectives of the study

The specific objectives of this survey were:

1. To describe maize-based cropping systems in the Ndop Plain.
   a) Physical and biological environment
   b) Farmers' cultural practices
   c) Factor inputs, with special emphasis on labor utilization
   d) Productivity of the system
2. To identify constraints to increasing the productivity of the maize-based cropping system.
   a) Low genetic yield potential
   b) Pests
   c) Soil fertility and erosion problems
   d) Weed control

[@] National Institute of Agronomic Research.

[@] Union Centrale des Coopératives Agricole dans l'Ouest.

3. To define the resources available to the farmer and his/her socio-economic environment.
   a) Farm household
   b) Land tenure
   c) Credit
   d) Costs of production factors
   e) Food crop commodity prices
4. To develop a budget for the maize-based cropping system and estimate farm family income.
   a) Production costs
   b) Gross revenue for the maize-based cropping system
   c) Returns to farmer resources, including farm family labor
   d) Total sales of farm produce

Methodology

The study took the form of a monitored farm survey. Twenty-four (24) farmers were randomly selected from six (6) of the thirteen (13) villages in the Ndop Plain [Appendix B]. A resident enumerator was recruited in each village and charged with collecting data on labor utilization, crop production and farm produce sales from the monitored farms; in addition to recording weekly food crop commodity prices from the village market.

Data was obtained by means of daily visits by the enumerators to the 4 selected farmers in each village, using questionnaires [Appendix A]. One maize field per farm (the "monitored field") was chosen for detailed data collection. The monitored field was measured using the triangulation method

[Appendix C], soil and tissue samples collected for analysis [Appendix D], and cropping pattern (crops, densities, and configurations) noted. The farmer was also interviewed at length about the cropping history and cultural practices of the monitored field.

The Ndop Plain

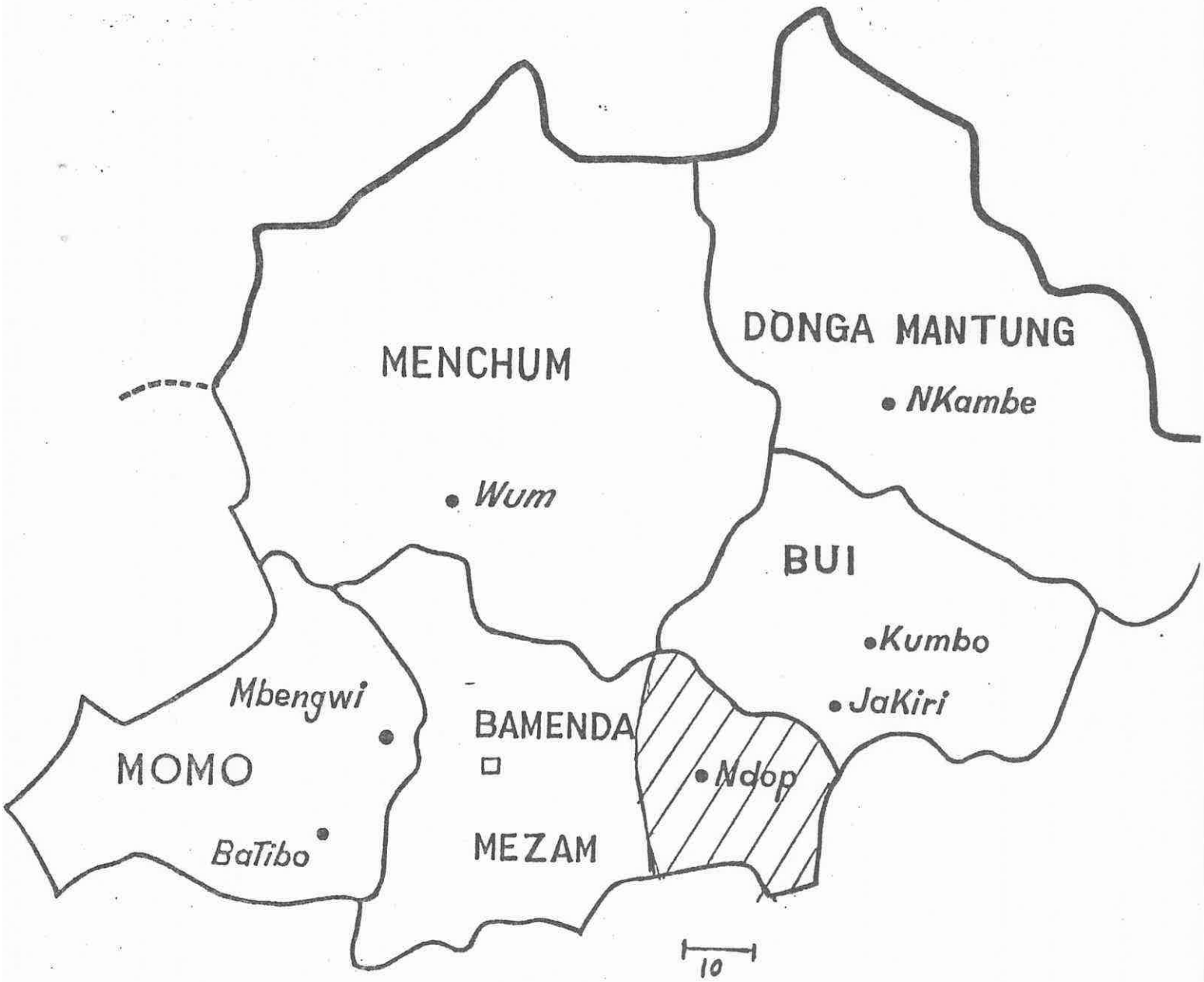
The Ndop Plain is a very fertile valley, lying between 1150 and 1300 meters above sea level (masl), most of which is included within the Ndop Subdivision in the Mezam Division of the North West Province of Cameroon **(map, figure 1)**. The Plain covers an area of 1,117 square kilometers, with population density of almost 100 inhabitants per square kilometer (110,000 total population). The dominant ethnic group is Tikari (80%) [SEDA, 1983].

The thirteen villages, each comprised of between 10 and 15 quarters, are small kingdoms ruled by a "Fon" and a "traditional council". Land is attributed to families, and is clearly demarcated. Free land or land of families without heirs is owned by the Fon. The Fon and traditional council can take land from a family for community use (school, water project, etc.) and compensate the family with other land. Land can be sold by the head of family, with the consent of the traditional council. Pasture land belongs to the Fon, who arranges with the transhumant Fulani herdsmen for use of the pasture during the dry season, sometimes to the detriment of his farming subjects [SEDA, 1983].

Eighty-five percent (85%) of the cultivated land is in food

NORTH WEST PROVINCE

FIGURE 1:



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crops. The mean farm size is 1.5 hectares, and the average family has 6 members, with 3 active in agriculture. Maize, the principle food crop, is almost universally intercropped with groundnuts, cocoyams and/or beans [SEDA, 1983]. The traditional cash crop (arabica coffee) has been somewhat superceded by rice beginning in the mid 1970's, encouraged by the establishment of the rice growing corporation UNVDA[4] [Samatana et al, 1986].

Annual rainfall varies between 1100 and 1800 mm, and temperatures range from 20 to 35°C.

Background information on the 6 study villages was obtained by interviewing "key informants" (chiefs of agricultural post, traditional council members, presidents of credit unions, etc.), and is summarized in Appendix B.

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[4] Upper Noun Valley Development Authority.

Chapter 2

Description of the Maize-Based Cropping System

Cropping Patterns

The following crops are commonly observed in maize fields in the Ndop Plain [Tame et al, 1987; and Prinz, 1984].

Common name	Botanical name
Avocado	Persea americana
Beans	Phaseolus vulgaris
Cassava	Manihot esculenta
Cocoyam/Macabo	Xanthosoma sagittifolium
Cocoyam/Taro	Colocasia esculenta
Coffee	Coffea spp.
Cowpea	Vigna unguiculata
Egusi melon	Citrullus lanatus
Groundnut	Arachis hypogaea
Irish Potato	Solanum tuberosum
Maize	Zea mays
Mango	Mangifera indica
Oil Palm	Elaeis guineensis
Okra	Hibiscus esculentus (Abelmoschus esculentus)
Plantains/Banana	Musa x paradisiaca
Raphia Palm	Raphia hookeri
Soybean	Glycine max
Sweet Potato	Ipomoea batatas
Yam	Dioscorea spp.

Cropping patterns varied considerably across the 24 monitored fields, with an average of 6 crops present in the

sampling quadrants (2 x 20 sq m) on each field. In independent observations on 130 maize fields in the Ndop Plain, the average was even higher (7.4)[Appendix D (III)]. In an attempt to rationalize this complex array of cropping patterns, only those crops present at specified minimum densities were considered as "effective intercrops". Threshold densities used were 10,000/ha for maize, groundnuts, beans, cowpeas, soybeans and okra; and 2,000/ha for cocoyam, yam, cassava, sweet potatoes and egusi melon. The resulting associations are listed in Table 1.1.

Table 1.1: Distribution of crop associations on the monitored fields, including only those crops present at effective densities

Crop association	Number of Fields	(%)
Four crop associations:		[13%]
Maize + Groundnut + Cocoyam* + Egusi	1	(4)
Maize + Groundnut + Bean + Egusi	1	(4)
Maize + Groundnut + Okra + Egusi	1	(4)
Three crop associations:		[39%]
Maize + Groundnut + Cocoyam	4	(17)
Maize + Groundnut + Bean	1	(4)
Maize + Groundnut + Cowpea	1	(4)
Maize + Groundnut + Okra	1	(4)
Maize + Bean + Cocoyam	1	(4)
Maize + Okra + Egusi	1	(4)
Two crop associations:		[35%]
Maize + Groundnut	3	(13)
Maize + Cocoyam	2	(9)
Maize + Bean	2	(9)
Maize + Yam	1	(4)
Sole crops:		[13%]
Maize**	3	(13)

* Colocasia (Taro) and Xanthosoma (Macabo)
** One field was pure maize. Two had other crops at low density.

The apparent diversity of patterns is somewhat misleading; the result of varying combinations of a few crops. Twelve (52 %) of the patterns are combinations of maize, groundnuts and cocoyams. Add beans, and 16 (70%) of the 23 patterns are encompassed.

Cultural practices

Land clearing: Land clearing for maize usually begins in late December or January. The method used varies somewhat from farmer to farmer, with the type of vegetation and the sequence within the rotation. In the first year after fallow, the vegetation is usually cut, stacked and burned. In some cases, the dried vegetation is piled on raised beds, covered with soil and burned (termed "ankara" in the local dialect). In subsequent years, the weed and crop residues are cut, laid in the furrow, and covered with soil when the ridges are formed (i.e., incorporated). Some farmers will burn the vegetation on the surface every year, especially the coarser vegetation that will not decompose quickly (e.g., elephant grass stalks and bushes with woody stems).

Land preparation: As a rule, farmers plant their food crops, including maize, on raised beds or ridges. There is some variation in the configuration of the seed bed (most notably in Babungo, where short, wide, low beds are used; instead of long narrow ridges). The main reason for doing this is apparently to facilitate the incorporation of plant residues, as a part of soil fertility management. The previous year's crop and weed residues are cut and stacked in the furrow. The old ridges are turned

over (actually split down the middle) into the furrows, burying the plant residues, and thereby forming new ridges where the furrows had been. In the case where a late bean crop follows the maize in August/September, the same procedure is repeated twice a year. A variation in the procedure occurs in the first year after bush fallow, when the plant residues are burned rather than incorporated.

Planting: Most farmers plant the local ("country own") variety, whose origin is unknown. Grain color varies from white to yellow, and grain type from flinty to denty. Farmers claim that the yellow maize is sweeter for roasting ears; but white is preferred for "fufu", the most common use. The local variety is low yielding, but appreciated for being early, and often flinty.

In independent interviews, farmers were asked to rank seven characteristics of a maize variety. The characteristics most often indicated as important were: 1) yield; 2) growth cycle (should be early); 3) plant height (short to minimize shading of associated crops and reduce lodging); and, 4) taste **(Table 1.2)**.

Seed selection is done after harvest on stored ears, as the maize is removed for consumption or sale. The larger ears with fat healthy grains are set aside in the "banda" (loft above the kitchen). Planting begins with the first rains. Most farmers identify this time as March 15, although some will plant as early as late February if it rains. Dry seeding of maize (in anticipation of rain) does not seem to be common. Planting continues as late as May, but not into June. Many plant as they prepare their land; and to maximize the area cropped to maize, they start early and continue as long as possible (if they have

Table 1.2: Farmer ranking of the importance of selected maize variety characteristics (n=104)

Characteristic	Mean Ranking	Preferred Characteristic
	(1-7)	
Yield	3.3	-
Growth Cycle	3.5	early = 100%
Plant Height	3.7	short= 70% / tall= 30%
Taste	4.0	-
Disease Resistance	4.1	-
Grain Color	4.2	yellow= 57% / white= 43%
Grain Type	5.2	Flinty= 69% / Denty= 31%

the land). The maize, which is intercropped by virtually all farmers, is planted on ridges, in one or two rows. The other crops in the association are planted within the maize row or in alternate rows. Two to five seeds are placed in each hole (not strictly controlled); and the maize is not thinned except when stands of five or more occur, or when transplanting to neighboring hills lacking plants (due to birds or poor germination).

Mean maize planting density on the monitored fields was 31,100 plants/ha. This compares with a Province wide mean of 22,000 estimated by MIDENO in 1983. Average densities for other crops were: groundnuts (22,200), beans (5,400) and cocoyams (2,900). The mean distance between ridges was 1.5 meters.

Weeding: Weeding is begun at 3 to 4 weeks after planting (April), and continues into June, with most farmers weeding twice. It is done by hand and hoe, mostly by women.

Fertilizer use: A majority of the farmers (75-80%) are not

applying fertilizer to maize [Agricultural Census, 1984] because: 1) it is not available in a timely fashion through the cooperatives, 2) many farmers have no access to it (fertilizer is targeted at particular farmers, e.g. rice farmers; or cash crops, e.g. coffee), 3) the farmer lacks the cash to buy the fertilizer, or 4) she/he is not familiar with its use on maize. Nevertheless, a not inconsiderable number of farmers (particularly rice farmers) apply fertilizer to maize, when and if the fertilizer can be had, and they have the means. Unfortunately these latter conditions are not often met. Those who dc use fertilizer, apply it as a ring application to the growing maize plant at anywhere from three to six weeks after planting. The fertilizer is directed to the maize and not to any of the intercrops. Those who do not use fertilizer depend on organic matter management (incorporation of crop and weed residues) and/or fallowing of the land to maintain soil fertility.

Harvest and storage: Maize is harvested in August in the husk; carried to the house; and packed into the loft above the ceiling of the kitchen ("Banda"). A fire is lit below it to dry the maize. Complete drying takes up to one month, with more or less continuous fire. The husk is left on the maize to: 1) avoid the labor needed to remove it; 2) protect the maize from the blackening effect of the smoke; and, 3) reduce weevil damage. Maize is removed from the "banda", dehusked and shelled, as needed for consumption or sale. Chemical treatment (even nontoxic Actellic 2% powder) is generally not used for want of knowledge of its use, or its nonavailability. In addition,

farmers have expressed doubt as to its safeness, when used on food maize.

Double cropping: Second season cultivation of maize is not practiced because: 1) the incidence of stem borers increases considerably; 2) the first season crop is still in the field as late as mid August; 3) there are labor conflicts with the rice crop that is being transplanted at the same time; and, 4) the potential for cattle damage is much greater.

Intercropping: Groundnuts (Arachis hypogaea) is the most common intercrop with maize in the Ndop Plain. It is present in 2/3 of the maize fields [Appendix D (III)]. It is grown for consumption (in soups, as a paste called "Mboh", and as nuts) and sale. The most serious pests are Rosette and animals (bush fowl, rats, monkeys, etc.). Groundnuts are planted with, and harvested just after the maize. They yield very little in this zone (less than half a tonne) because of low temperatures, high humidity, reduced sunshine hours during the rainy season, and shading by the maize. The improved varieties of maize are generally taller, and shade the groundnuts even more. Groundnuts do not respond to nitrogen fertilizer [NCRE, 1982-86].

Cocoyam (Colocasia esculenta and Xanthosoma sagittifolium) is a very distant second in staple food-preference to fufu corn (eaten as "achu" or "Kwa": pounded cocoyam). Nevertheless, both Colocasia (Taro/"Ibo"/"Mommy Coco") and Macabo (Cocoyam) are commonly intercropped with maize (present in 65% of maize intercrops). They are planted with maize at the beginning of the rains, and harvested after maize, right up to the beginning of the next cropping season. They thrive on fertile soil and are

often planted at the beginning of a rotation, following a bush fallow. Cocoyams also do well on "ankara" (burned) ridges, along with egusi melon. An obvious problem is the need for large quantities of seed material, characteristic of root crops, for which the yield to seed ratio can be as low as 5:1, compared with more than 100:1 for maize.

Province-wide, beans (Phaseolus vulgaris) are the most common intercrop with maize. However, in Ndop and at lower elevations, groundnuts are more frequently seen. Nevertheless, beans are still quite common (present in half of the observed maize fields) and play an important role in the local diet. Both bush (determinate) and pole or climbing (indeterminate) beans are observed. The bush bean is preferred, having larger beans. The climbing bean has small seeds, but continues to yield over a longer period, and thus yields more. It wraps itself around the maize plant, using it as a support. Beans are always eaten with another starch such as plantains, sweet potatoes or rice; and might thus be considered a vegetable or relish. They are planted along with maize in March, and harvested in June (the first crop to come out of the field). Because of its precocity, beans are less adversely affected than groundnuts by the shading of maize. Beans prefer a fertile soil, with high organic matter content and a fine texture. In most cases, you either find beans or groundnuts in a maize field, and not both. This is because beans do well where groundnuts don't, and vice versa. Bean yields are generally low (under 500 kg/ha in association with maize).

Cowpeas (Vigna unguiculata) are observed in many maize fields, but at very low densities, and frequently only on part of

the field. The leaves are used in soups (both fresh and dried). The beans are used to make "corky" (a pudding, often made with dried fish). The cropping cycle is similar to that of beans.

Cassava (Manihot esculenta) is more common in some villages than others, especially in the areas with poorer soils. It is a secondary food, either eaten when more preferred foods (maize and cocoyam) are not available; or to provide occasional variety in the diet. It is eaten as "gari" (grated, and fried; after which it is used to prepare a fufu-like starchy food to eat with okra soup); Cassava-fufu (dried and ground to a flour, and prepared like corn fufu); or, roasted. Some is sold in the market, usually as gari. Farmers in the Plain identify 4 varieties: 1) "Timber" (a 2-3 year type with a large thick stem and very large tubers); 2) "Senegal" (a 6 month to 1 year variety that produces many small tubers); 3) "Local Yellow or Red" (best tasting, but with poor cooking quality); and, 4) "Local White" (good for gari, but not for roasting). Cassava was present in 32% of maize fields. It is planted with the maize, but stays in the field for between 1 and 3 years, with maize being planted around it each year.

Intercrops are not generally planted uniformly over the entire field. Although one or two crops (e.g., maize and groundnuts) may be present throughout field, other crops are likely to be found only on parts of the field. Reasons for this heterogeneity in planting pattern include:

1) variations in natural fertility across the field (beans on more fertile parts, groundnuts on less fertile parts);

2) differences in soil or crop/weed residue management (cocoyam and egusi on "ankara ridges");

3) insufficient seed to plant the whole field;

4) limited need for the produce (e.g., pumpkin); and,

5) fears of crop failure (cowpeas are prone to crop failure from disease and insect pests).

Crop rotation: Various factors are considered by farmers when determining what crops to plant in a particular field: 1) Native vegetation (spear grass, Imperata cylindrica, indicates groundnuts will do well and elephant grass indicates maize.); 2) Soil fertility, organic matter content and soil texture (Beans do well on fertile, loamy soils with high organic matter, whereas groundnuts prefer a sandy less fertile soil); 3) Position in the rotation (Cocoyams, okra and beans, with maize, are planted early in the rotation, right after the fallow period. Maize and groundnuts are planted at the end, just before fallow); 4) Location in the village (Cassava is not grown in areas where goats and cattle are free to roam during the dry season).

The cropping pattern sequence varies considerably from farmer to farmer. Some farmers crop the land continuously, growing the same association year after year. This might be considered a variation on monocropping, where an intercrop (e.g., maize-groundnuts) replaces a sole crop. Others plant the same association for several years, followed by one or two years of bush fallow. Still others vary the association throughout the rotation putting crops more demanding of fertile soils (e.g., beans, okra and cocoyams) immediately after the bush fallow, and

less demanding crops (e.g., groundnuts) toward the end of the rotation. The length of the rotation also differs from village to village and farm to farm, largely in response to soil fertility conditions. The following are a few examples of the crop-fallow rotations reported in the Plain:

Crop (3 years) ---> Bush Fallow (1 year)

Crop (5 years) ---> Bush Fallow (1-2 years)

Crop (10 years) ---> Bush Fallow (1-3 years)

Continuous Cropping

Maize problems: In the opinion of farmers, the most important maize pests are weevils and rats in storage, and birds and stem borers in the field. Other pests include: goats, pigs, cattle (in dry season), cane rats and monkeys. Farmers are apparently not as aware of disease and its effects on maize yields, as of insect and animal losses for which the cause, if not the solution, is so evident.

Birds pick the seeds and young seedlings as they emerge, often reducing maize stands significantly. Farmers have little recourse. But the following strategies have been reported: 1) spreading wood ash over the maize pockets (repels birds; but requires too much labor and ashes to be practicable on the whole farm); 2) use of audio cassette tapes, where the tape is stretched around the field (the tape twists and vibrates in the wind reflecting light and producing a humming sound that startles the birds; more commonly used in rice); 3) Scaring, usually by children (also more common in rice); 4) Use of scare crows (human shapes or pieces of various materials that flap in the wind); and, 5) Transplanting maize from other hills having a

surplus of plants (or from a maize nursery).

When asked what their most serious maize problem is, almost all farmers say storage weevils. The only control method used is storing the maize in the husk. Few use chemicals. However, it is commonly believed that maize with flinty grains will store longer than denty maize. Therefore, flinty varieties are preferred **(Table 1.2)**. (Tame et al, 1987)

Rainfall

Average rainfall at Babungo in the center of the Ndop Plain, recorded since 1976, is 1600 mm, distributed over 8 months from March to October, with a single peak in July-September. In 1987, the rains came as usual in mid-March. But after two weeks, they ceased. April was almost completely dry in most villages. With the return of the rains in May, most crops, including maize, recovered. Groundnuts, however, never fully recovered, and yields were down significantly from previous years.

Agricultural posts in 4 of the study villages recorded daily precipitation **(figure 2)**. The drought in April not only retarded the growth of the crops, but also weed growth. Therefore, there was a shift in the timing of weeding; as well as fertilizer application for those who used fertilizer. Rainfall was heavy from June through September, and total precipitation was close to the normal annual level. Harvest dates were little affected.

Soils

Four major soil classes have been identified in the principally colluvial and alluvial soils of the Plain (SEDA,

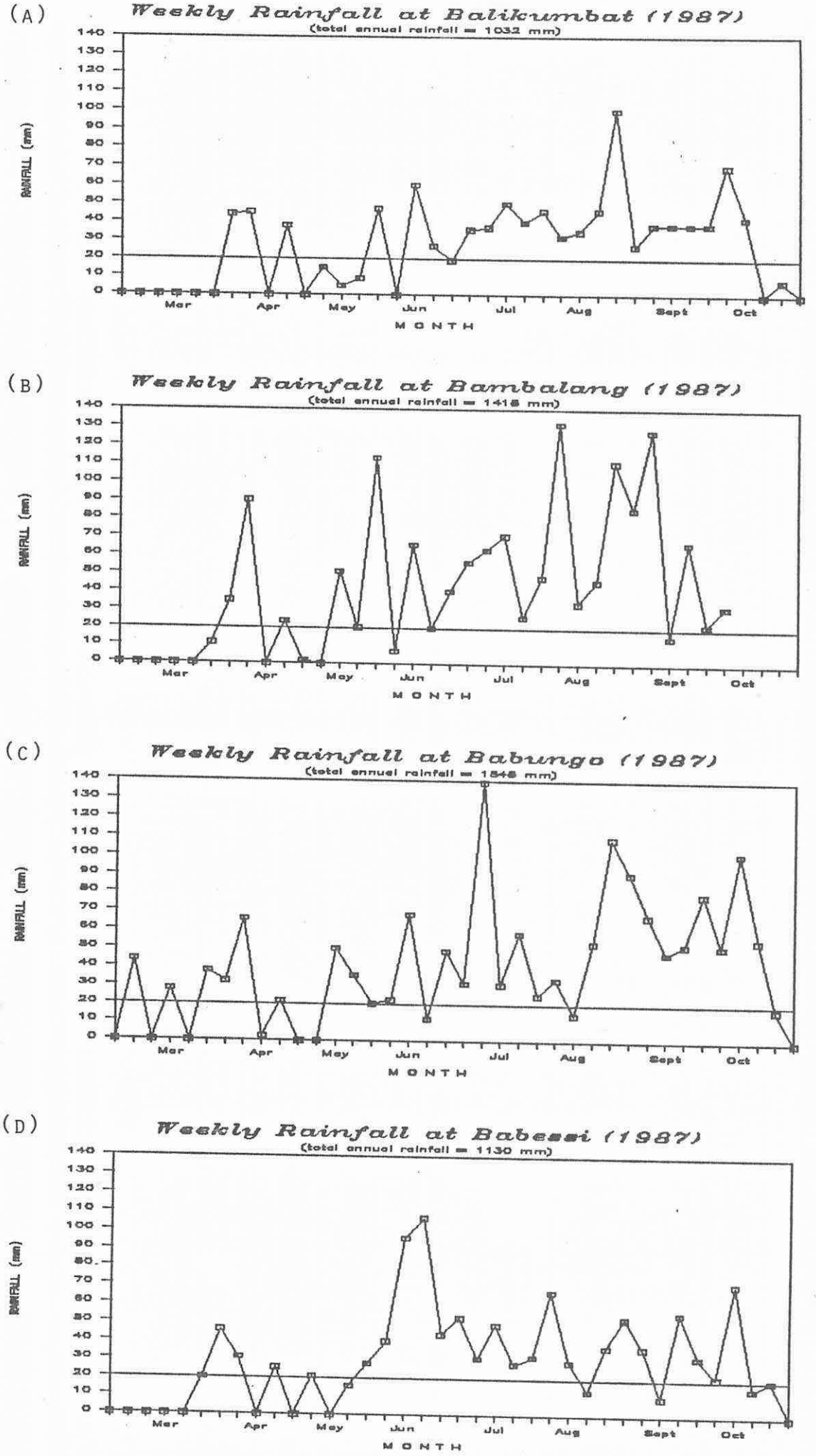

FIGURE 2: RAINFALL IN THE NDOP PLAIN (1987)

1983]. These soils are among the most fertile and productive in the Western highlands of Cameroon. Yields from TLU on-farm maize trials in Ndop have been consistently higher than those in any other zone in the North West and West Provinces over a 6 year period.

Soil samples were taken from the selected maize fields on the 24 monitored farms for chemical analysis at the National Soils Centre at IRA-Ekona, and physical analysis at the NCRE soils laboratory at IRA-Dschang* [Appendix D (I)].

The sampled soils were sandy-clay loams with a mean cation exchange capacity (CEC) of 20 meq/100g, and a pH range of 5.2 to 6.3. Mean organic carbon content was 4.6%, and available phosphorus a very high 17 ppm (Bray-2). The high phosphorus status has been confirmed in on-farm fertilizer response trials by the TLU.

The soil analyses were complemented by analysis of maize tissue samples, taken at 6 weeks after planting on the same fields, and sent to the National Soils Centre [Appendix D (II)]

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* Set up and operated by the NCRE rice agronomist, Dr. A. Roy.

Chapter 3

Labor Utilization

In manual foodcrop production systems characteristic of most developing countries, labor dominates production costs (as much as 80% of total costs). However, it has been difficult to quantify, if not qualify, labor utilization in such systems. A number of approaches have been proposed and used, each having its advantages and drawbacks. Generally, the more accurate the method, the costlier it is.

Ideally, the farmer can be timed in an unobtrusive manner, while carrying out operations on the farm. Too costly! Researchers turned to methods dependent on farmer recall [Ay et al, 1986]. Of course, the sooner the farmer is interviewed after the actual work is done, the more credible the data. Alternatively, a low cost method, using farmer comparisons of the relative labor requirements of a target crop with those of two crops of known labor requirements, was described by Knipscheer [1981].

In the present study, the farmers were interviewed daily, upon their return from the fields in the evening, using standard questionnaires [Appendix tables A(II) - A(V)]. The farmer was asked what farm operations were carried out during the day, by whom, in which fields, the time started, time finished, and the amount of intervening time not worked (resting, eating, etc.). In addition, any harvested produce from the monitored maize field was weighed, and any sales from the farm that day recorded. The considerable data generated (720 "daily labor input report forms"

per month, plus "harvest yield forms" and "proc ce marketing forms") was processed at the end of each month using a computer spread sheet (LOTUS 1-2-3).

The farm family

The monitored farm families had an average of 8 members. Most households were monogamous (mean of 1.3 wives). Four households were lacking husbands (1 unmarried woman, 2 living separately and 1 deceased), leading to possible bias in the estimate of the labor share of men. However, assuming the survey sample is representative of households in the Ndop Plain, the estimates will reflect the true relative labor contribution of men throughout the zone. The mean age for the monitored farmers was 41.4 years, and mean education 1.2 years (primary school).

Available weekly family labor per household was computed as follows:

adults (15 years and above): 40 man-hours/week

children: 20 working-hours/week x 0.5 man-hour/working-hour= 10 man-hours/week

Accordingly, the mean available family labor per monitored farm household was 183 man-hours/week.

Other sources of labor

Besides family labor, farmers in Ndop plain, as in most of the North West Province, depend on farmers' cooperative labor groups (67% of monitored farmers) and hired labor (88%). Farmer work groups vary in size from 2 to 20. They are usually comprised of women, although there are some men's farming groups.

They are never mixed.

Labor distribution by farm operation

There are seven (7) major field operations for maize-based cropping systems: land clearing, land preparation, planting, weeding, fertilizer application, harvesting and transporting. There are a few minor operations (in the sense that few farmers do them), that are classified under "other operations". These include such activities as: thinning of maize, earthing up of maize (usually combined with weeding), pruning of coffee in the few maize fields with coffee, etc..

Because of the manner in which they are carried out in the Ndop Plain, it was impossible to separate land preparation labor from planting labor, or harvesting labor from labor for transporting of produce from the farm. Therefore, for purposes of labor use data collection, production was divided into six (6) operations.

1. Land clearing;
2. Land preparation (tilling/ridge making) and Planting;
3) Weeding;
4) Fertilizer application;
5) Harvesting and Transporting; and,
6) Other operations.

The average distance from the house to the monitored field was 2.2 km (measured). The labor estimates for field operations do not include traveling (walking) to and from the field; with the exception of transporting produce from the farm, which is included in harvest labor.

Because of a certain amount of flexibility in carrying out field operations (more for some than for others), individual farmers will not necessarily be performing the same operation during the same week. For example, one farmer may weed her maize field in week 1 and not work in the field in week 2; while, a second farmer is working in other fields in week 1 and weeding the maize field in week 2. The mean weeding labor estimate for the two farmers will show that the "average farmer" spreads the weeding labor over two weeks. Thus, mean estimates tend to smooth out the weekly labor trend, and are not necessarily descriptive of how individual farmers actually schedule their labor. Nevertheless, the weekly means are indicative of the general timing of operations, and a good estimate of total labor requirement for each operation.

The mean labor utilization estimates, by operation, are presented in Appendix E(I).

Land clearing: Most of the monitored fields had been cropped in the preceding year. Therefore land clearing entailed cutting of crop residues and standing weeds (mainly grasses). In some cases, clearing was done before data collection commenced (i.e., before 9 February). For others, the residues were few enough to be removed and/or incorporated by hoe during the tilling operation. For the latter, land clearing labor could not be separated from land preparation labor.

To obtain a better estimate of the land clearing labor requirement, a reduced sample (n=17) was used, omitting those farmers for which there was no reported land clearing labor (either carried out before reporting began, or indistinguishable

from land preparation).

Most farmers cleared the land between February and March **(Figure 3, Appendix E(V))**. The mean labor input was 207 man-hours/hectare (median=203). [In a skewed distribution, the median value sometimes serves as a better estimate of the population mean than the sample mean. Therefore, both mean and median estimates will be given in all cases].

Wives contributed most of the labor (45%) for land clearing **(Figure 4, Appendix E(III & IV))**, followed by the husband (25%), children (15%) and other [adult] household members (12%). This is not a typical farming group operation (1%). And few farmers hired labor (2%) to clear their maize farms.

Within limits, the land clearing operation can be assumed to be cropping system independent. The primary determinants of the labor requirement are: composition of the labor force; type and quantity of vegetation to be cleared (trees, brush, herbaceous weeds and crop residues); topography; and, weather. What is to be grown on the cleared field has little or no effect on the land clearing operation. Therefore, these labor estimates can be broadly applied across varying cropping systems, at least within the same zone.

Land preparation and planting: By land preparation is meant tillage of the soil and preparation of the seedbed. The soil is arranged in ridges, on which the crops are planted. This is done with the aid of a short handled hoe with a large rounded blade ("country hoe").

In the Ndop Plain, many, if not most farmers, plant their crops as they make the ridges. The farmer will prepare one or

FIGURE 3: **Land Clearing Labor on Monitored Field**

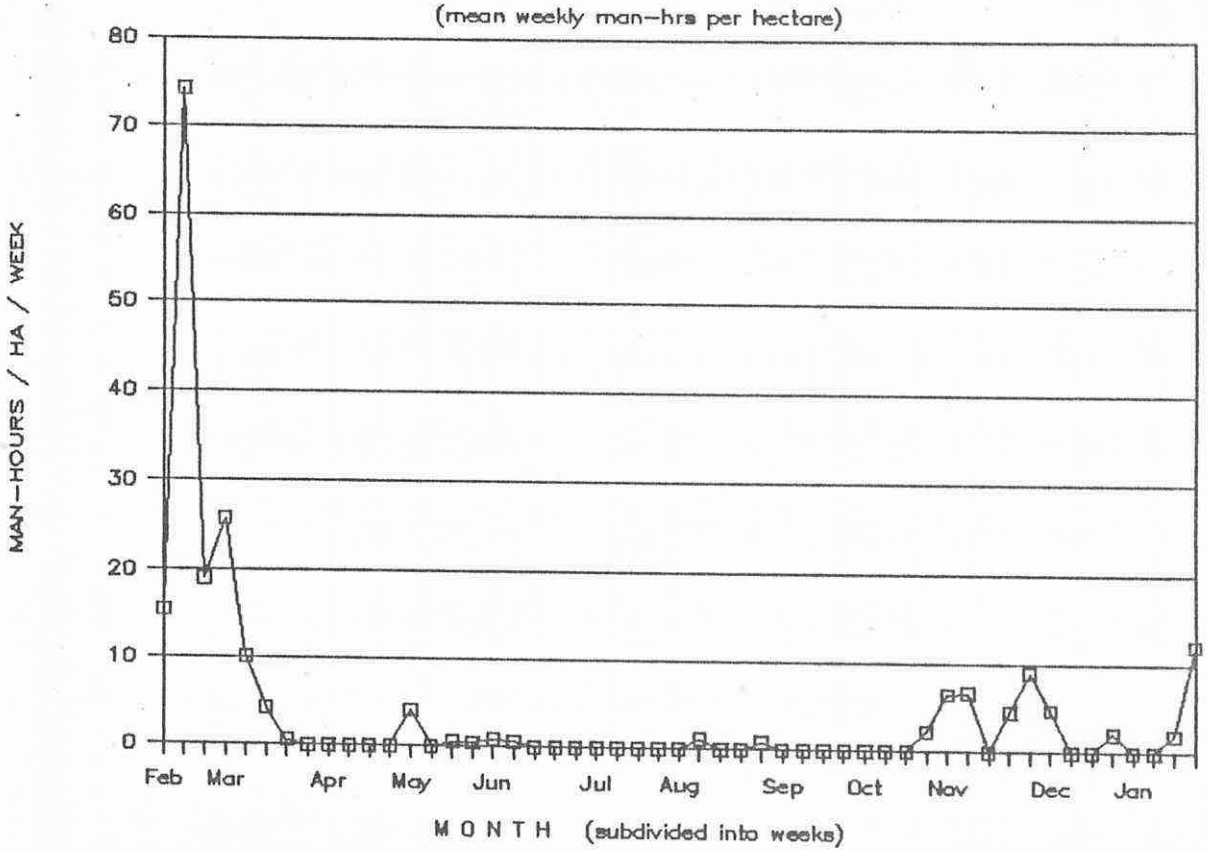
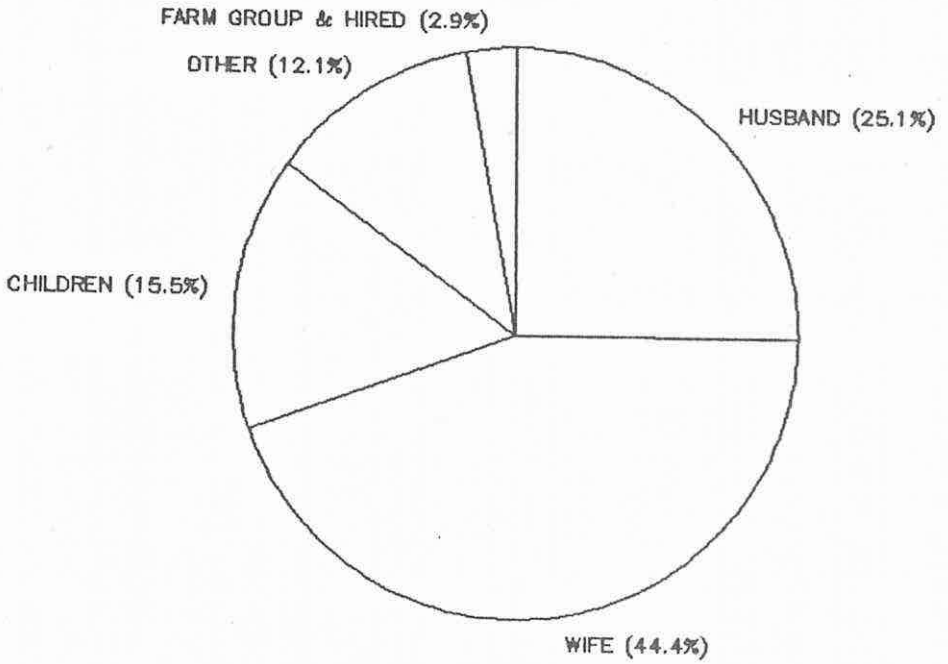


FIGURE 4: **Distribution of Land Clearing Labor**

(by labor class)



two ridges, and then plant them before continuing with ridge making. For this reason, and because of the data collection method, it was impossible to separate labor inputs for land preparation and planting. Therefore, the two operations are treated as one.

Land preparation and planting is the most labor intensive operation of all (mean = 659 man-hours/hectare; median = 548). It begins as early as mid-February, and can continue as late as mid-April **(Figure 5, Appendix E(V))**. There is also some land preparation for the late bean crop in September and October. The reason given by farmers for not preparing the land earlier to avoid a labor bottleneck during planting (say January, as is done in the highland zone in Bui), is that the soil is too hard to work before the first rain falls.

The largest share of the labor input for land preparation and planting is, again, by wives (49%); followed by the husband (18%), children (11%) and hired labor (11%) **(Figure 6, Appendix E(III & IV))**. This is the peak period of labor use during the year for the maize-based cropping system **(Figure 13)**. That is why hired labor is used more for land preparation than for any other operation. Farmer groups (4%) also play a more important role in tilling and planting than at other times of year.

Weeding: Weeding of the maize crop is done twice during the season, on average. It is done by hand and hoe, and is usually combined with earthing up of the maize (i.e., pulling soil up around the base of the maize stalk to provide better support against lodging).

The normal timing of the first weeding is in mid to late

FIGURE 5: **Land Preparation & Planting Labor Input**

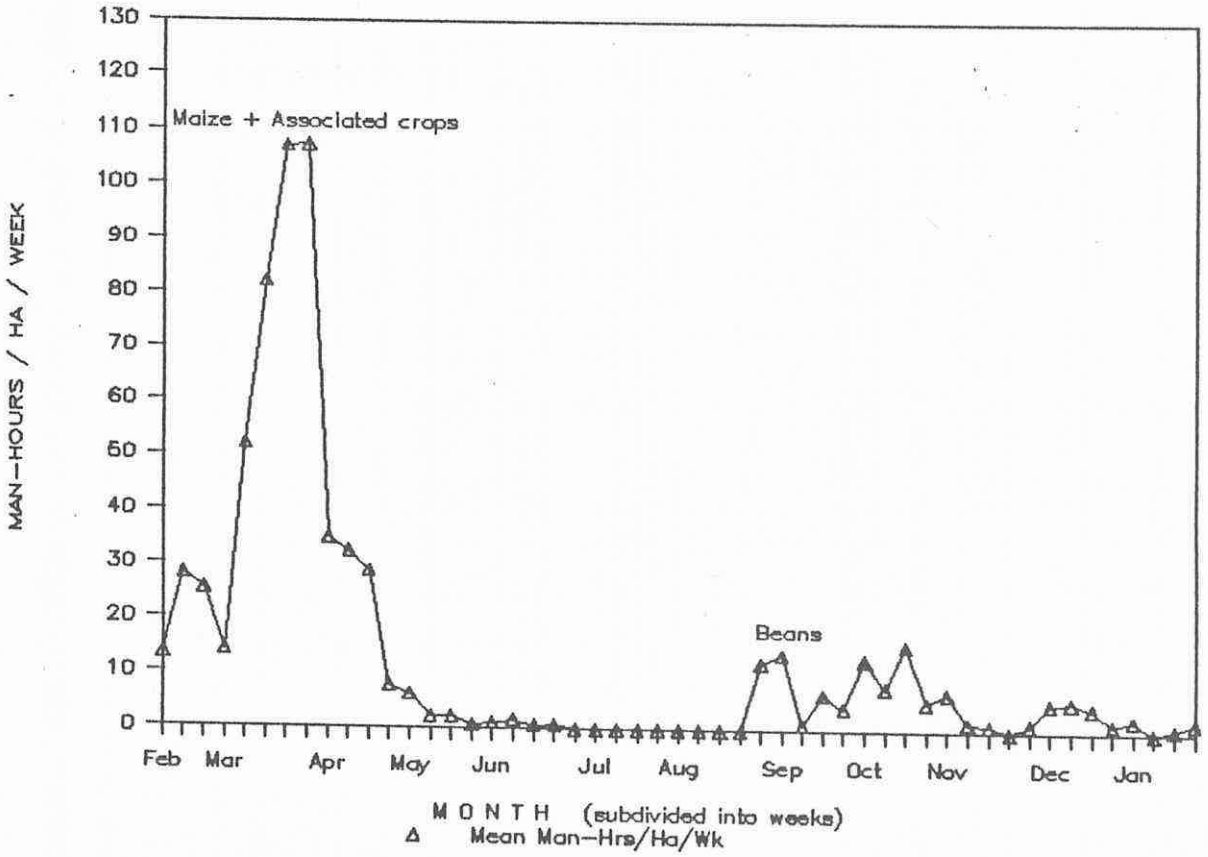
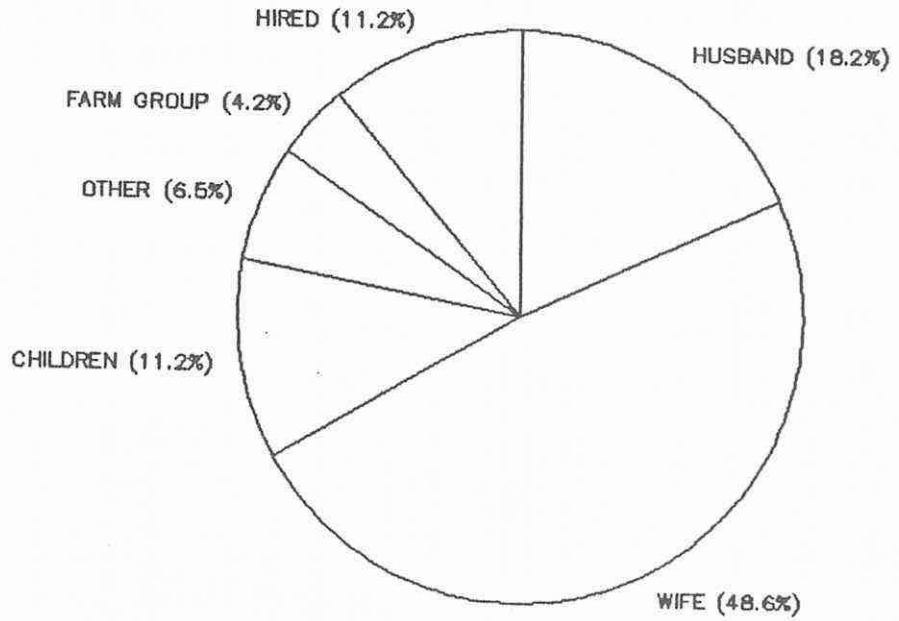


FIGURE 6: **Land Prep & Planting Labor Distribution**

(by labor class)



April, one month after planting. However, with the extended drought in April, weed (and crop) growth was retarded, and the first weeding by most farmers delayed until May **(Figure 7, Appendix E(V))**. The mean total labor requirement for weeding was 513 man-hours/hectare (median = 502). Although weeding has a relatively high labor requirement, flexibility of timing, plus the fact that weeding is commonly done twice, permits farmers to spread out the labor to avoid constraining peaks.

Once more, the labor share for wives was dominant (55%) **(Figure 8, Appendix E(III & IV))**. However, this time children were second (15%), followed by the husband (14%) and other household members (8%). Weeding, along with land preparation and planting, were the activities most commonly carried out by cooperative farming groups (4% of weeding labor). Hired labor (4%) was used less than in the preceding operation, but is still important.

Fertilizer application: Only seven (29%) of the monitored farmers applied fertilizer to the maize on their monitored field. Typically, either 20-10-10 compound fertilizer or ammonium-sulfate (21% N) is applied at the base of the maize stands after the first weeding in late April or early May. However, because of the drought and the delayed first weeding, farmers didn't apply the fertilizer until the maize had fully recovered in late May, one month later than normal.

The fertilizer applied by the seven farmers gave an average rate of 56 kg/ha of nitrogen (N) and 23 kg/ha each of phosphorus (P_2O_5) and potassium (K_2O).

FIGURE 7: **Weeding Labor Input on Monitored Field**

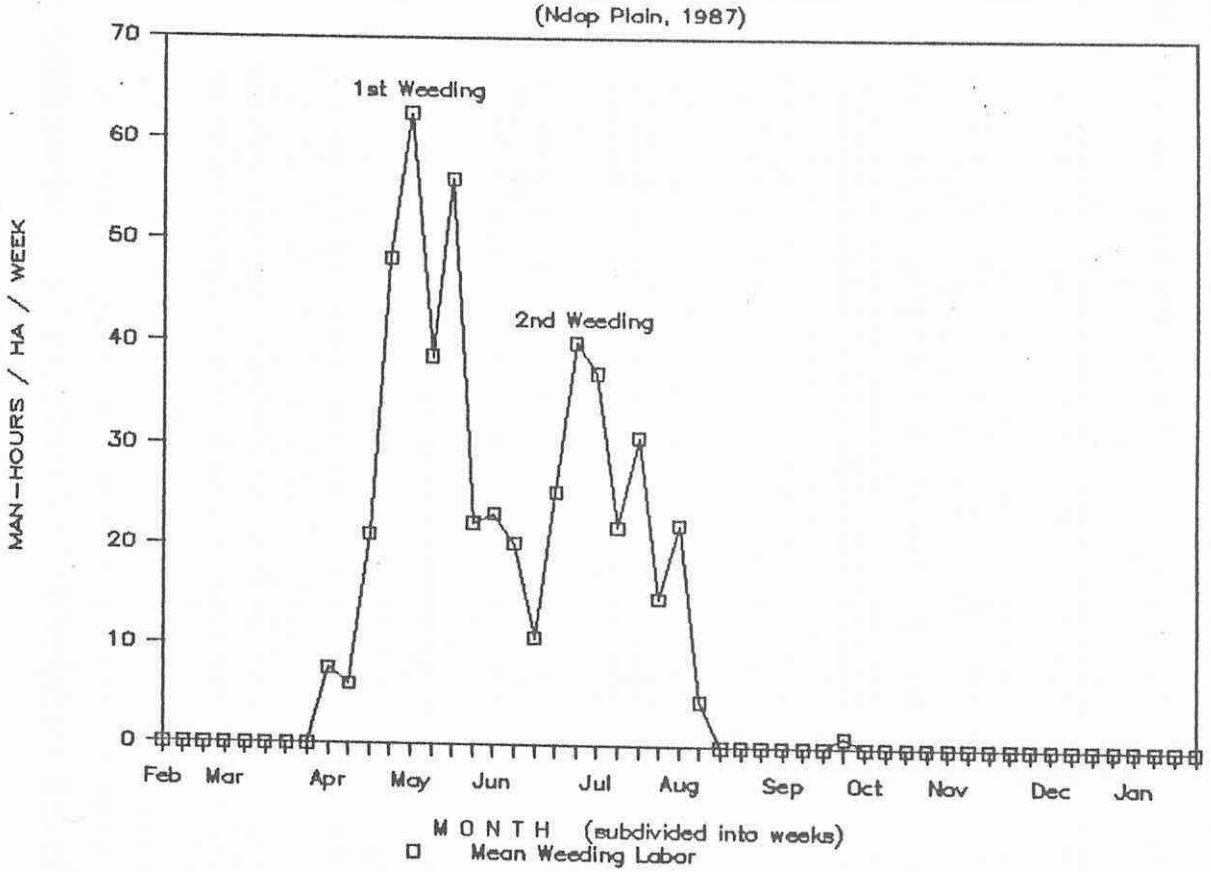
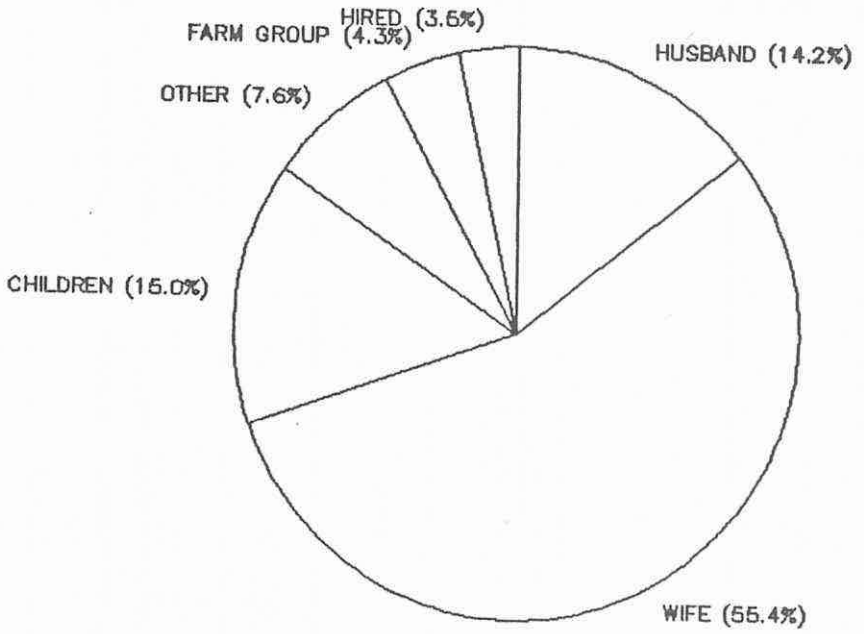


FIGURE 8: **Distribution of Weeding Labor**

(by labor class)



Mean labor utilization for fertilizer application was 24 man-hours/hectare (median = 20) **(Figure 9, Appendix E(V))**. Wives (46%) and children (54%) applied the fertilizer **(Figure 10, Appendix E(III & IV))**.

Harvest and transporting: With the exception of a few ears that are picked green for roasting, most of the maize is harvested dry (at between 20 and 40% grain moisture content). The maize is ready for harvest anywhere from the end of July to the beginning of September **(Figure 11, Appendix E(V))**, depending on the maize variety, the date of planting and the climatic conditions. Groundnuts are harvested just after maize in the Ndop Plain. First season beans are ready in June, and late season beans are harvested in November or December.

Total harvest and transporting (from the field to the house) labor is less than total weeding labor (mean = 342 man-hours/hectare, median = 284). But because of less flexibility in timing, the labor peak was more pronounced **(Figure 13)**. The maize is harvested during the height of the rainy season, when it is particularly vulnerable to lodging and ear rot. In addition, when the harvest is unduly delayed there are mounting risks of damage by animals and birds, and theft of the maize in the field. This leaves a relatively narrow window within which the harvest must be completed (within 2 to 4 weeks of maturity).

Wives continue to dominate the labor share (44%) **(Figure 12, Appendix E(III & IV))**. Children are home from school (holidays), and also play a important role in harvesting the maize and groundnuts (27%). Wives and children, thus, account for nearly 3/4 of the total harvest labor between them.

FIGURE 9:

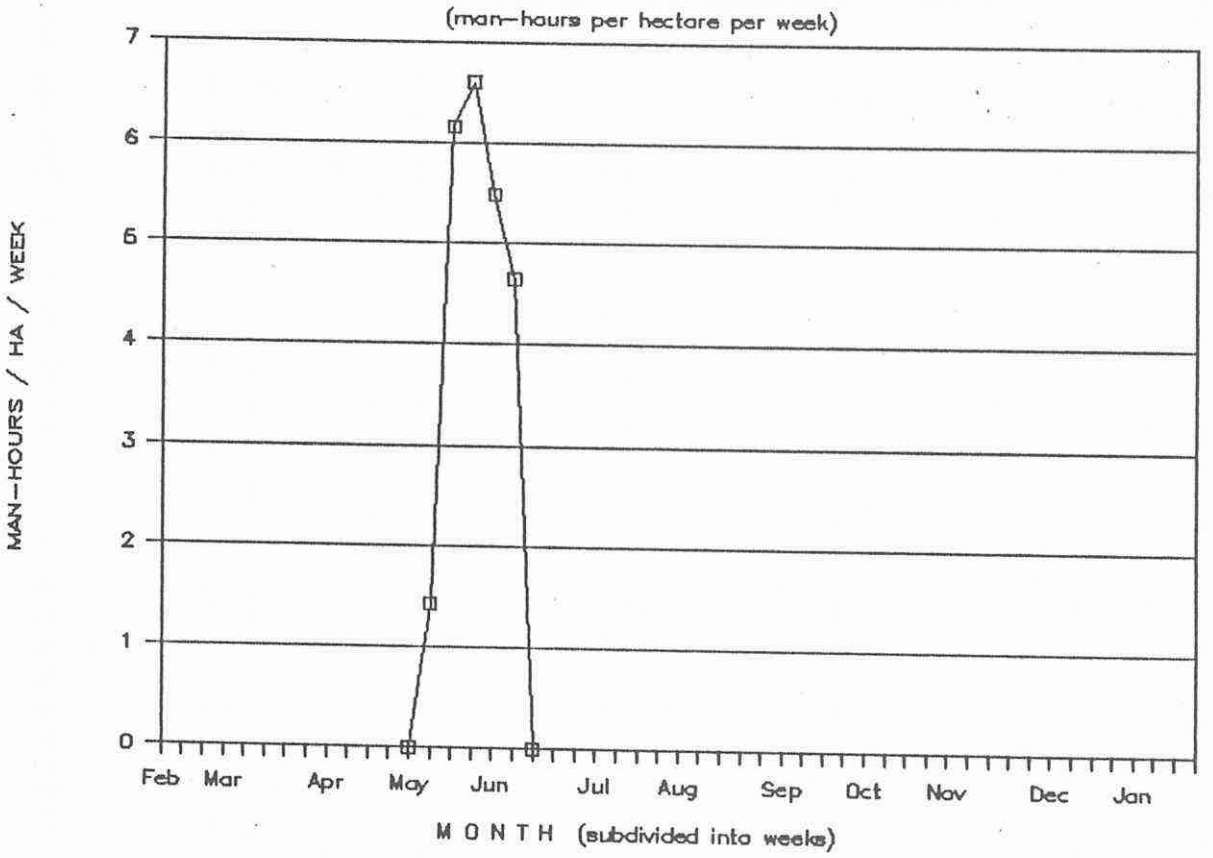


FIGURE 10:

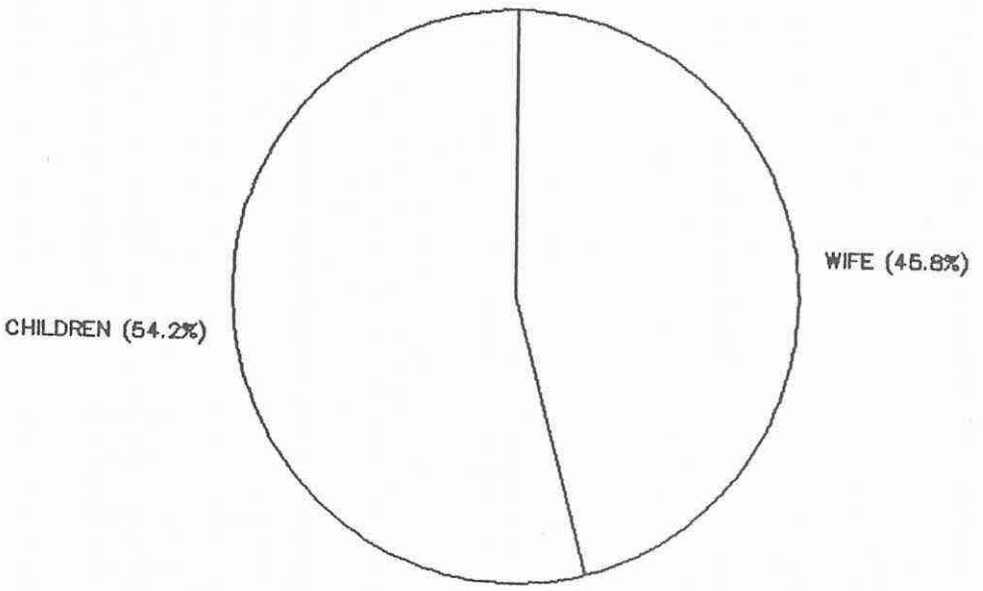


FIGURE 11:

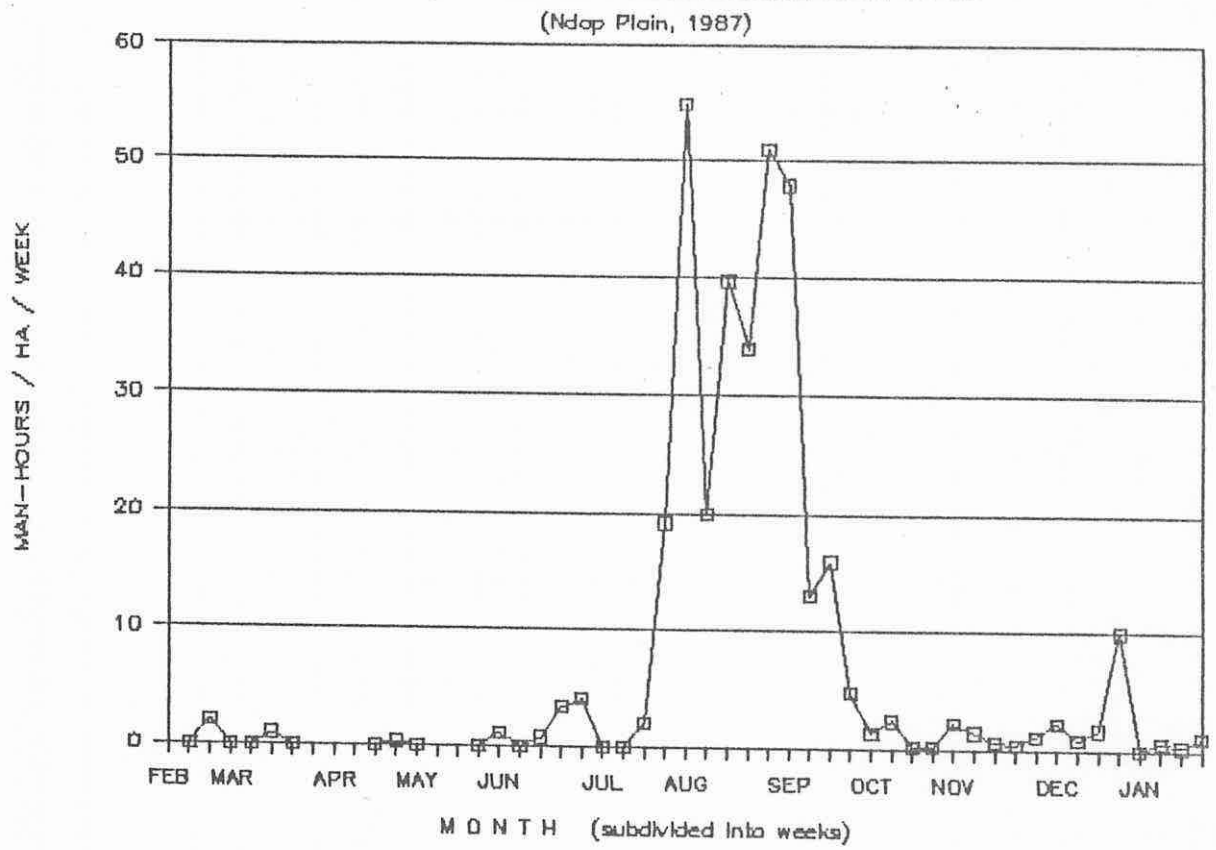
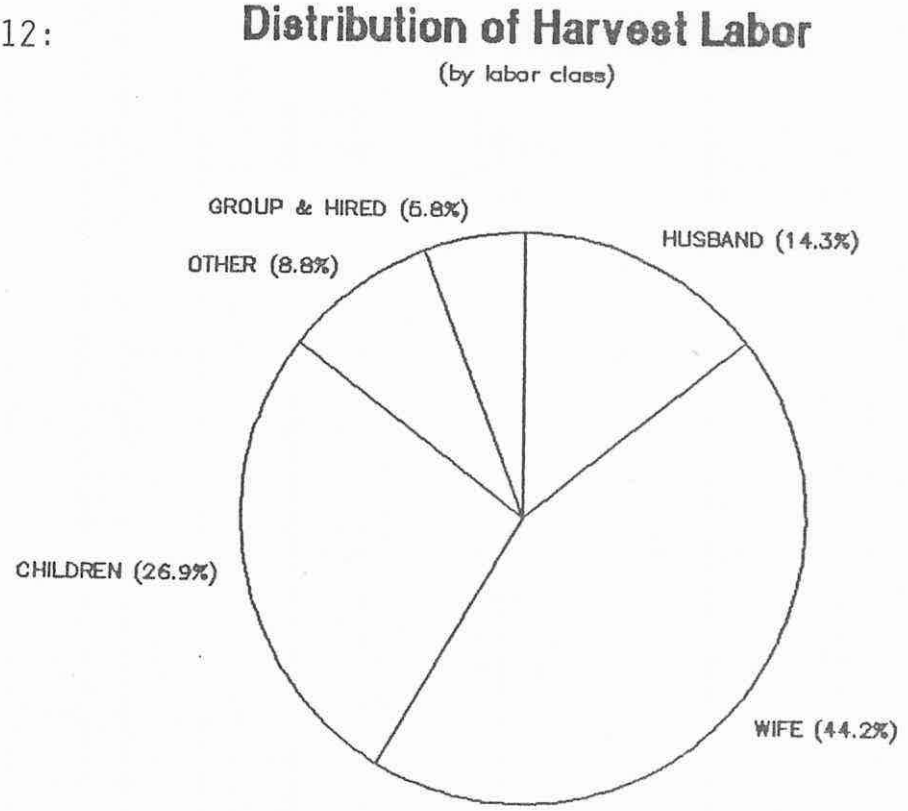


FIGURE 12:



Total labor for the maize-based cropping system

In addition to the above operations, an average of 93 man-hours/hectare (median = 118) was spent on "other operations", mentioned previously. Mean total labor utilization for the maize-based cropping system (monitored field) was **1838 man-hours/hectare** (median = 1675) **(Figure 13, Appendix E(I & V))**.

Labor peaks occurred in February (land clearing), March (land preparation & planting), May (1st weeding) and August (harvest). The biggest peak was at the end of March, when mean weekly labor use surpassed 110 man-hours/hectare. As mentioned before, mean weekly estimates tend to spread the labor distribution, smoothing out the weekly labor peaks. For individual farmers the peaks are usually higher and more condensed in time **(Figure 14)**.

The distribution of maize-based cropping system labor utilization, by field operation, is shown in **Figure 15 (also Appendix E(I))**. The most labor intensive operation is land preparation & planting (36%); followed in order by weeding (28%), harvesting and transporting (19%) and land clearing (11%). Fertilizer application and "other operations", combined, only account for 6% of total labor use.

Total labor distribution, by labor class, as presented in **Figure 16 (also Appendix E(III & IV))**, shows that wives contributed over 48% of the labor. Children were second with 18%, and the husband third at 16%. The farm household provided 91% of the overall labor input for the maize-based cropping system.

FIGURE 13:

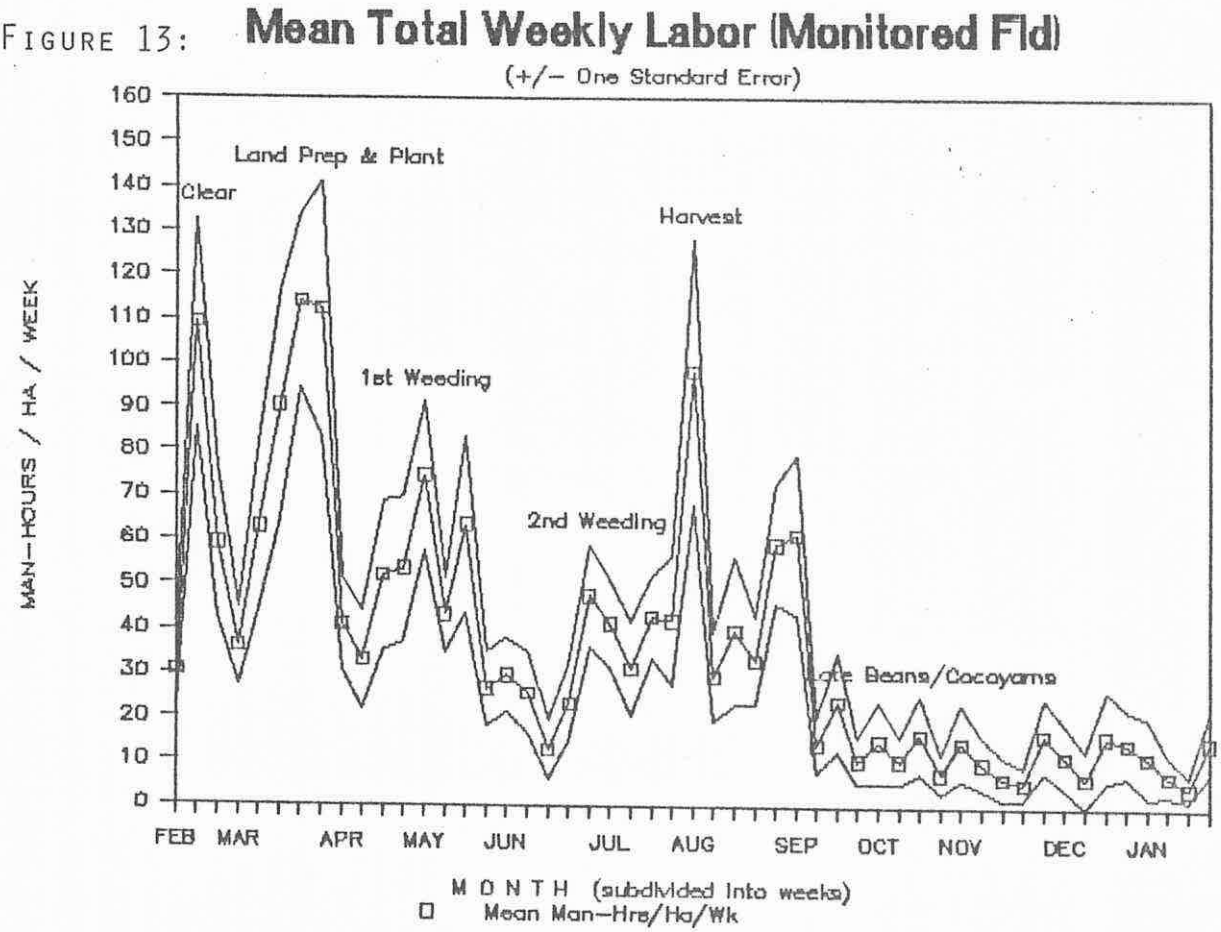


FIGURE 14:

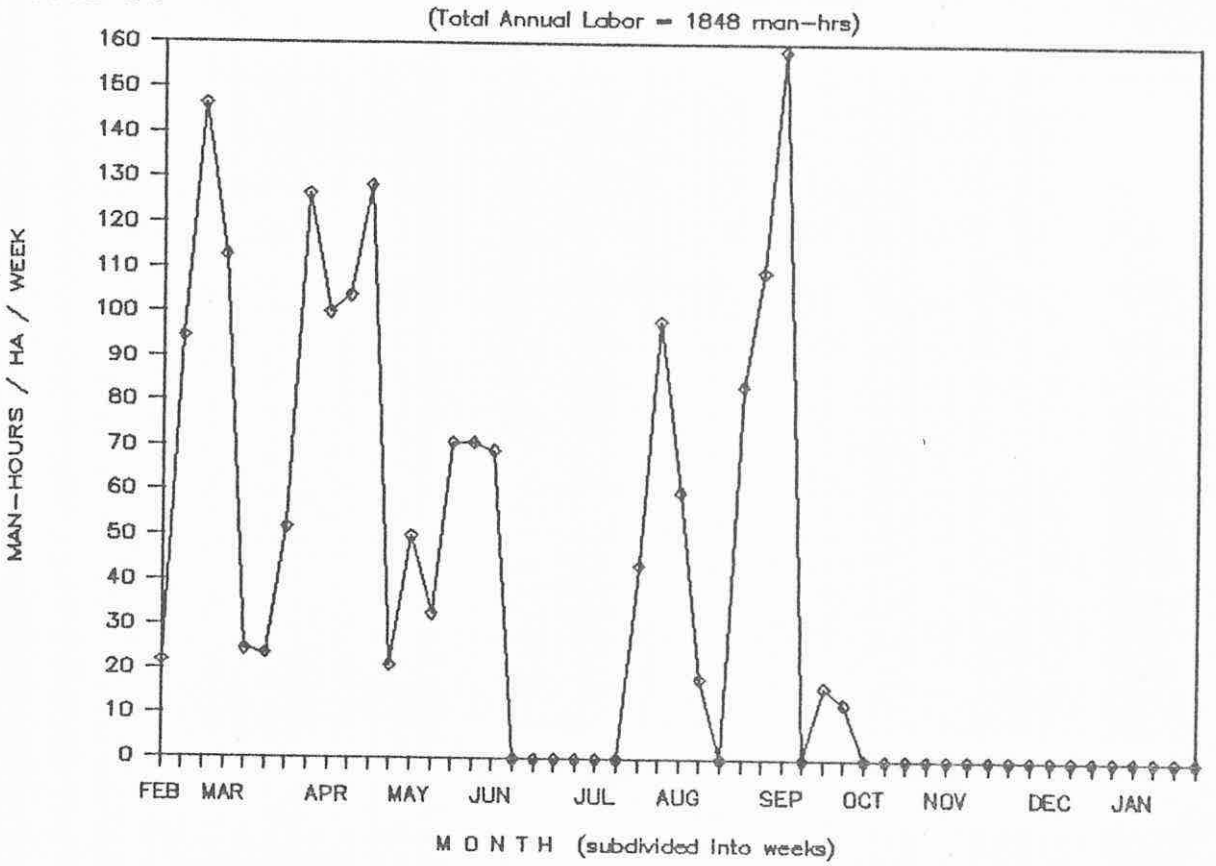


FIGURE 15:

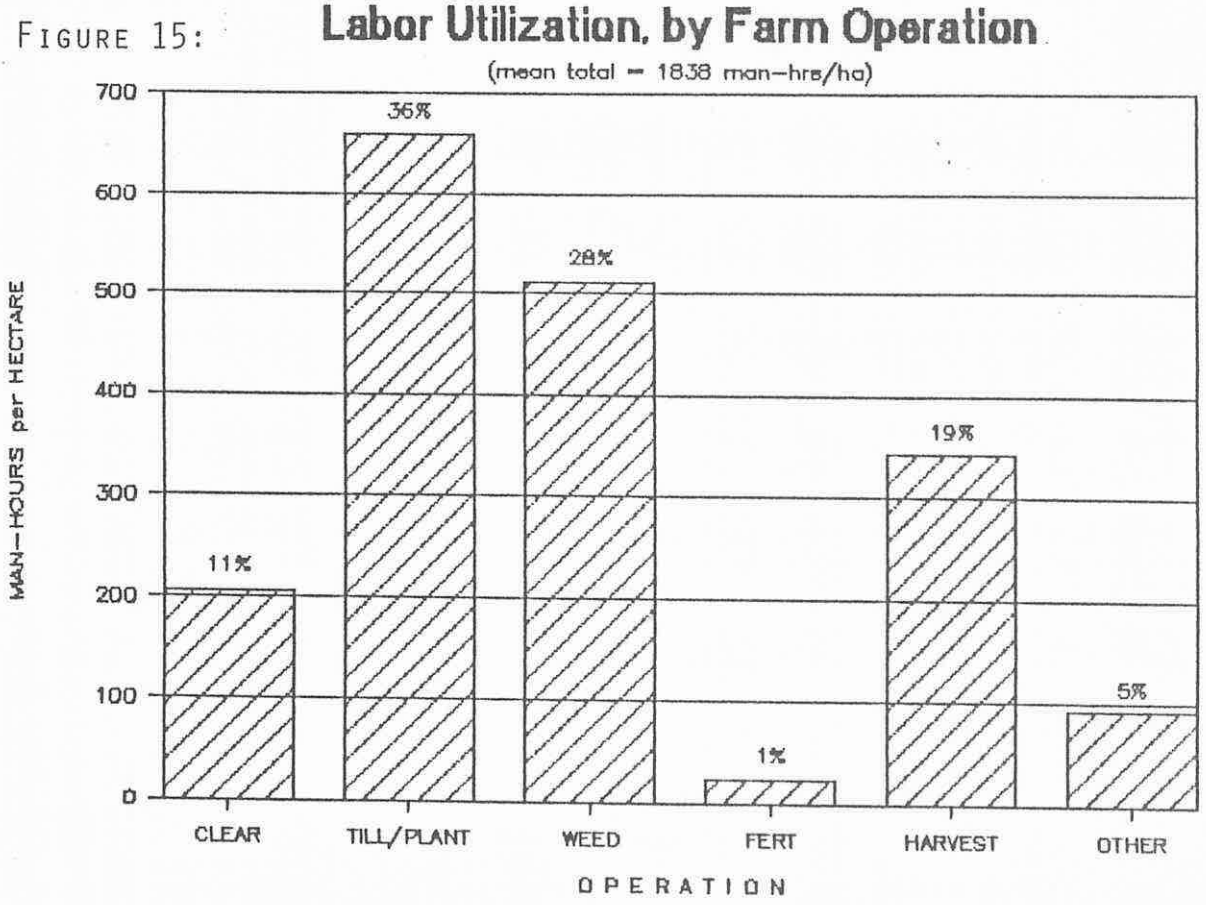
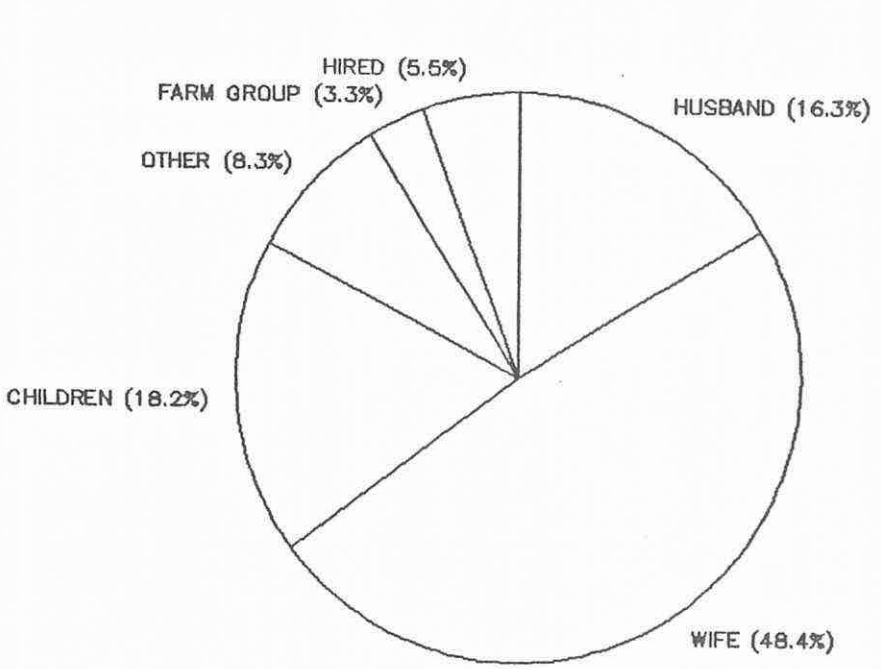


FIGURE 16:



Total cropping system labor

Up to this point, only labor for the maize-based cropping system has been discussed. By measuring the area of the monitored fields, we were able to standardize the labor inputs to man-hours/hectare.

In addition to the monitored field, the enumerators collected labor use data on the other fields (coffee, rice, plantains, other maize fields, etc.). This data could not be standardized, because the other fields were not measured. Nor could the data be disaggregated by field or cropping system, because all other fields were treated as a single enterprise on the daily labor input questionnaire [Appendix A(II)]. Therefore, labor utilization for the total cropping system is estimated in man-hours (not man-hours/hectare), and can be expected to vary with farm size and available family labor.

Mean total labor for all crops, including the monitored field, was 2283 man-hours (median = 2162) **(Figure 17, Appendix E(II & VI))**.

As might be expected, weekly labor utilization for the total cropping system is more uniform than for the maize field alone (compare figure 17 with figure 13). When the farmer isn't working on the maize crop, he/she is usually working on another crop. When operations on other crops coincide with those on maize, potential labor constraining peaks arise. In August, maize/groundnut harvest overlapped with transplanting of rice, producing the highest labor peak of the year (70 man-hours).

The labor distribution among the labor classes for all crops shows a slight increase in the participation of the husband

FIGURE 17: **Mean Weekly Labor Input for All Crops**

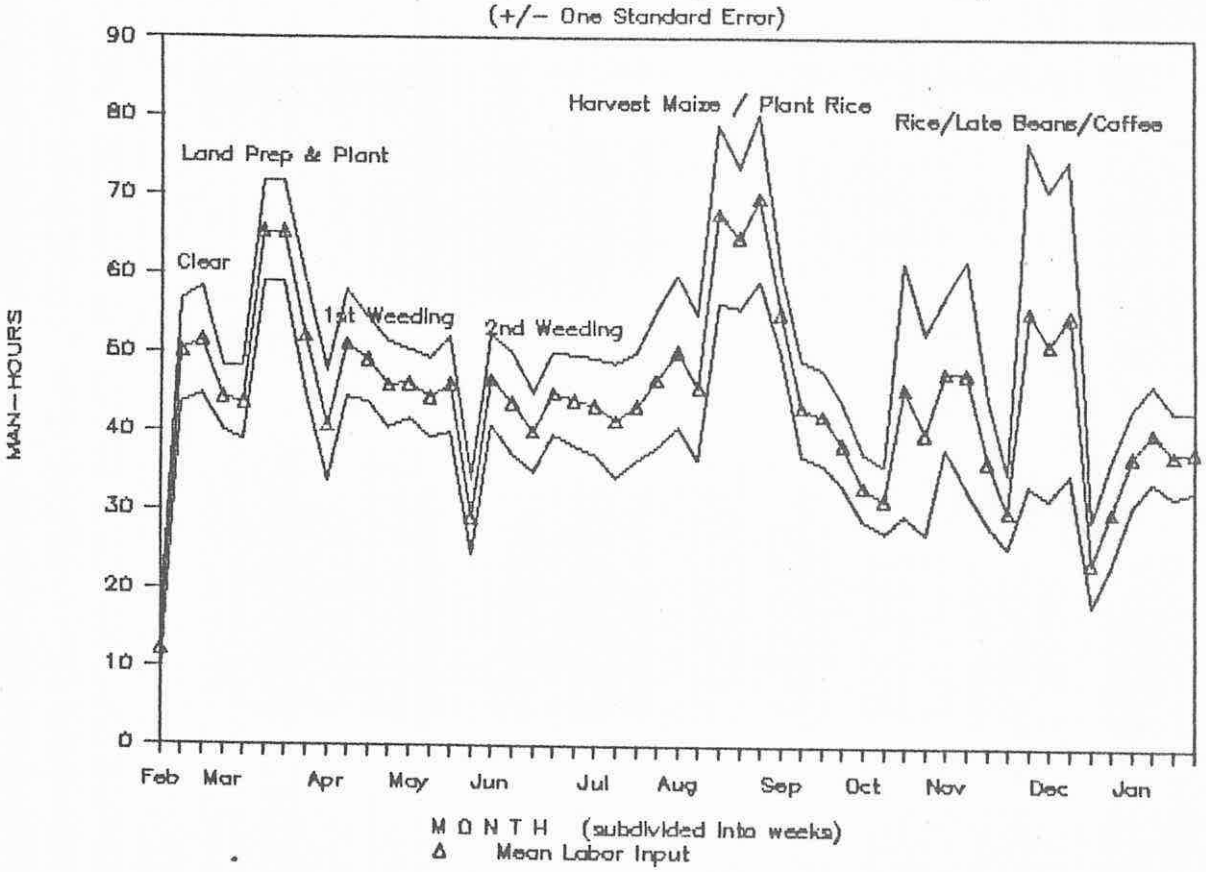
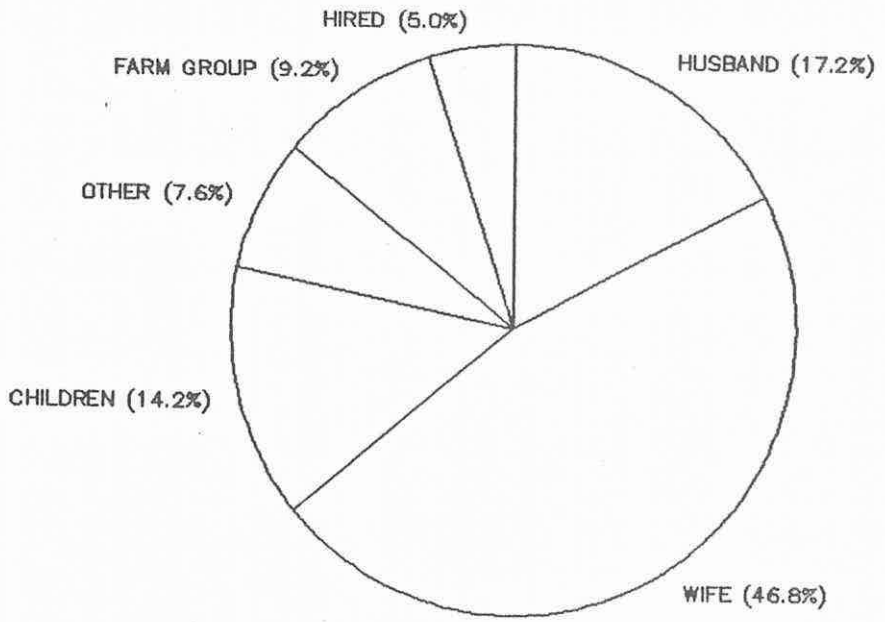


FIGURE 18: **Total Crop Labor Distribution**

(by labor class)



(17%), and reduction in the relative participation of children (14%). This probably reflects the husband's greater role in cash crop cultivation (coffee and rice). However, wives continue to contribute the overwhelming share (47%) (**Figure 18**). The labor contribution of farming work groups increased from 3% to 9%; a result of the extensive use of farming groups for tilling of rice fields.

Total farm labor:

In addition to the cropping enterprises, labor data was collected on household and off-farm activities of an income-generating nature or those supporting crop production. These included such things as:

- processing farm produce for sale in the market ("gari", "egusi pudding", corn beer", pulping coffee, etc.);
- handicrafts (making mats, hats, carpentry, etc.)
- marketing activities (selling in the village market, cooperative or the house);
- purchasing production inputs (fertilizer);
- working in farming groups on other farms;
- contract work on other farms; etc.

Household and off-farm labor, together with cropping enterprise labor, comprised total (or whole) farm labor utilization.

Animal enterprises in the Plain are of minor importance. Most farmers have a few chickens that are left to scratch for their food, or a goat or 2 that is tethered during the cropping season, and left free to graze in the dry months. A few farmers have pigs that are fed overripe papaya, avocados, waste corn,

etc. The small amount of labor used to manage the animals was included under household labor.

Mean total farm labor for the 24 farmers was 2728 man-hours (median = 2734) **(Figure 19, Appendix E(II & VI))**. Eighty-four percent (84%) was accounted for by the crop enterprises. Wives (48%) provided almost half the total crop production and income generating labor for the farm, in addition to the ordinary household chores (house cleaning, cooking, child care, etc.) **(Figure 20)**. The husband contributed a fifth (21%) and the children one eighth (13%); the remaining sixth (18%) coming from the other household members, farming groups and hired labor.

Labor distribution by labor class

Figure 21 (also Appendix E(III & IV)) shows the distribution of labor inputs into the maize-based cropping system, by operation and by labor class. With the exception of fertilizer application, wives were the dominant class in all field operations, from land clearing to harvest.

The operations that consumed most of the wives' time were land preparation & planting (36% of wives' total labor contribution) and weeding (32%) **(Appendix E(IV))**. The most important activities for the husband were also land preparation & planting (40% of husband's labor) and weeding (24%). Children devoted the largest portion of their labor share to harvesting (28%) and weeding (23%). Hired labor and farming group labor inputs were most exploited during land preparation/planting (73% and 46%, respectively) and weeding (18% and 36%, respectively).

Looking at the labor distribution over time, by labor class,

FIGURE 19: **Mean Weekly Labor for the Whole Farm**

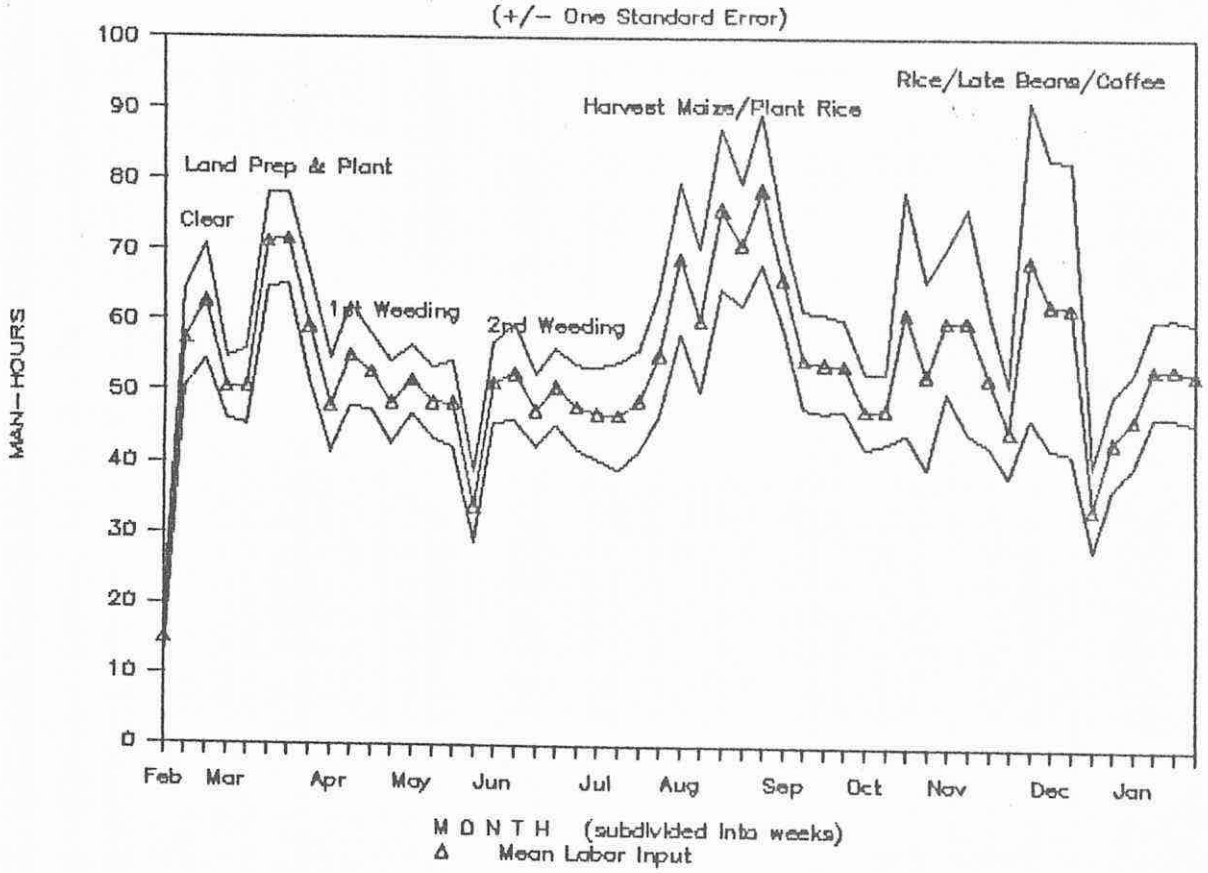


FIGURE 20: **Total Farm Labor Distribution**

(by labor class)

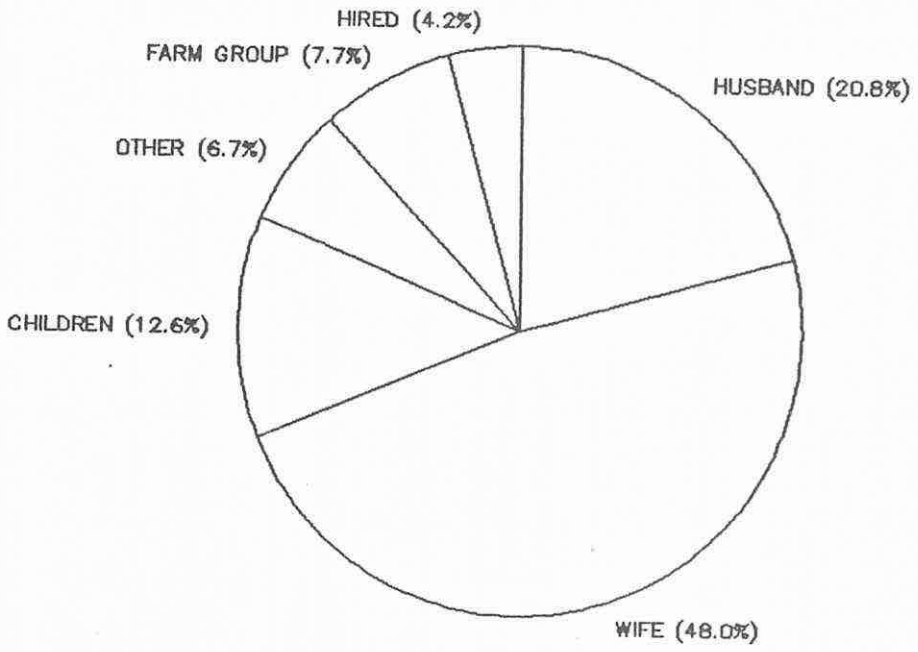


FIGURE 21: **Labor Input by Operation by Labor Class**

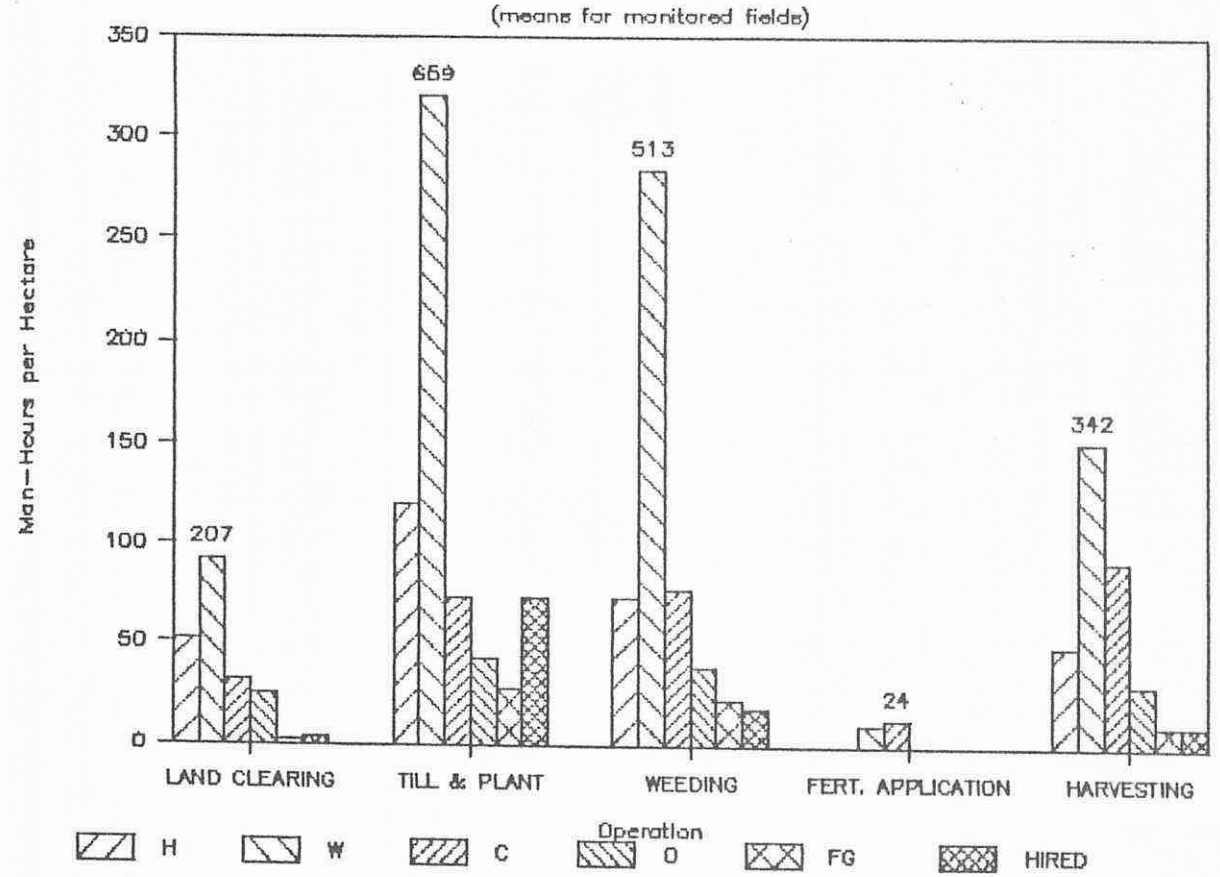
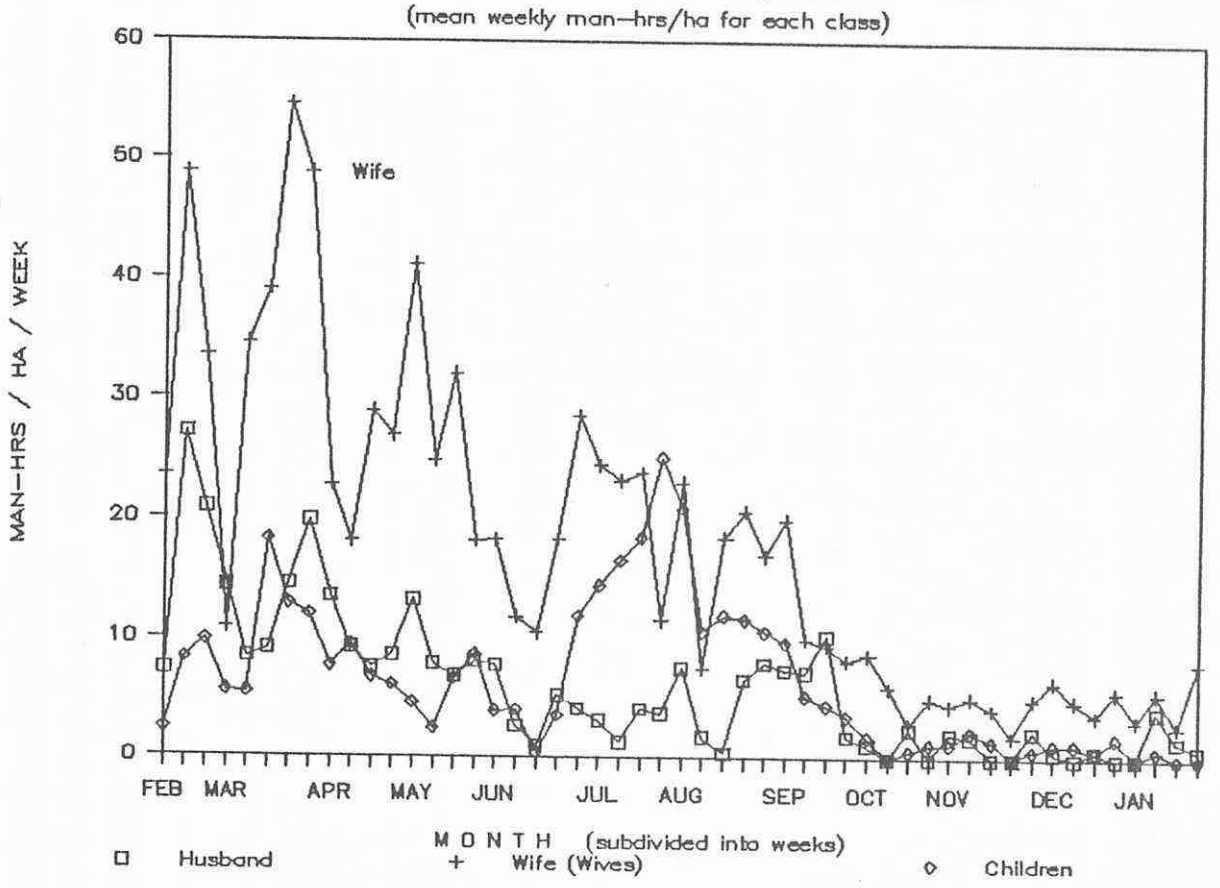


FIGURE 22: **Monitored Field Labor, by Labor Class**



it is clear that wives worked more man-hours per week in the maize-based cropping system than any other class throughout most of the year **(Figure 22)**. This was equally true for the total cropping system and the whole farm, as well **(Appendix E(VII))**. Children's labor contribution rose dramatically at the end of June, when the long school holidays commenced, and dropped just as precipitously in September with the beginning of the school term.

Hired labor was always paid for in cash, before or shortly after the work was done. The mean total paid (for all crops) was 20,341 CFA, equal to 16% of mean total crop sales from the farm. It is an important cost for the farmer, and its distribution over time a critical component in the cash flow for the farm.

Mean total use of hired labor (whole farm) was 114 man-hours, with the highest use in August (27 man-hours) when maize harvest coincided with rice transplanting **(Figure 23, Appendix E(IX))**. Fifty-one percent (51%) of total hired labor was used during three months (July-Sept). Another 21% was hired in March and April for land preparation. Twenty-one of the 24 monitored farmers (88%) hired laborers at least once during the year. On a monthly basis, and excluding February for which only 2 weeks data was available, the proportion of farmers hiring labor varied from 21% in May to 46% in August, October and November **(Figure 24)**.

FIGURE 23: **Mean Monthly Utilization of Hired Labor**

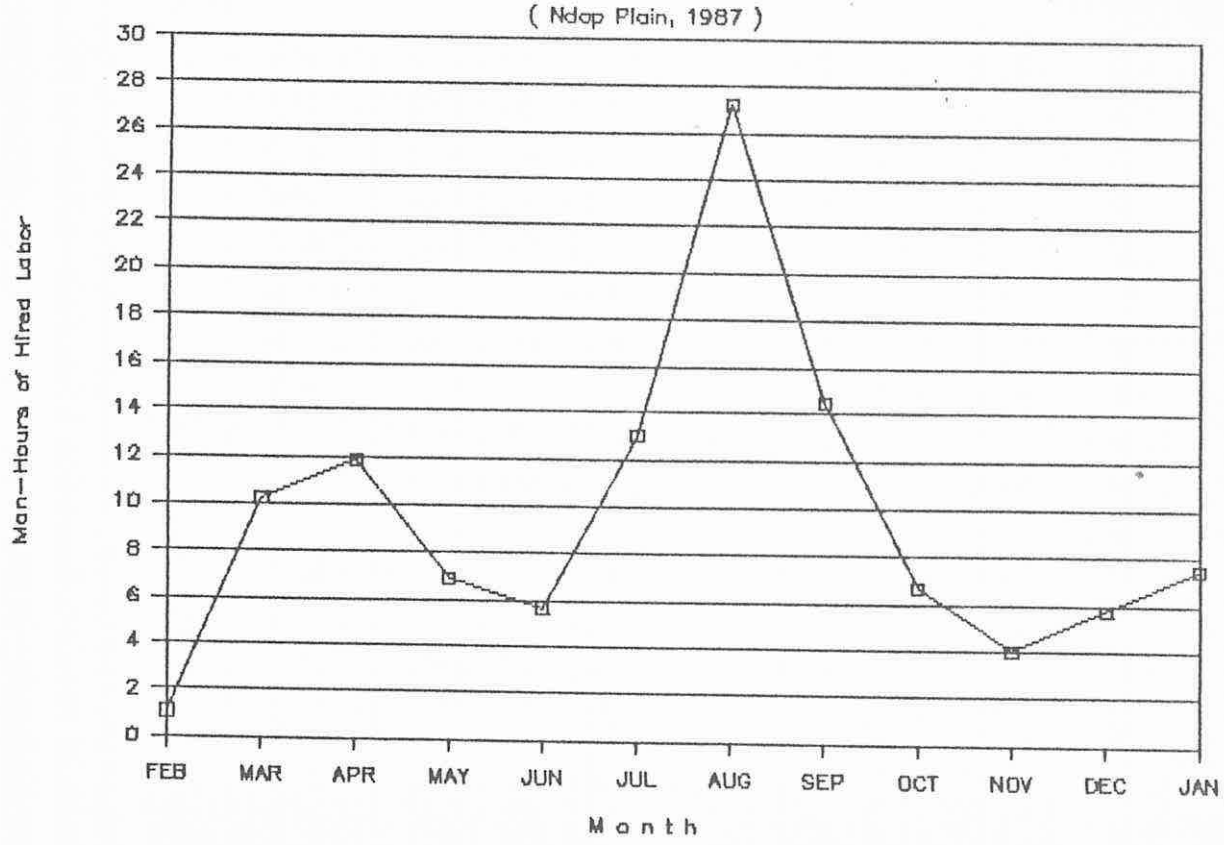
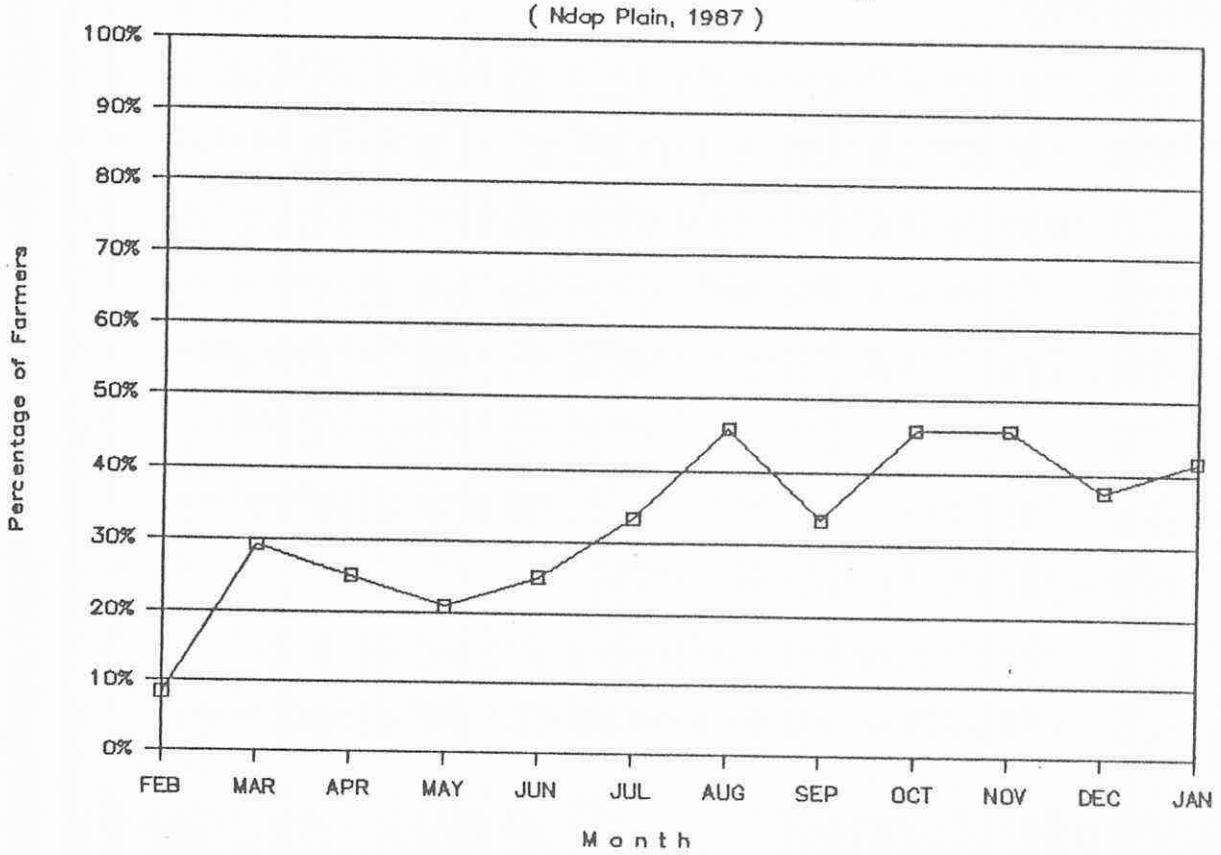


FIGURE 24: **Percentage of Farmers Hiring Labor**



Chapter 4

Costs and Returns

In this chapter, we'll be looking at costs and returns to the maize-based cropping system. Net returns to farm family labor will be estimated.

Production costs

Production factors for the maize-based cropping system include variable physical inputs (seed and fertilizer), labor and land. For these, cash outlays are required for seed (purchased as opposed to saved seed, e.g., groundnuts), fertilizer, hired labor and interest on loans.

Land, for the most part, is inherited, not bought. Farmers often borrow ("beg") land from eachother, or from the "Fon", for temporary use (e.g., to be cropped until the owner has need of it), without payment. It becomes difficult to impute a cost to land, and no attempt is made to do so. Land is treated as the final residual factor.

Seed costs: Quantities of seed material were estimated, based on the mean planting densities for the four principal crops in the maize-based crop associations in the Ndop Plain (maize, groundnuts, cocoyams and beans)(see p. 11). The seed costs were based on market prices at planting time (March).

Fertilizer costs: Fertilizer is available through the coffee cooperative and the rice corporation (UNVDA), at a subsidized (50%) price (2250 CFA per 50 kg bag). The mean fertilizer use for all the monitored fields was 73 kg 20-10-10/ha and 16 kg ammonium sulfate/ha.

Labor costs: Farm family labor will be treated as a residual factor. Only hired labor is considered a direct cost to production. As was mentioned above, farmers use hired labor for specific tasks; and thus demand for it varies though the year. As might be expected, wages also vary during the year, in response to demand for and/or relative scarcity of hired workers **(Figure 25, Appendix E(IX))**.

Mean wages, by month, ranged from 100 CFA/hr (August) to 326 CFA/hr (March). The seeming contradiction of lowest wages coinciding with highest demand for hired labor in August can be explained by the large pool of children on holiday from school, who are hired at very low pay to transplant rice. Mean hired farm worker wages for the year was 206 CFA/hr.

Interest on loans: Beside loans from family and friends, farmers have a variety of credit sources, ranging from credit unions to tontines ("Njangi"). Credit unions are present in 4 of the 6 villages. The interest rate for loans is 12% per annum. If the maize crop is sold immediately after harvest and drying, the loan could be repaid in 6 months with 6% interest. This rate is used in the maize cropping-system enterprise budget that follows **(Table 4.1)**.

Crop production levels (yields)

Mean crop yields are presented in **Appendix G(I)**. Maize yields on individual farms varied from 436 to 7044 kg/ha. But 77% of the farms had yields between 1000 and 3500 kg/ha, with a mean maize yield of 1973 kg/ha (median=1566).

By way of comparison, mean maize yields from 21 on-farm

FIGURE 25: **Mean, Max & Min Wages for Hired Labor**

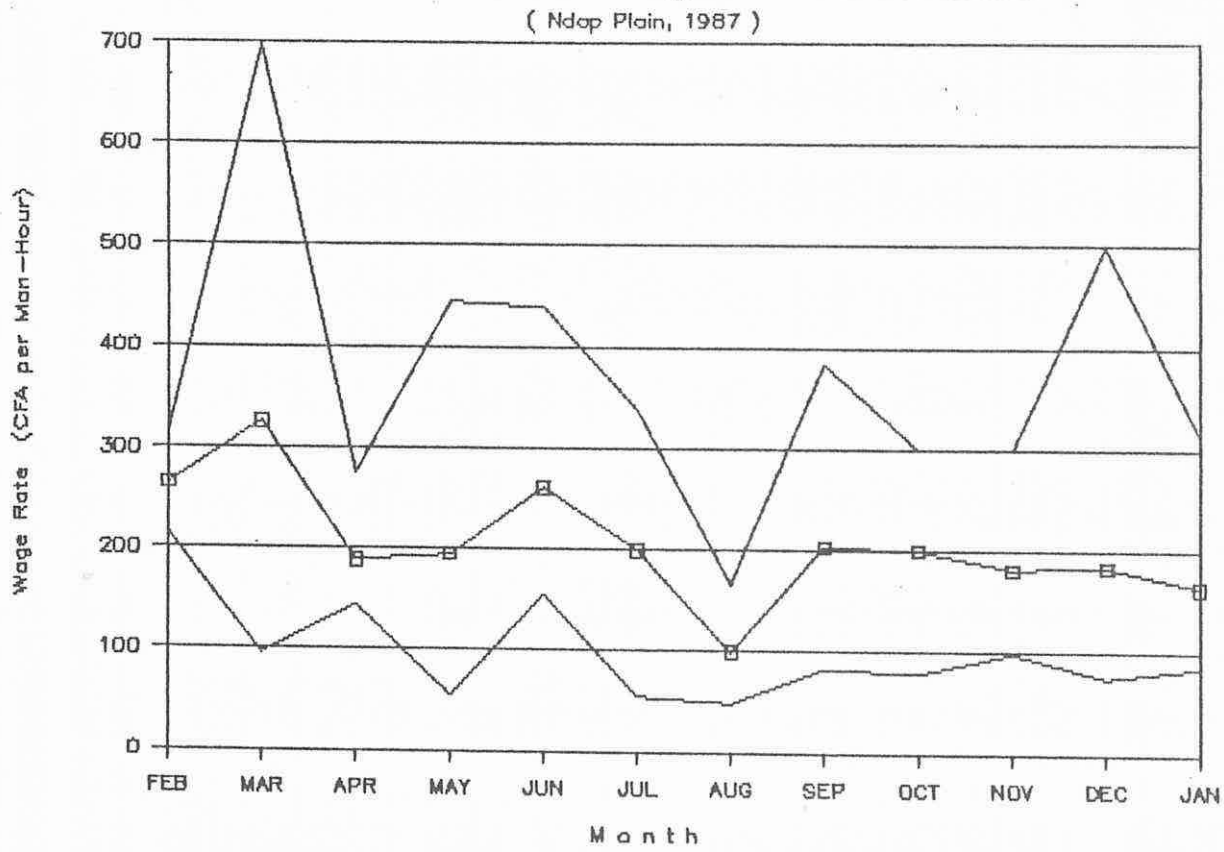
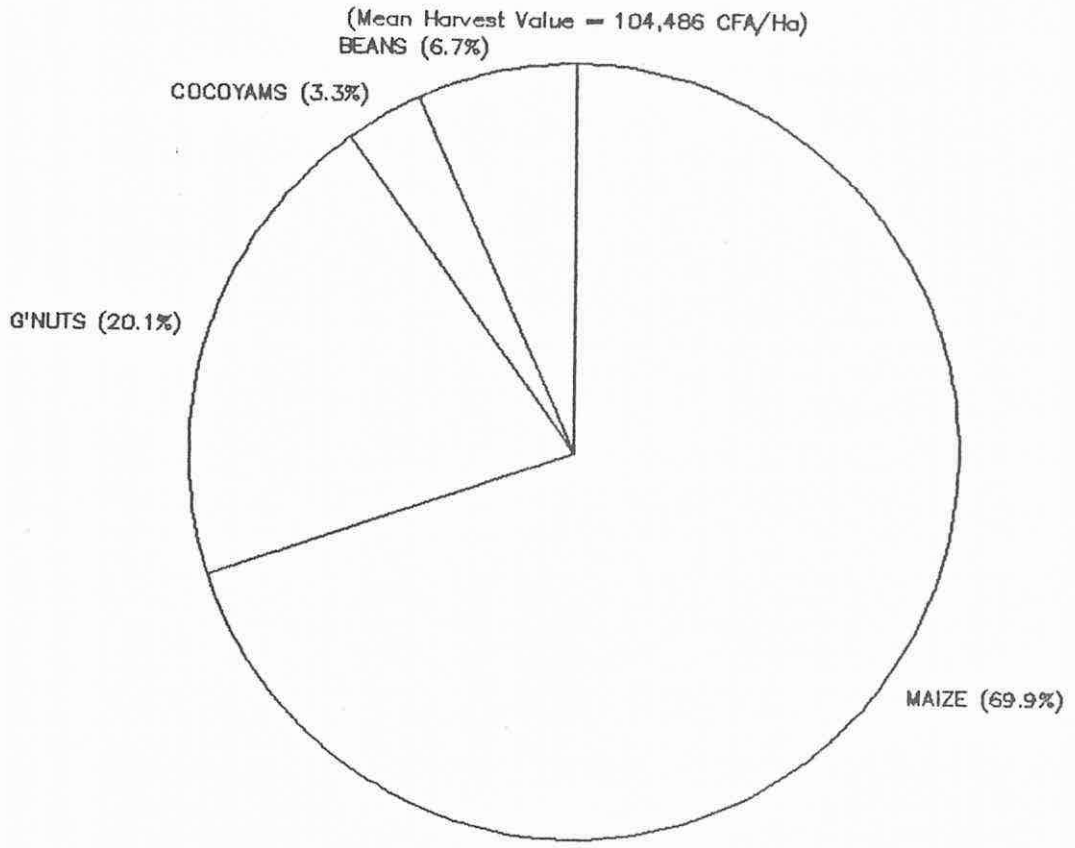


FIGURE 26: **Distribution of Harvest Value, by Crop**



trials (2 replications/farm) in the Ndop Plain for the local variety, planted at low density (20,000 plants/ha) and without fertilizer, was 2620 kg/ha. Changing to an improved variety (Kasaï I), adding fertilizer (N=50 & P=25) and doubling the plant density (40,000) boosted the yield to 4810 kg/ha; an 84% increase.

Mean yields for groundnuts, beans and cocoyams, respectively, were 54, 38 and 77 kg/ha. Maize accounted for 70% of the total value of the harvested crop **(Figure 26)**.

Food crop market prices

Records of food crop commodity prices were kept for the 6 village markets. Weekly prices for maize, groundnuts, beans, cocoyams and rice (local & imported) can be found in **Appendix F(I)**.

Maize: Maize prices began the year (February) at 70 CFA/kg and climbed to a peak of 100 CFA/kg at the end of May **(Figure 27)**. From there it steadily dropped through June/July, and sharply in August, settling at a low of under 40 CFA/kg in the first week of September. The low price persisted until the end of the year, and into the new year.

Maize prices clearly followed the production cycle, peaking 9 months after one harvest and just before the next harvest. As the previous year's stores were exhausted, increasing numbers of farmers were forced to purchase maize, adding to the demand and pushing the price upwards.

Although most of the maize is harvested in early August, it must be dried from an average field moisture content of 30-40%,

FIGURE 27: **Mean, Minimum and Maximum Maize Prices**

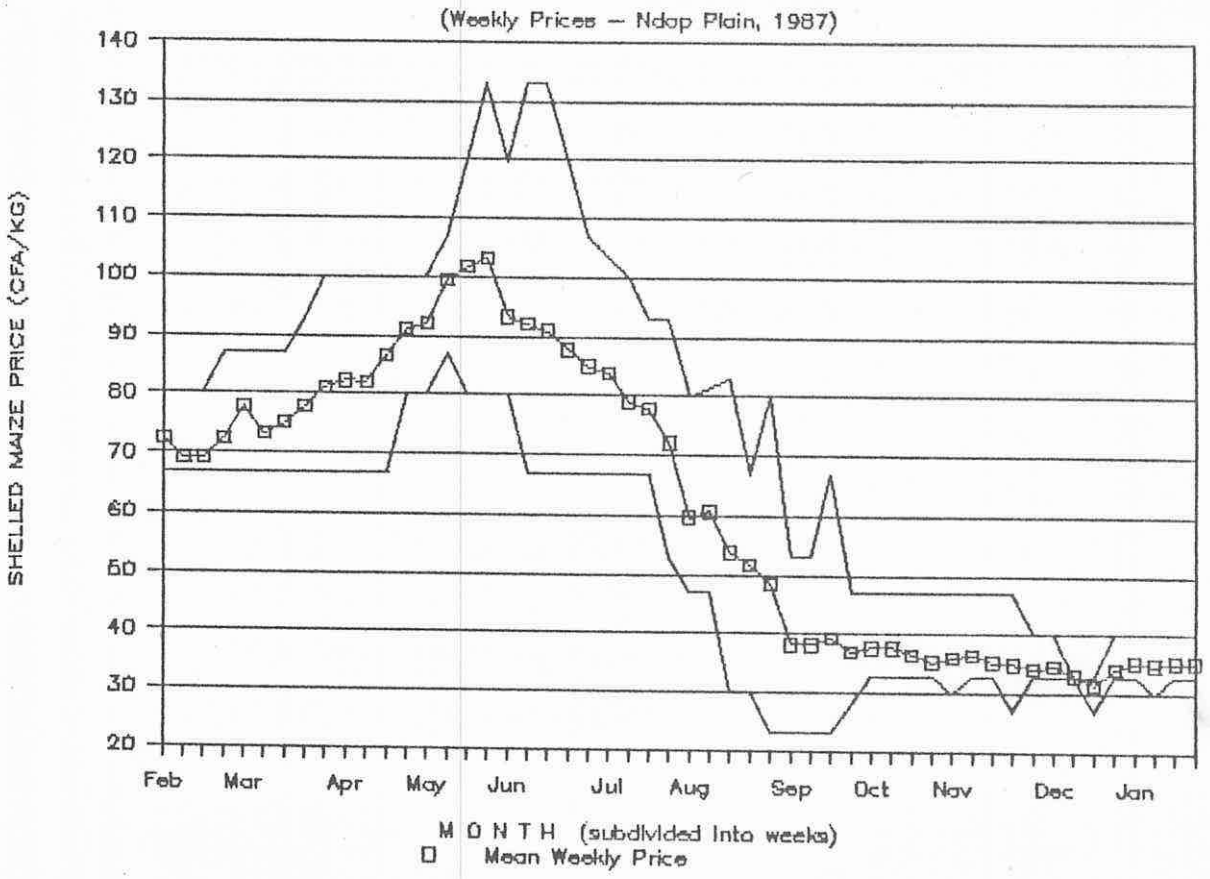
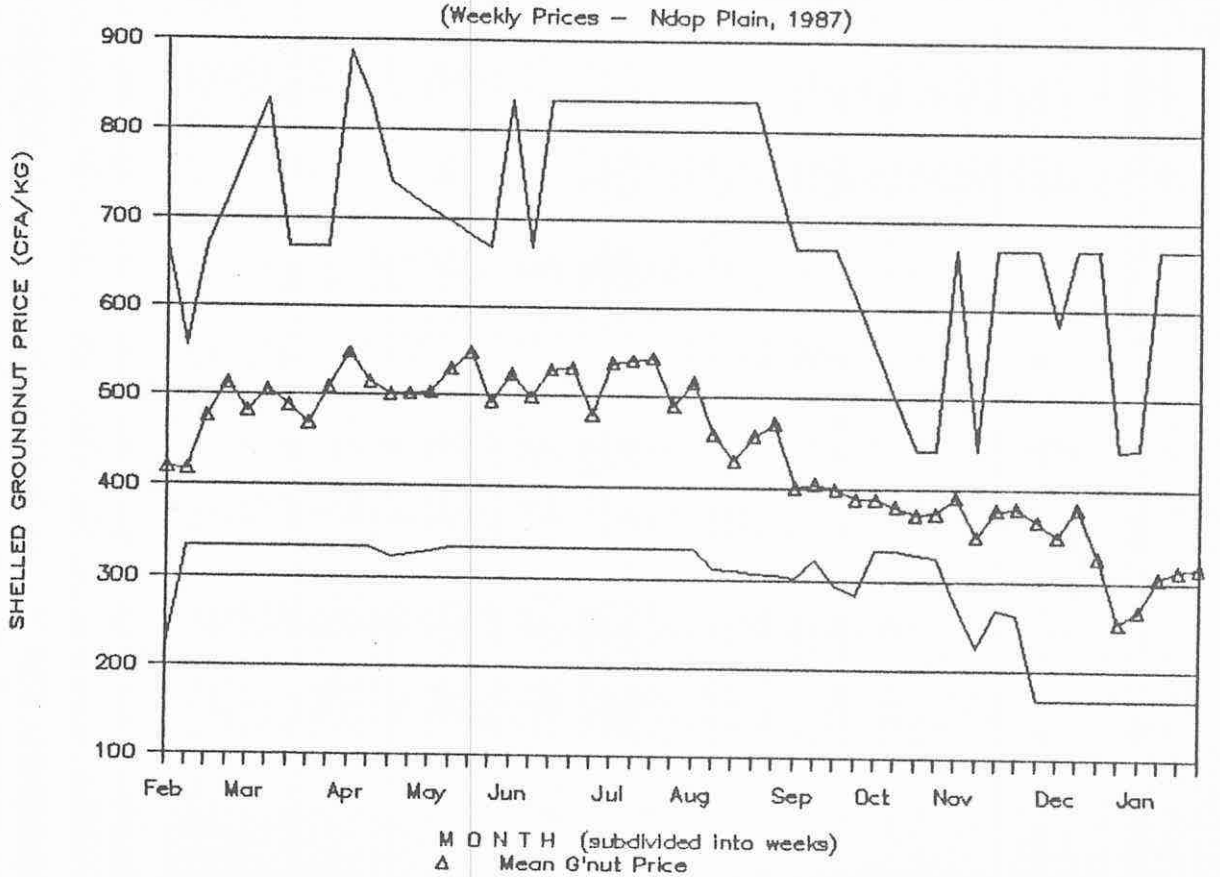


FIGURE 28: **Mean, Min. and Max. Groundnut Prices**



down to 15%, before it can be safely stored or shelled for use or sale. Drying takes up to one month, which might explain the delayed drop in price after harvest.

Maize is not generally sold all at once, as are the cash crops (rice and coffee). The steady low maize price through December reflects a constant flow of maize to the markets for the last 4 months of the year, keeping supplies high. Furthermore, most of the farming population have enough maize for consumption at this time, and therefore demand is low.

The volume of maize produced in the Ndop Plain, plus the ability to store it for many months, serves as buffer, reducing the volatility of maize prices over the year. Nevertheless, in June, prices in different village markets varied by as much as 60 CFA/kg.

Groundnuts: Most of the groundnuts in the Plain are produced in association with maize. As a result, groundnut yields are very low (10-25% those of maize)(see page 13). Groundnuts are also planted on a smaller area than maize, don't store as well, and require a larger proportion of the harvest for seed for the next year. Therefore, the volume available for marketing is relatively small, falling short of local demand.

A regular influx of groundnuts from North Cameroon ("Garoua groundnuts", a Virginia type compared to the local Spanish type) helped stabilize prices throughout the year. In general, mean prices remained high and only dropped slightly after harvest (August/ September) **(Figure 28)**. In contrast, groundnut price differences between village markets in the same week were very high.

Beans: Beans are harvested twice a year (May-September and November-January). The price cycle reflects this fact (**Figure 29**). Mean bean prices increased from a low of 156 CFA/kg at the beginning of the year, immediately after the late harvest for the previous year (1986), to a high of 230 CFA/kg in late April and early May. It declined rapidly in late May/June with the first harvest for 1987. Staggered plantings and harvests helped to maintain a more or less steady supply of beans to the markets through the end of the year. Therefore, there were no dramatic price rises, only minor fluctuations.

Cocoyams: Cocoyams include taro and macabo. The mean annual price for the two species differed by only 1 CFA (50 and 51 CFA/kg, respectively). Therefore, the two are treated as one commodity, although they have distinct cooking characteristics and are clearly differentiated by the population.

Cocoyams are planted with maize (March). Harvest begins in September and continues until as late as February or March. Sometimes land preparation coincides with harvesting of cocoyams.

Price followed the production cycle closely, with peak prices being reached in July (above 65 CFA/kg), when supplies from the previous harvest were down (**Figure 30**). Reduced supplies of maize at this time also force many farmers to substitute pounded cocoyams for maize fufu in their diets, adding to the upward pressure on cocoyam prices. The price bottomed out in January (below 35 CFA/kg) while cocoyams were still being harvested.

Rice: Rice is grown under the auspices of UNVDA, which developed the land and provides the inputs (fertilizer and

FIGURE 29:

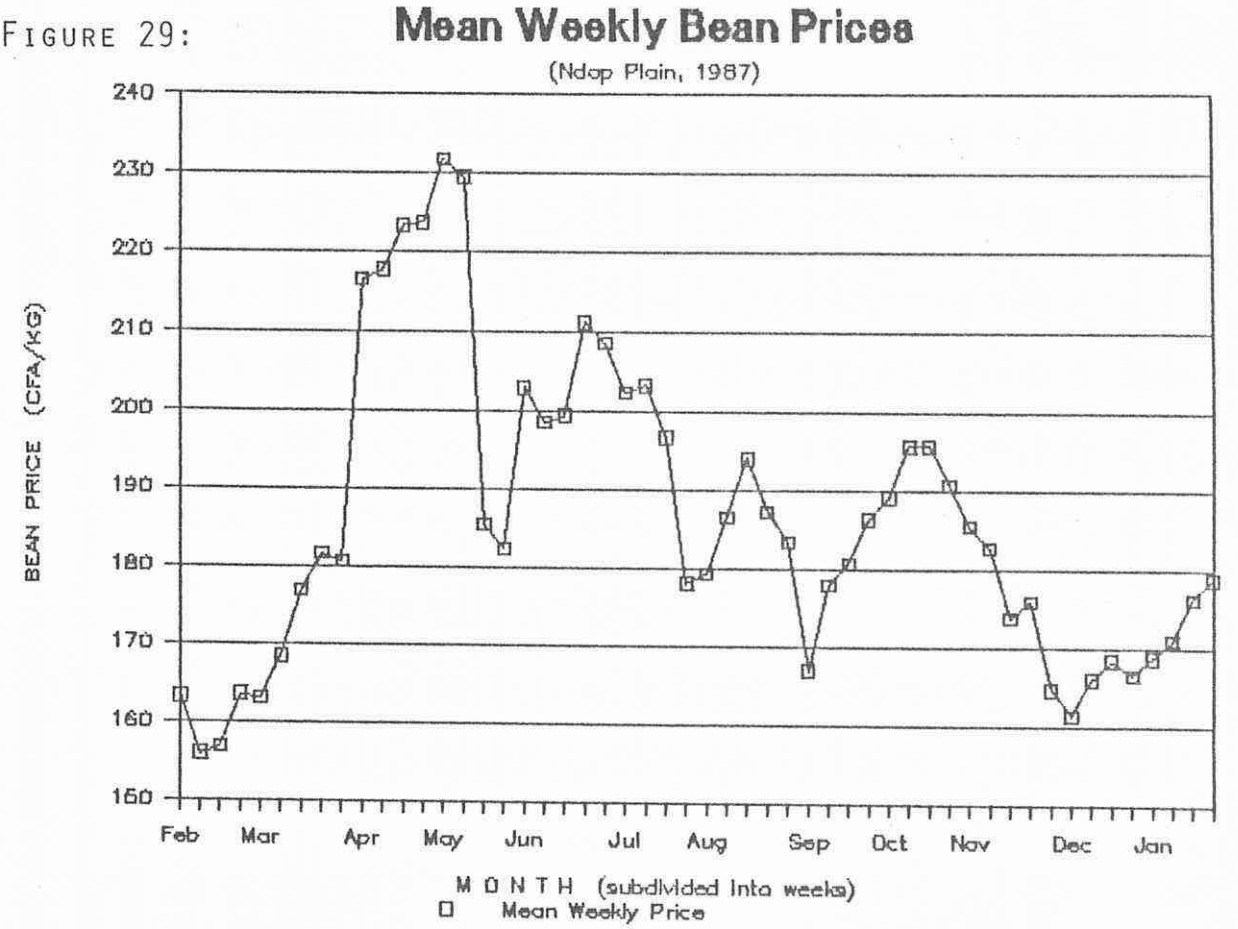
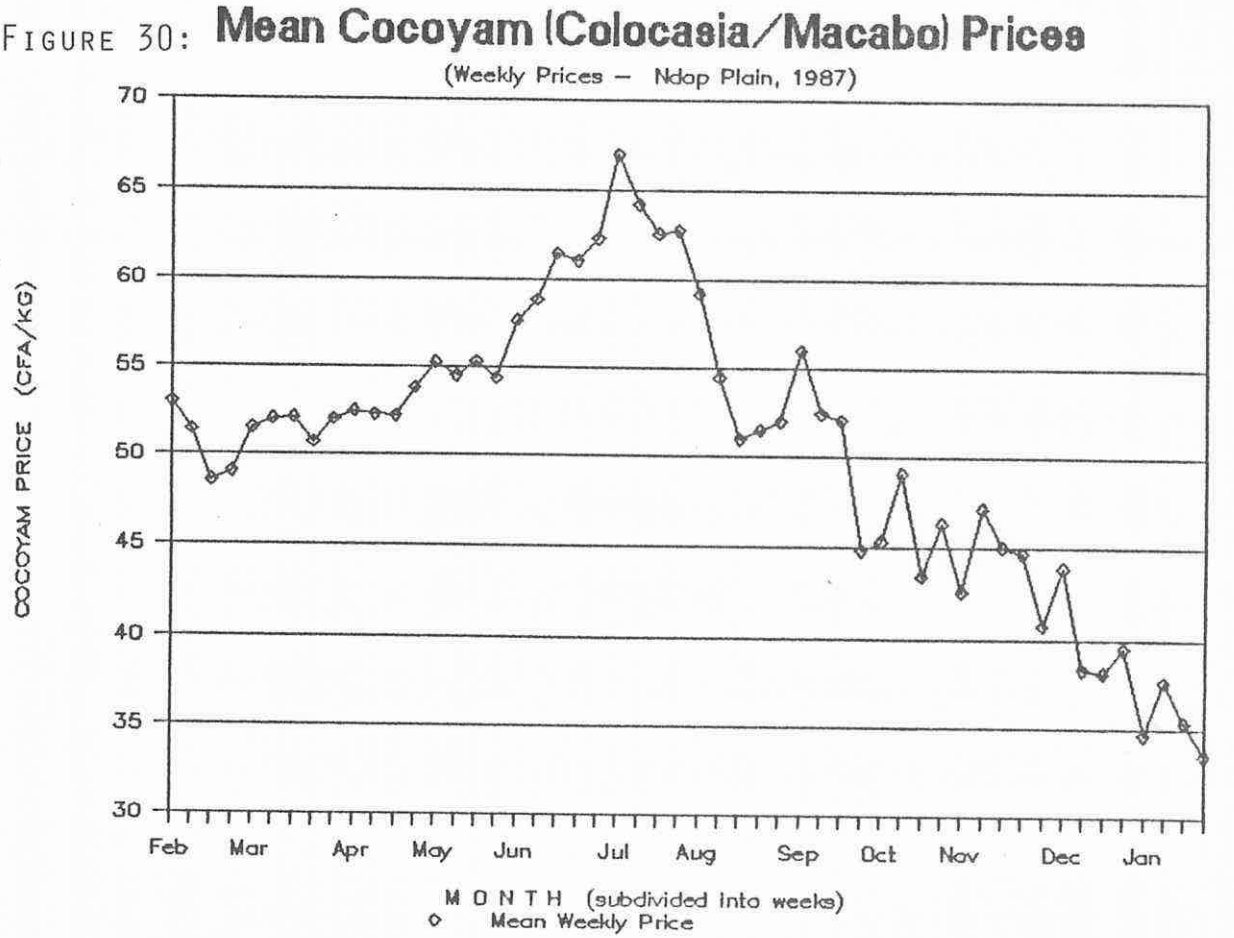


FIGURE 30:



seeds)[Samatana et al. 1986]. Almost all of the rice is sold to UNVDA. The price is, therefore, fixed by UNVDA. The price for paddy (unhulled rice) in 1987 (for the 1986 crop, harvested in December/January) was 78 CFA/kg. Assuming a 60% milling percentage, that translates into a price for milled rice of 130 CFA/kg.

However, in 1987, UNVDA was unable to pay farmers cash. Farmers were paid for their paddy in hulled rice. Rice is a cash crop. Little is consumed, maize fufu being the principal staple. In normal years, a small proportion of the production is sold directly in the local markets, in direct competition with imported rice. With the normal marketing channel (UNVDA) closed, more than the usual quantity of rice found its way to the village markets.

Throughout the year, local rice was selling at between 10 and 20 CFA/kg less than the price for imported rice (**Figure 31**). Starting at 160-170 CFA/kg in February, the price descended in fits and starts to a low of 130 CFA/kg in July, before rising again to 160 CFA by December.

The local rice price paralleled that of imported rice. The price of imported rice probably responded to supply, and the local rice price was pushed down to maintain a price margin commensurate with the difference in quality.

Returns to farm family labor

An enterprise budget for the maize-based cropping system is presented in **Table 4.1**. Total benefits are calculated using mean crop yields for the monitored fields and market prices at the

FIGURE 31: **Mean Local and Imported Rice Prices**

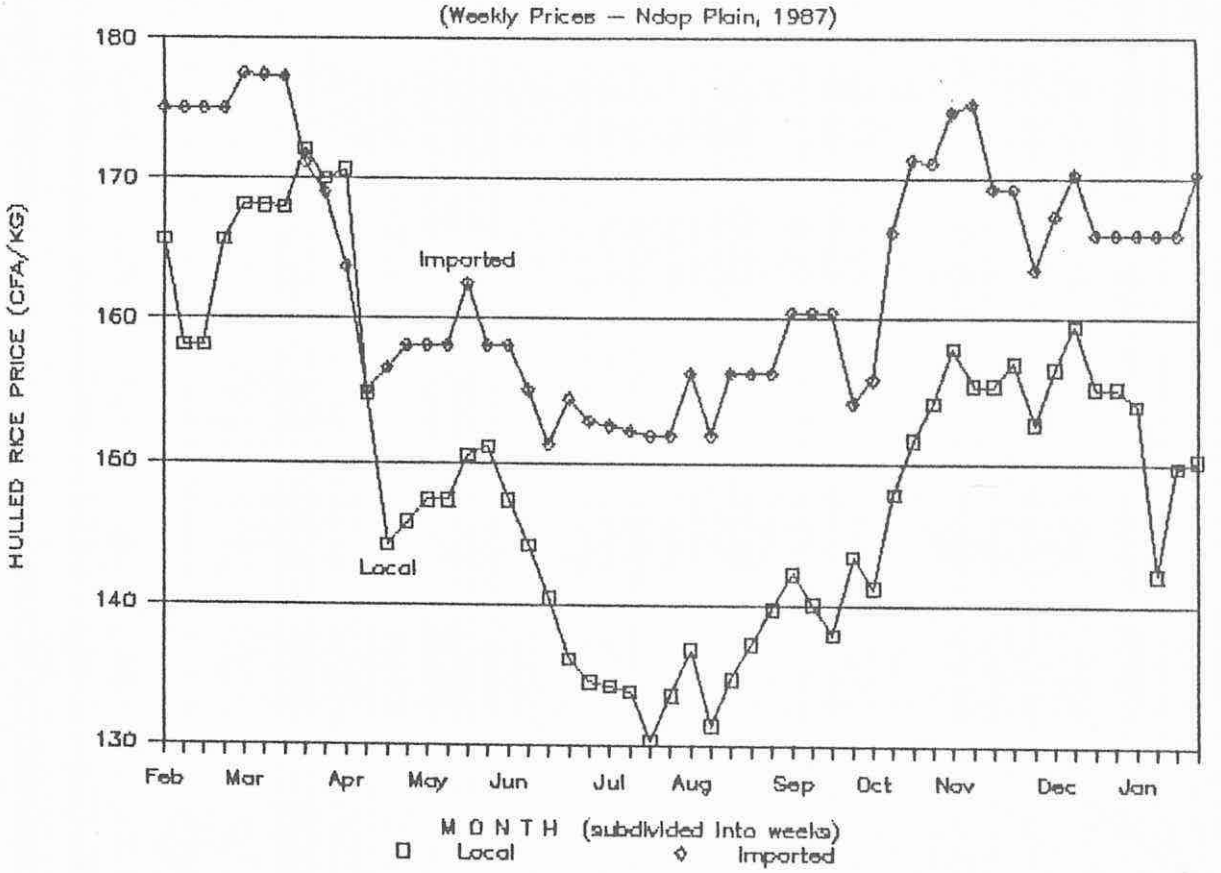


FIGURE 32: **Mean Total Crop Sales (Monitored Farms)**

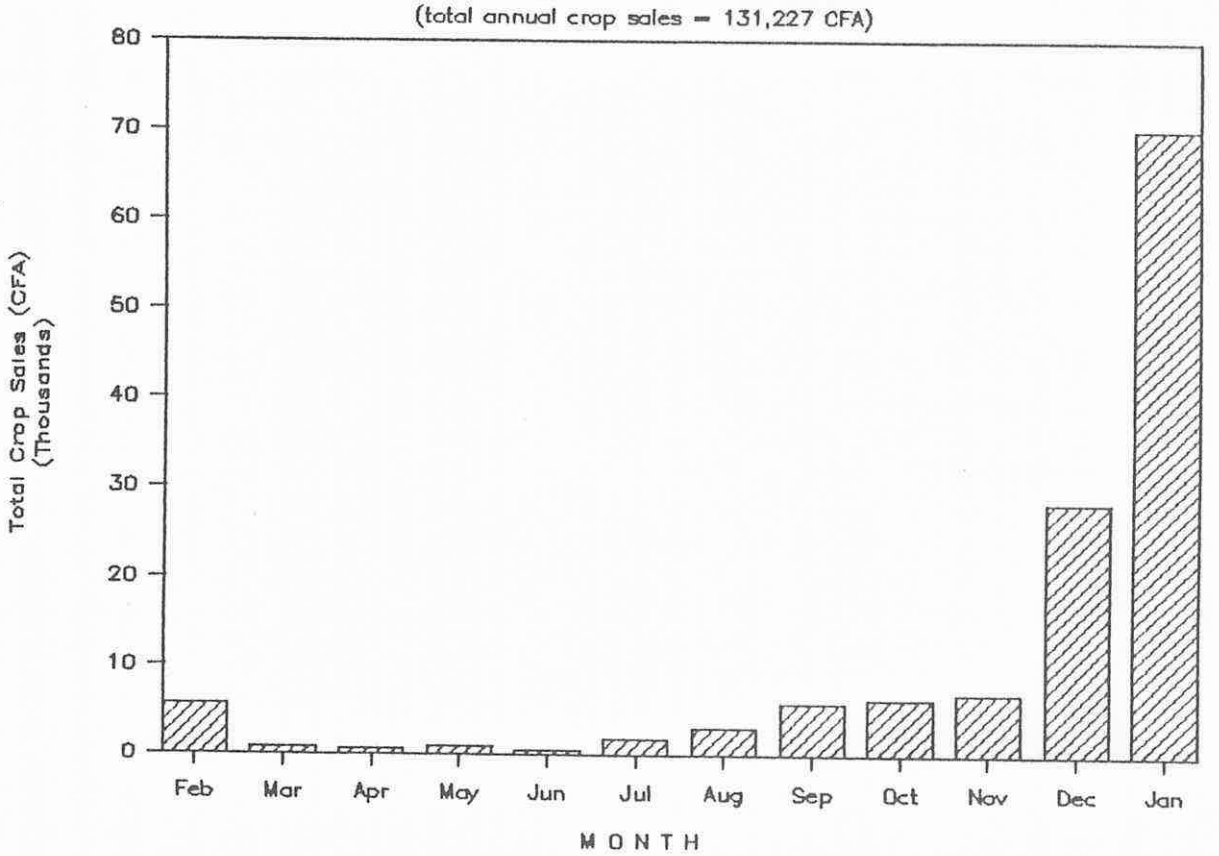


Table 4.1: Enterprise budget for the maize-based cropping system

Item		
Mean crop yields:	(kg/ha)	
Maize	1973	
Groundnuts	53	
Beans	39	
Cocoyams	77	
Benefits:	(CFA/ha)	
Maize	72,999	
Groundnuts	21,050	
Beans	7,036	
Cocoyams	3,402	
Total Benefit	104,487	
Costs:	(CFA/ha)	
Seed	9,350	
Maize (15 kg)		1,050
Groundnuts (10 kg)		5,000
Beans (5 kg)		800
Cocoyam (50 kg)		2,500
Fertilizer	3,996	
20-10-10 (73.2* kg)		3,294
Ammonium-sulfate (15.6 kg)		702
Hired labor (102 man-hours)	21,012	
Interest on capital (6%**)	2,061	
Total Cost	36,419	
Total Net Benefit	68,068 CFA/Ha	
Net return to family labor	39 CFA/man-hour	

* mean per farmer = (230 kg/ha x 7 farmers using fert)/22 farmers
** Credit union rate (12% p.a.) for 6 months.

time of harvest. Fertilizer costs were based on the mean quantity of fertilizer used on the monitored fields and fertilizer prices paid to coffee cooperatives in the Plain. Seed quantities were made proportionate to mean planting densities,

and the prices used were those in the village markets at planting time (March). Hired labor costs were estimated using the mean wage rate of 206 CFA/man-hr. Interest on capital investment was put at the credit union rate of 1% per month times 6 months, or 6%.

Total net benefit is 68,068 CFA/ha. It represents a net return to farm family labor and land.

Labor contributed by farming groups is reciprocated by farm family members working an identical number of hours on the farms of other group members. Therefore, farming group labor is only borrowed labor, and effective farm family labor can be calculated by deducting hired labor from total labor (1838 - 102 = 1724 man-hrs/ha).

The net return to farm family labor was computed by dividing total net benefit by the number of man-hours worked by the family (39 francs CFA per man-hour).

On-farm trials in the Ndop Plain (1982-87) have shown that by simply planting an improved open-pollinated variety (such as COCA or Kasaï I) at a higher density (40,000 plants/ha), and applying a moderate rate of fertilizer (N=50 & P=25), maize yields can be increased by at least 50%. At the same time, groundnut yields will be depressed by the shading of the maize (an estimated 20% reduction).

Even assuming that there are no other crops planted on the field, total benefit would increase by 21%. And despite a 14% rise in variable costs, total net benefit is increased by 25%. This would give a net return to farm family labor of 49 CFA/man-hour.

Total farm sales

All sales from the monitored farms were recorded under one of four categories:

1) monitored field crops;
2) crops from all other fields;
3) animals or animal products (meat, eggs, etc.); and,
4) other goods (handicrafts, processed foods, commodities bought and sold, etc.)

Although, small quantities of food crop commodities (e.g., shelled maize and plantains) were sold throughout the year, the largest part (80%) of crop generated income came from the sale of coffee (December) and rice (January) **(Figure 32, Appendix G(II))**. Mean total crop sales per farm for the year amounted to 131,227 CFA.

Total farm sales were dominated by sales of crops. The monthly distribution showed this bias, with 74% of total farm sales occurring in November, December and January **(Figure 33)**. Crop sales accounted for 77% of total farm sales **(Figure 34)**. Twenty percent (20%) of sales were for "other goods", while only 3% were for animals or animal products.

Although they were the largest maize fields on each farm, sales of crops from the monitored fields represented only 7% of total crop sales. Cash crops (coffee and rice) provided the dominant share of farm income from sales (58%).

Mean total cash income deriving from farm sales amounted to 171,100 CFA.

FIGURE 33:

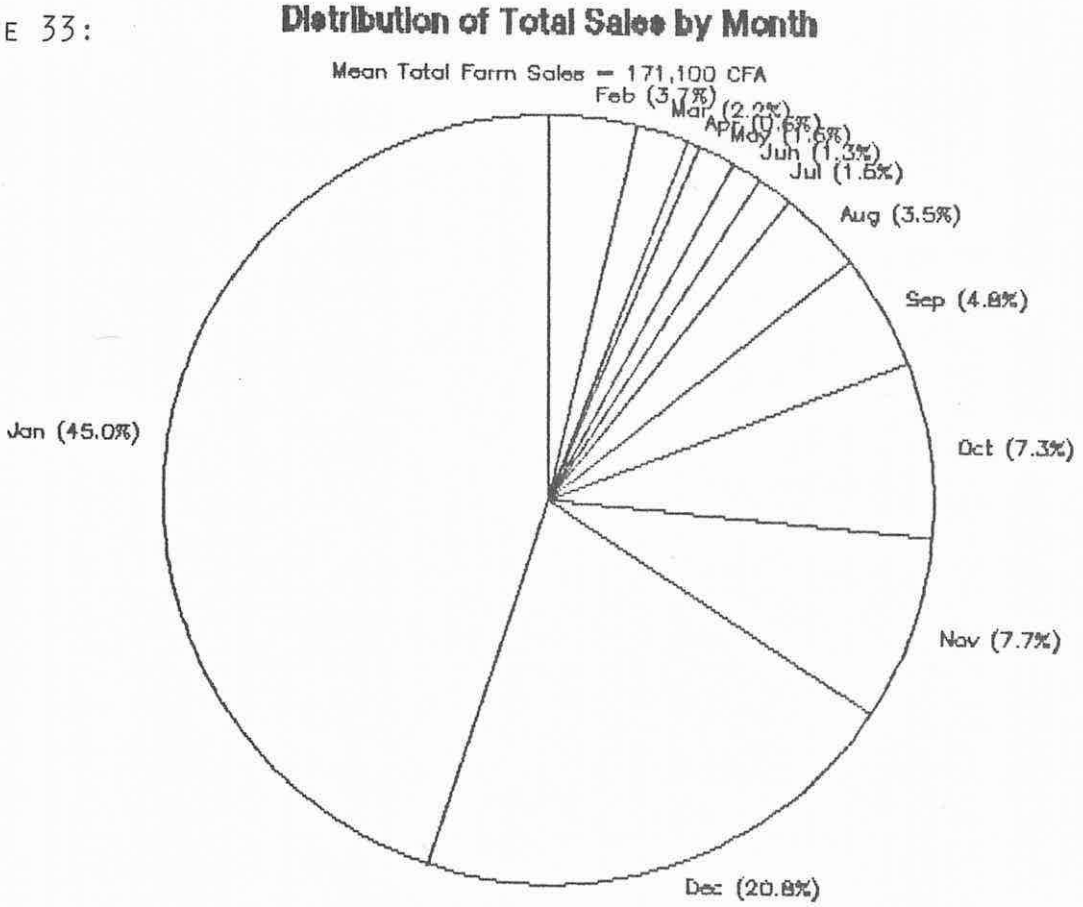
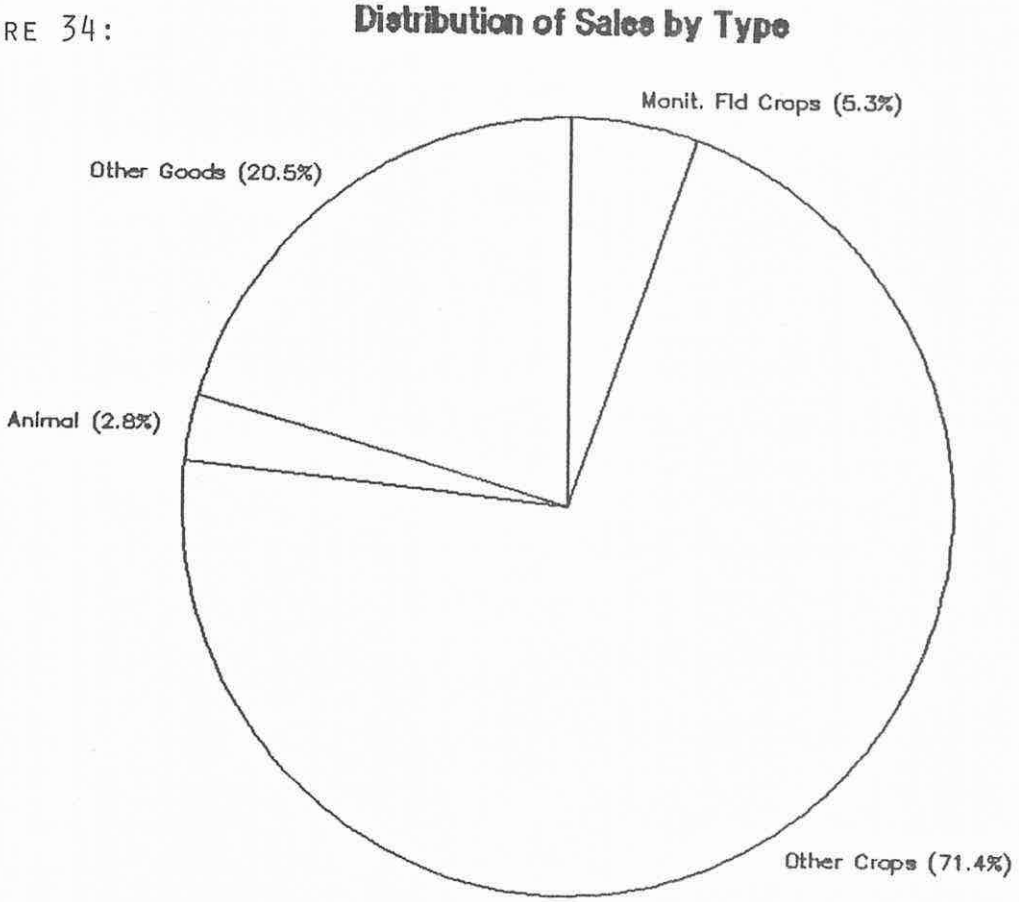


FIGURE 34:



- Conclusion -

Maize is one of the two major cereals crops in Cameroon. It is the staple food crop for the vast majority of peoples in the western highlands, where 70% of the total national crop is produced. The most common use is in a stiff porridge called "corn fufu", that is eaten with leafy vegetables or soup.

The Ndop Plain, located in the southeastern corner of the North West Province, is one of the most fertile and productive agricultural areas in Cameroon. Covering an area of over 1,000 square kilometers, at elevations of between 1150 and 1300 meters above sea level, the Plain has a population of 110,000 inhabitants. A large area of formerly unexploited hydromorphic soils has been developed for rice cultivation beginning in the mid 1970's by UNVDA; and rice now rivals coffee as a cash crop for some 6,000 farmers. While maize remains the most important subsistence crop, it is lately assuming greater importance as a secondary cash crop.

In the Ndop Plain, maize is grown in association with other crops (groundnuts, cocoyams, beans, egusi melon, etc.), and on ridges, in which weed and crop residues have been incorporated. Planting begins at the start of the rainy season in March. Maize can be harvested as early as the end of July and as late as the second week of September. The other crops in the intercrop are planted at the same time as maize; but following their different growth cycles, are harvested either before or after maize. Double cropping of maize is not practiced, because of the heavy infestation of corn borers and disease (streak virus) in the late

planted crop.

Labor is the most costly, and potentially constraining, factor in maize production. With the exception of a few "progressive" farmers (e.g., oxen farmers or those few who rent tractors), all field operations are done by hand. Labor use is intensive and onerous. Land preparation and planting, carried out simultaneously by the majority of farmers, were the most demanding tasks, requiring 659 man-hours per hectare (36% of total labor). This was followed, in order, by weeding (513 man-hours/ha, 28%), harvesting & transporting (342 man-hours/ha, 19%) and land clearing (207 man-hours/ha, 11%).

Wives contributed the predominant share of labor inputs to the maize-based cropping system (48%); followed by children (18%) and husbands (16%). Lesser amounts of labor were provided by "other household members" (8%), hired labor (6%) and cooperative farming groups (3%).

Hired labor was relatively costly (206 CFA per man-hour), and was only used when absolutely necessary. Hired labor is usually employed for land preparation and weeding.

The monitored fields yielded an average of 1,973 kg of shelled maize per hectare, plus relatively small amounts of groundnuts, cocoyams and beans. Mean yields of other crops (egusi, cowpeas, yams, cassava, etc.) were insignificant.

The mean total value of crops harvested was 104,487 CFA/ha. Total production costs, including hired labor, but excluding household labor, amounted to 36,419 CFA/ha. This left a total net return to farm family labor and land of 68,068 CFA/ha.

Net returns per hour of farm family labor was very low (39

CFA per man-hour). Results from on-farm trials in the Ndop Plain over 6 years have shown that by changing to an improved maize variety (Kasaï I or COCA) and applying a moderate rate of nitrogen (50 kg/ha), farmers can boost returns to farm family labor by at least 25%, and quite possibly by as much as 50 to 75%.

Crops accounted for 77% of total farm sales and cash crops (rice and coffee) accounted for 75% of crop sales. This left 19% of total farm sales coming from food crops, including maize. Mean total sales for the monitored farms was 171,100 CFA.

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APPENDIX A

Questionnaires

and

Data Collection Forms

A (I) VILLAGE BACKGROUND INFORMATION QUESTIONNAIRE Date:_____

1) Village:_____ Area Council:_____

Subdivision: Ndop Division: Mezam

Quarters (distance from village center): _____(__km)

_____(___) _____(___) _____(___)

_____(___) _____(___) _____(___)

_____(___) _____(___) _____(___)

Distance from village center to Ndop:_____km Elev:_____masl

2) Estimated Village Population: _____

3) Village Market (Y/N):_____ Location in village:_____

How often?_____ Date of next market day:_____

Who regulates the market?_____

Marketing fees for farmers?_____

4) Transportation Road motorable all year?___ How often graded?_____

No. vehicles pass through village in 1 day? Low___ High____ Avg____

Cost: Passenger to Ndop?_____CFA Bag of maize (100 kg)?_____CFA

No. Handtrucks in village?_____ Cost bag fertilizer 1 km:_____CFA

5) Agricultural Post (Y/N):_____ Name of Post:_____

Name of Chief of Post:_____ No. Years there:_____

Training?_____ Native of _____

Names of VEW's	Yrs in village	Training	Where from
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Services given farmers:_____

_____

Rainfall records for 1986 (mm)? Total rainfall:_____

Jan_____ Feb_____ Mar____ Apr____ May____ June____

Jul____ Aug____ Sept____ Oct____ Nov____ Dec____

Temperature records for 1986 (min/max/mean)?

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Min	___	___	___	___	___	___	___	___	___	___	___	___
Max	___	___	___	___	___	___	___	___	___	___	___	___
Mean	___	___	___	___	___	___	___	___	___	___	___	___

6) Credit Union (Y/N)?____ Name:_____

Name of president:_____Location in Village:_____

Number of members:_____ How long in village?_____

Total current savings:_____CFA Interest rate on loans:_____

No. Outstanding loans?_____ Total outstanding loans:_____

Rate of defaults on loans?_____ Comments:_____

7)

Cooperatives	Crop(s)	Services (market, inputs, credit)
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

8)

Other Agencies	Purpose	Services offered
_____	_____	_____
_____	_____	_____

9)

Schools	Type	Students	Teachers	Cost/year/student
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

10) Traditional Ruler. Name of the Fon:_____

How long reigned?_____ Area under his control:_____

Role in agricultural land distribution:_____

_____

11) Taxes. Who must pay official taxes?_____ Rate:_____CFA/man

What, if any, traditional taxes?_____

A (II) DAILY LABOR INPUT REPORT FORM FOR MONITORED FARM

Village:_____ Farmer:_____ Day_____ Date_____

Operations on Monitored Field[1]:_____ Crops:_____

Tools used[2]:_____ Inputs[3]:_____ Quantity_____

	Number of Workers	Time Started[4]	Time Ended[5]	Period Not Worked[6]	Hours Worked[7]
Husband	1				
Wife (s)					
Children					
Other Household					
Farm Group					
Hired					

(Amount Paid to Hired Labor = _____CFA)

All Other Farms: Crops:_____

Operations:_____

Tools used:_____ Inputs:_____ Quantity:_____

	Number of Workers	Time Started	Time Ended	Period Not Worked	Hours Worked
Husband	1				
Wife (s)					
Children					
Other Household					
Farm Group					
Hired					

(Amount Paid to Hired Labor = _____CFA)

****

Household Activities:	Activities	Time used (Man-Hours)
Husband:		
Wife (s)		
Children (<15)		
Other household		

Off-Farm Activities:	Activities	Time used (Man-Hours)
Husband:		
Wife (s)		
Children (<15)		
Other household		

---

[1] Land Clearing, Land Preparation, Planting, Fertilizer application, Thinning, Weeding, Harvest, Transporting, etc.

[2] Hoe, Cutlass, Oxen and Plow, Tractor, Hand truck, etc.

[3] Improved seed, Chemical fertilizer, Animal manure, Pesticide, etc.

[4] Time that the worker in question actually begins the operation.

[5] Time that the worker in question stops working on the operation.

[6] Length of time spent resting, or eating lunch, or working on another operation (hours).

[7] Hours Worked = Time Ended - Time Started - Period Not Worked.

A (III) WEEKLY LABOR INPUT REPORT FORM FOR MONITORED FARM

Village:_____ Farmer:_____ Dates:_____

Operation on Monitored Field	Total Man-Hours Worked	Amount Paid
Clearing: Tool=_____ (Cutting grass/bush___; Removing___; Burning___)		
Husband	_____	
Wife (Wives)	_____	
Children (<15 years)	_____	
Other Household[1] (_____)	_____	
Farmers Group	_____	
Hired Labor	_____	_____CFA
Land Preparation: Tool=_____ (Tilling___; Making ridges___; Ankara___)		
Husband	_____	
Wife (Wives)	_____	
Children (<15 years)	_____	
Other Household (_____)	_____	
Farmers Group	_____	
Hired Labor	_____	_____CFA
Planting: Crops = _____ (Fertilizer?___)		
Husband	_____	
Wife (Wives)	_____	
Children (<15 years)	_____	
Other Household (_____)	_____	
Farmers Group	_____	
Hired Labor	_____	_____CFA
Fertilizer Application: (Fertilizer___; Manure (_____?)___; Moulding___)		
Husband	_____	
Wife (Wives)	_____	
Children (<15 years)	_____	
Other Household (_____)	_____	
Farmers Group	_____	
Hired Labor	_____	_____CFA
Weeding: (Hand___; Hoe___; Moulding___)		
Husband	_____	
Wife (Wives)	_____	
Children (<15 years)	_____	
Other Household (_____)	_____	
Farmers Group	_____	
Hired Labor	_____	_____CFA
Harvest: Crops = _____ (Cutting/digging___; Threshing/shelling___)		
Husband	_____	
Wife (Wives)	_____	
Children (<15 years)	_____	
Other Household (_____)	_____	
Farmers Group	_____	
Hired Labor	_____	_____CFA

[1] All other members of the household (other relatives, etc.)

Transporting: Crops = _____ (Farm to house___; House to mkt___)
[Means: Head___; Hand truck___; Vehicle___; Other (_____?)___]

Husband	_____	
Wife (Wives)	_____	
Children (<15 years)	_____	
Other Household (_____)	_____	
Farmers Group	_____	
Hired Labor	_____	_____CFA

Other: [Apply Chemicals (Name=_____,Crop=_____;Use=_____)___;
Pruning___; Processing (_____?)___; Other (_____?)___]

Husband	_____	
Wife (Wives)	_____	
Children (<15 years)	_____	
Other Household (_____)	_____	
Farmers Group	_____	
Hired Labor	_____	_____CFA

****

All Other Farms: Crops_____ Operations_____

Husband	_____	
Wife (Wives)	_____	
Children (<15 years)	_____	
Other Household (_____)	_____	
Farmers Group	_____	
Hired Labor	_____	_____CFA

****

	Activities	Total Man-Hrs Used
Household Activities[a]:		
Husband	_____	_____
Wife (Wives)	_____	_____
Children (<15 years)	_____	_____
Other Household (_____)	_____	_____
Off-Farm Activities[b]:	Activities	Total Man-Hrs Used
Husband	_____	_____
Wife (Wives)	_____	_____
Children (<15 years)	_____	_____
Other Household (_____)	_____	_____

	Total Number of Sick Days
Sick Days:	
Husband	_____
Wife (Wives)	_____
Children (<15 years)	_____
Other Household (_____)	_____

Enumerator_____ Signature_____

---

[a] Processing foodcrops, Processing cash crops, Handicrafts, etc.

[b] Off-farm employment, Selling at the market or cooperative, Purchasing fertilizer, etc.

A (IV) HARVEST YIELD REPORT FORM FOR MONITORED FIELD

Village:_____ Quarter:_____

Farmer:_____ Date harvested:_____

Crop Harvested	Number[1]	Fresh Field Weight	Dry (Shelled) Weight
Maize (for grain)	_____	_____	_____
" (green ears)	_____	_____	_____
Groundnuts		_____	_____
Beans (color_____)		_____	_____
Cowpeas		_____	_____
Soybeans		_____	_____
Cassava	_____	_____	Processed:_____
[How processed: gari___; flour/kumkum___; other (?)___]			
Cocoyam (Colocasia)	_____	_____	
" (Macabo)	_____	_____	
Sweet Potatoes	_____	_____	
Irish Potatoes	_____	_____	
Vegetables (egusi)	_____	_____	Processed:_____
" (jamajama[2])		_____	
" (other:_____)	_____	_____	_____
" (other:_____)	_____	_____	_____
Plantains	_____	_____	
Bananas (sweet)	_____	_____	
" (achu)	_____	_____	
Coffee		_____	Processed:_____
Cocoa		_____	Processed:_____
Other:_____	_____	_____	_____

Enumerator:_____ Signature:_____

_____

[1] Number of Ears of Maize; Tubers or Corms of Cassava, Cocoyam, Sweet Potato and Irish Potato; or, Regimes of Bananas and Plantains.

[2] Huckleberry.

A (V) FARM PRODUCE MARKETING QUESTIONNAIRE (Monitored Farms)

1) Farmer:_____

2) Village:_____ Quarter:_____

3) Date:_____ Day:_____ Time:_____

4) List the agricultural produce from the MONITORED field that was sold.

Crop	Form Sold[1]	Where Sold[2]	Quantity Sold Nº.	Quantity Sold Kg	What Price (CFA)	Transport Cost (CFA)
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____

5) List the agricultural produce from all other fields that was sold.

Crop	Form Sold	Where Sold	Quantity Sold Nº.	Quantity Sold Kg	What Price (CFA)	Transport Cost (CFA)
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____

6) List the animals or animal products sold from the farm.

Animal	Form Sold[3]	Where Sold	Quantity Sold Nº.	Quantity Sold Kg	What Price (CFA)	Transport Cost (CFA)
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____

7) Other goods sold in the market or elsewhere (mats or handicrafts, commercial goods, agricultural commodities bought from other farmers)

Item	If bought, What Cost?	Where Sold	Quantity Sold Nº.	Quantity Sold Kg	What Price (CFA)	Transport Cost (CFA)
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____

Enumerator:_____ Signature:_____

[1] Roasting ears, Dry grain, flour, miando, egusi pudding, oil, etc.

[2] Village market, Another market, Cooperative, Trader, etc.

[3] Live animal, meat, eggs, milk, skin, manure, etc.

A (VI) MARKET FOOD CROP COMMODITY PRICES

- Survey Questionnaire -

Market: _____

Date: _____ Day: _____. Time: _____

Village: _____ Quarter: _____

Commodity & Form		Unit (bucket, glass)	Price per Unit	Weight per Unit	Price per Kg
Maize	grain				
	corn flour				
	roasting ears				
	other _____				
Rice	Local				
	Imported				
	other _____				
Groundnut	Shelled				
	in Shells				
	other _____				
Beans	Speckled				
	Red				
	Black				
	White				
	other _____				
Cowpeas	beans				
	other _____				
Cocoyams (Taro)	tubers (corms)				
	other _____				
(Macabo)	tubers (corms)				
	other _____				
Yams	tubers				
	other _____				

Commodity & Form		Unit (bucket, glass)	Price per Unit	Weight per Unit	Price per Kg
Cassava (bitter)	tubers				
	gari				
	flour (kumkum)				
	miando				
	other_____				
Cassava (sweet)	tubers				
	other _____				
Sweet Potatoes	tubers				
	other _____				
Irish Potatoes	tubers				
	other _____				
Vegetables	egusi seeds				
	egusi pudding				
	jamajama (huckleberry)_____				
	tomatoes				
	onions				
	peppers				
	others_____				
	_____				
	_____				
Plantains	regimes/hands				
	other _____				
Bananas	regimes/hands				
	other _____				
Others_____					
	_____				
	_____				
	_____				

Enumerator: _____ Signature: _____

A (VII) SURVEY QUESTIONNAIRE FOR THE MONITORED FIELD

I General Information:

1) Farmer's Name:_____ 2) Village:_____

3) Date of Interview:_____ Interviewer:_____

4) Location of Monitored Field: a) Elevation:_____ m.a.s.l.

b) Distance from the house:_____ km _____ hours

II History of the Monitored Field:

5) Land Tenure:

a) How long have you had this field?_____

b) How was it obtained (inherited,etc.)?_____

c) Can you easily obtain more land? (Y/N)_____

If yes, how?_____

If no, why not? _____

6) Cropping History (Rotation):

a) What crops were planted this year? last year? 2 years ago? 3 years ago? (1st season? 2nd season?)

	Y		E		A		R	
	This year		Last year		2 yrs ago		3 yrs ago	
CROP:	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Maize								
Groundnuts								
Beans								
Cowpeas								
Soybeans								
Colocasia								
Macabo								
Yam ( )								
Cassava								
Sweet Potatoes								
Irish Potatoes								
Banana								
Plantain								
Coffee								
Egusi Melon								
Huckleberry								
Okra								
Other ( )								
Bush Fallow								

b) Who decides what is planted on the field? Husband___ Wife___

c) Have you ever left this field fallow? (Y/N)_____

- Why or why not?_____

- If yes, for how many years?_____

- After how many years under cultivation?_____

d) Have maize yields been increasing?_____ decreasing?_____

- What of other crop yields?_____

e) How much maize did you harvest last year?_____ bags

7) Factor Inputs used on the monitored field:

a) Maize Variety: - What maize varieties did you plant?_____

- Where did you get the seed?_____

- At what cost?_____

- Why do you plant this variety?_____

b) Do you use an improved variety of any other crops? (Y/N)_____

- If yes, which crops? _____ _____ _____

- Name the varieties? _____ _____ _____

c) Fertilizer:

- Did you apply fertilizer this year or last? (Y/N)_____

Why or why not?_____

If yes, what kind? And how much?

Type of Fertilizer	Quantity (bags)
This Year	
20-10-10	
Ammonium Sulfate	
Other ( )	
Last Year	
20-10-10	
Ammonium Sulfate	
Other ( )	

- Which crops do you apply it to?_____

Why?_____

- How many times do you apply the fertilizer?_____

- At what plant stages (weeks after planting)?_____

- How do you apply it? Broadcast_____ Band_____ Ring_____

- How much did you pay for a bag of fertilizer?

  Last year?_____CFA This year?_____CFA

- Where did you buy your fertilizer?_____

  - How far is the source from your farm?_____km

  - Mode of transport?_____ What cost?_____CFA/bag

  - Did you pay cash? (Y/N)_____

  - If credit, how do you pay back?_____

- Who decides to apply fertilizer? Husband_____ Wife_____

d) What other inputs did you use last year?

Input	Name	Source	Quantity	Cost	Crop(s)
Insecticide					
Fungicide					
Herbicide					
Animal Manure					
Wood Ashes					
Other_____					

8) Production Problems:

a) What production problems did you experience last year?

- Birds____ - Animals____ - Soil Insects___
- Borers____ - Disease____ - Weeds____
- Soil fertility____ - Soil erosion____ - Drought____
- Flooding____ - Hail____ - Thieves____
- Other ( )____ - Other ( )____

b) Indirect causes? Labor constraint____ Cash constraint____

9) Use of the Produce:

a) How much of each crop was harvested last year? How much was sold? Where? For how much?

Crop	Quantity harvested	Quantity Sold	Quantity Stored	Price Received

III Description of the Monitored Field:

10) Size of the Field_____ ha. Shape?_____

11) Soil Analysis (from sample taken from the field). Sample N°____

- pH:_____ - Organic Carbon:_____ % - CEC:_____ meq/100 g

- Texture:_____ - Sand___ % - Silt___ % - Clay___ %

Available N_____ Available P_____

(_____)_____ (_____)_____

(_____)_____ (_____)_____

- Approximate depth of top soil_____ cm

12) Average Slope of the Field: From _____ % to _____ %
(flat = 0 - 5%; medium = 6 - 15%; steep = > 15%)

- Degree of erosion: Little____ Moderate____ Severe____

13) Seedbed Configuration: - Ridges_____ Mounds____ Flat____

- Mean distance between centers of ridges_____ m

- Mean width of the ridge itself_____ m

- Mean length of Ridges/Mounds_____ m

- Orientation of Ridges/mounds? contour_____ Slope_____

14) Shading by trees: None:___ Little___ Moderate___ Serious___

IV Crop Association on the Monitored Field:

15) Check off the crops in the field.

Maize(M)__	G'nut(G)__	Beans(B)__	Cowpeas(Cp)__
Soybean(Sb)__	Colocas.(Co)__	Macabo(X)__	Cassava(C)__
Yams(Y)__	S.Potato(Sp)__	I.Potato(Ip)__	Banana(Ba)__
Plantain(P)__	Coffee(Robusta)(Rc)__	(Arabica)(Ac)__	
Egusi(E)__	Pumpkin(Pu)__	Hucklber.(H)__	Okra(O)__
Sorghum(S)__	Bambara Nut(Bg)__	Rice(R)__	Sugar Cane(Sc)__
Oil Palm(OP)__	Raphia Palm(RP)__	Avocado(A)__	Mango(MT)___
Other (_____)___		Other (_____)___	

16) Are there any crops that you grew 5 years ago, but don't grow now? (Y/N)_____ Name them.

_____ _____ _____

Why don't you grow them any more? _____

17) Are there any new crops that you grow now, that you didn't grow 5 years ago? (Y/N)____ Name them.

_____ _____ _____

Why did you start growing them? _____

18) Draw a map of the plant configuration.

V Crop Protection (with the assistance of the pathologist and entomologist)

20) Diseases on the crops:
- Maize: H.turcicum___ H.maydies___ P.sorghi___
  P.polysora___ MSV___ Curvularia___
  Head Smut___ Common Smut___ Other (_____)___
- G'nut: Rosette___ Cercospora___ Other (_____)___
- _____: (_____)___ (_____)___
- _____: (_____)___ (_____)___

21) Insects on the crops:
- Maize: Leaf Hopper___ Stem Borer___ Cut Worm___
  Other (_____)___ (_____)___
- _____: (_____)___ (_____)___
- _____: (_____)___ (_____)___

22) Weeds: Imperata cylindrica___ Elephant grass___
Other (_____)___ (_____)___ (_____)___

23) Animals (wild and domestic) and bird damage:
Goats/Sheep___ Cows___ Pigs___ Fowl___
Birds___ Cutting Grass___ Other (_____)___

VI Cultural Practices.

24) Land Clearing method: Slash/Bury___ Slash/Burn on surface___
Ankara___ Slash/Carry away___ (_____)___

Tools: Cutlass___ Hoe___ (_____)___

When (months)?_____

Problems?_____

25) Land Preparation (Tilling and Ridging):

When (months)?_____

Tools used? Hoe___ Oxen & Plow___ Tractor & Plow___
(_____)___ (_____)___

26) Planting:

Crop	Variety	Timing	Spacing(plt/hill)
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

_____ _____ _____ _____
_____ _____ _____ _____
_____ _____ _____ _____
_____ _____ _____ _____
_____ _____ _____ _____

Problems?_____

27) Maize thinned?Y/N___ # seeds planted?____ # plants desired___

28) Weeding: - Method? Hand___ Hoe___ Oxen___ Tractor___
Mulch___ Herbicide (_____)___

- How many times?_____

- When (months)?_____

Problems?_____

29) Other operations: (moulding/ridging, transplanting, spraying, pruning, mulching, etc.)

Operation	Crops	Timing

VII Harvest and Post-Harvest.

30) When did you harvest last year's crops from the field? How were they transported from the field? What was their final use? How were they processed?

Crop	Month Harvested	Transport	Use	How Processed

31) How did you store last year's produce from the field? In what form? What problems were encountered? How much produce was lost? What control methods did you use?

Crop	Form	Storage Method	Problems	Loss	Control Method

A (VIII) MONITORED FARM HOUSEHOLD and FARM LABOR DISTRIBUTION

1) Farmer's Name: _____ Village: _____

2) Enumerator: _____ Date: _____

3) List the members of the farm household (husband, wife or wives, children, relatives and non-relatives).

Name	Sex	Age	Relationship to Head of Household	Education	Works on the Farm? (Y/N)

4) Farm labor distribution: Who does what on the farm?
M = Husband (Man); W = Wife; C = Children, <= 15 years;
O = Other household members; F = Farmers' group; H = Hired

Operation	Crop(s)	Who does it?
Land Clearing	Cash (Coffee)....	M__ W__ C__ O__ F__ H__
	" (Rice)	M__ W__ C__ O__ F__ H__
	Food Crops	M__ W__ C__ O__ F__ H__
Land Preparation	Cash (Coffee).....M__	W__ C__ O__ F__ H__
	" (Rice)	M__ W__ C__ O__ F__ H__
	Food Crops	M__ W__ C__ O__ F__ H__
Planting	Cash (Coffee).....M__	W__ C__ O__ F__ H__
	" (Rice)	M__ W__ C__ O__ F__ H__
	Food Crops	M__ W__ C__ O__ F__ H__
Weeding	Cash (Coffee).....M__	W__ C__ O__ F__ H__
	" (Rice)	M__ W__ C__ O__ F__ H__
	Food Crops	M__ W__ C__ O__ F__ H__
Fertilizer Appl	Cash (Coffee).....M__	W__ C__ O__ F__ H__
	" (Rice)	M__ W__ C__ O__ F__ H__
	Food Crops	M__ W__ C__ O__ F__ H__
Harvest&Transpt	Cash (Coffee).....M__	W__ C__ O__ F__ H__
	" (Rice)	M__ W__ C__ O__ F__ H__
	Food Crops	M__ W__ C__ O__ F__ H__
Processing	Cash (Coffee).....M__	W__ C__ O__ F__ H__
	" (Rice)	M__ W__ C__ O__ F__ H__
	Food Crops	M__ W__ C__ O__ F__ H__
Marketing	Cash (Coffee).....M__	W__ C__ O__ F__ H__
	" (Rice)	M__ W__ C__ O__ F__ H__
	Food Crops	M__ W__ C__ O__ F__ H

A (IX) FARMER RANKING OF IMPORTANCE OF MAIZE VARIETY CHARACTERISTICS

(Have each farmer rank the characteristics from 1 to 7, where 1 = the most important characteristic for a maize variety)

FARMER	CHARACTERISTICS						
	PLANT HEIGHT[1]	YIELD	EARLINESS[2]	GRAIN COLOR[3]	GRAIN TYPE[4]	DISEASE RESISTANCE	TASTE
1)							
2)							
3)							
4)							
5)							
6)							
7)							
8)							
9)							
10)							
11)							
12)							
13)							
14)							
15)							
16)							
17)							
18)							
19)							
20)							
21)							

[1] Tall variety vs short variety.

[2] Date of harvest.

[3] White vs yellow.

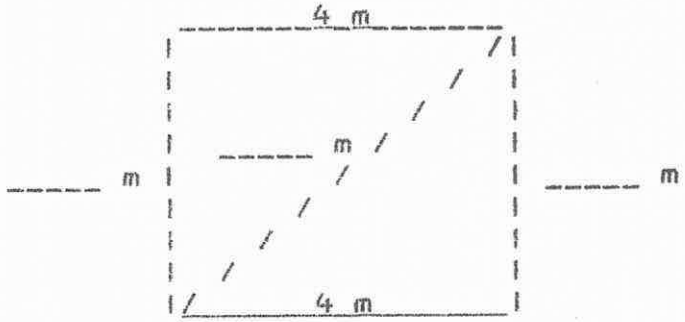
[4] Denty (soft) vs Flinty (hard) grain.

A (X) **CROP ASSOCIATIONS ON MONITORED FIELDS**

Village:_____ Farmer:_____

Date of Observation:_____ Observer:_____

1st Sample Sub-Plot: (Fill in the dimensions of the Subplot below)



Area of Plot (sq m):_____ Mean distance between ridges:_____m

Number of Plants of each crop in the sub-plot:

Maize (hills___ plts____) Groundnuts_____ Beans_____ Cowpeas_____

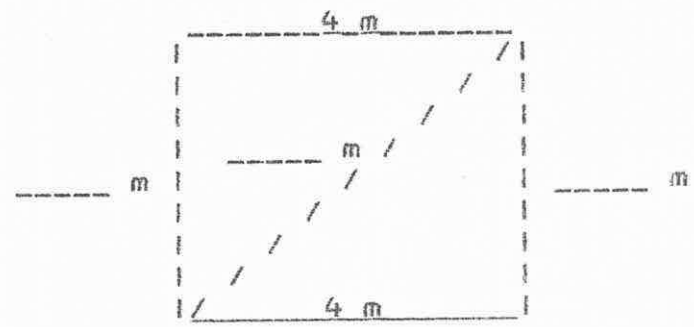
Soybeans_____ Colocassia_____ Macabo_____ Cassava_____

Yams ( )_____ Sweet Potatoes_____ Irish Potatoes_____

Bananas_____ Plantains_____ Coffee_____ Egusi Melon_____

Huckleberry_____ Okra_____ Other (_____)_____

2nd Sample Sub-Plot: (Fill in the dimensions of the Subplot below)



Area of Plot (sq m):_____ Mean distance between ridges:_____m

Number of Plants of each crop in the sub-plot:

Maize (hills___ plts____) Groundnuts_____ Beans_____ Cowpeas_____

Soybeans_____ Colocassia_____ Macabo_____ Cassava_____

Yams ( )_____ Sweet Potatoes_____ Irish Potatoes_____

Bananas_____ Plantains_____ Coffee_____ Egusi Melon_____

Huckleberry_____ Okra_____ Other (_____)_____

APPENDIX B

Village Background Information

B (I)

SURVEY OF MAIZE-BASED FARMING SYSTEMS

Village Background Information for the Ndop Plain

	V I L L A G E					
Item	Kedjom-Ketingo	Bali-Kumbat	Bambalang	Babungo	Babessi	Bangolan
Elevation	1170-2000 m	1230	1120	1120	1190	1200
SubDiv.	Bamenda	Ndop	Ndop	Ndop	Ndop	Ndop
R Council	Tubah	Ndop	Ndop	Ndop	Ndop	Ndop
Dist to Ndop	17 km	18	28	8	25	43
Fare to Ndop[1]	300 CFA	500	500	200	400	500
# Quarters	13	10	18	13	10	9
Main Qtr	Ntekizon	Bati	Mbasho	Finteng	Touchou	Makulung
Population[2]	6,300	14,000	15,000	13,000	8,000	-
# Markets	2	6	3	3	1	1
Main Mkt	Kwighe	3[3]	Mbasho	Finteng	Touchou	Mbuntaw
Frequency	8 days	8 days	8 days	8 days	8 days	8 days
Ag Post	Yes	Yes	Yes	Yes	Yes	Yes
CAP	Kweji	Forchick	G. Ngwa	Njuabe	J. Ngwa	Ngofon
Yrs there	4	1	< 1	3	3	1
Training	ATA[4]	ATA	ATA	ATA	ATA	ATA
# VEW's	5[5]	2	4[6]	2[7]	2	1
Training	MIDENO	none	none	none	ATA & none	none
Rainfall	-	1113	1389	-	1225	-
Temp Minimum	-	11° C	9°	-	-	-
Maximum	-	35° C	39°	-	-	-
Credit Union	Yes	Yes	Yes	Yes	No	No
President	Mukong	Celestine	Kombo	Tumenta	-	-
# Members	-	-	-	80	-	-
Coffee Coop	Yes	Yes	Bamunka	- Joint Coffee Coop, Ndop East		-
UNVDA Buy C.	No	Yes	No	Yes	Yes	Yes
Health Post	Yes	Yes	Yes	Yes	Yes	Yes
MINEPIA Post	Yes	No	Yes	No	No	Yes
Prim Schools	4	-	4	4	4	2
Fon	Viyhugho	Gwanyin	Yakumto	Zofoa	Nchafua	-
Yrs reigned	5 (child)	10	9	32	-	-

---

[1] Fare during the dry season. In the rainy season, when road conditions are bad, the fare can rise by as much as 100 to 400%.

[2] Approximation given by the CAP (usually based on the last Census).

[3] Three main markets and three small markets. The main markets are spaced evenly over the week: 1) "Bati Market" (Bati Qtr) 2) "Small Market" (Bagam Qtr) and 3) "Nyamgin Market (Baba Qtr).

[4] Agricultural Assistant (Cycle C at RCA Bambili; now TSA Bambili).

[5] One (1) VEW covers Bambili, which falls under the Post.

[6] Three are in Bamali, which falls under the Bambalang Post.

[7] One (1) VEW in Baba Village, which is covered by Babungo Post.

APPENDIX C

Monitored Field Maps

Triangle Method of Measuring Field Size

Sometimes farmers' fields are in the form of squares, rectangles, parallelograms or trapezoids. However, in most cases, the shape can only be described as "irregular". Nevertheless, any field can be described (delimited) or at least closely approximated (in the case of curving boundaries) by a perimeter consisting of straight sides (i.e., a polygon: convex or concave). It therefore follows that any field can be subdivided into triangles by connecting the corners of the field. If the areas of the triangles can be calculated and summed, the area of the whole field is obtained.

If the lengths of the three sides are known, the area of a triangle can be computed using the following formula:

$$\text{Area} = \sqrt{s * (s-a) * (s-b) * (s-c)}$$

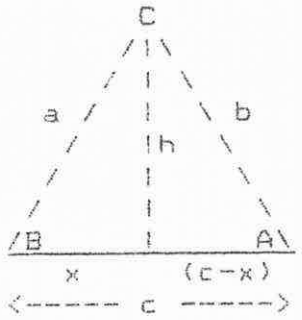
where: a, b and c = the lengths of the 3 sides
and, $s = (a + b + c)/2$

(example: $a = 5$, $b = 5$, $c = 6$
$s = (5+5+6)/2 = 8$

$$\text{Area} = \sqrt{8 * (8-5) * (8-5) * (8-6)} = \underline{12}\ )$$

By this method, the area of any field can be measured, using only a tape measure.

****



Knowing the sides of a triangle, the three angles can also be computed. First, the following simultaneous equations are solved for x and h (the altitude):

$$x^2 + h^2 = a^2$$
$$(c-x)^2 + h^2 = b^2$$

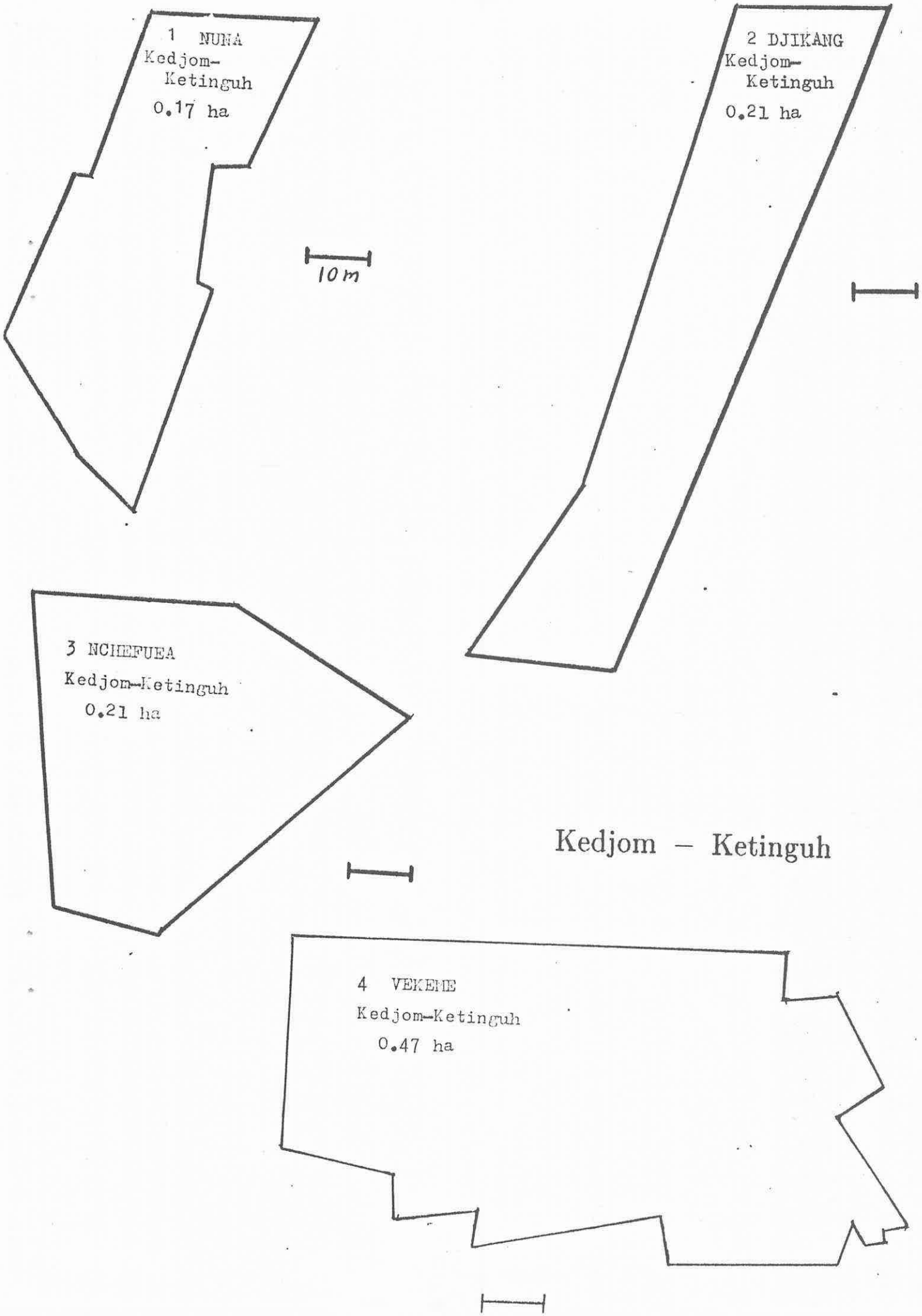
where a, b and c are known (measured). Solving:

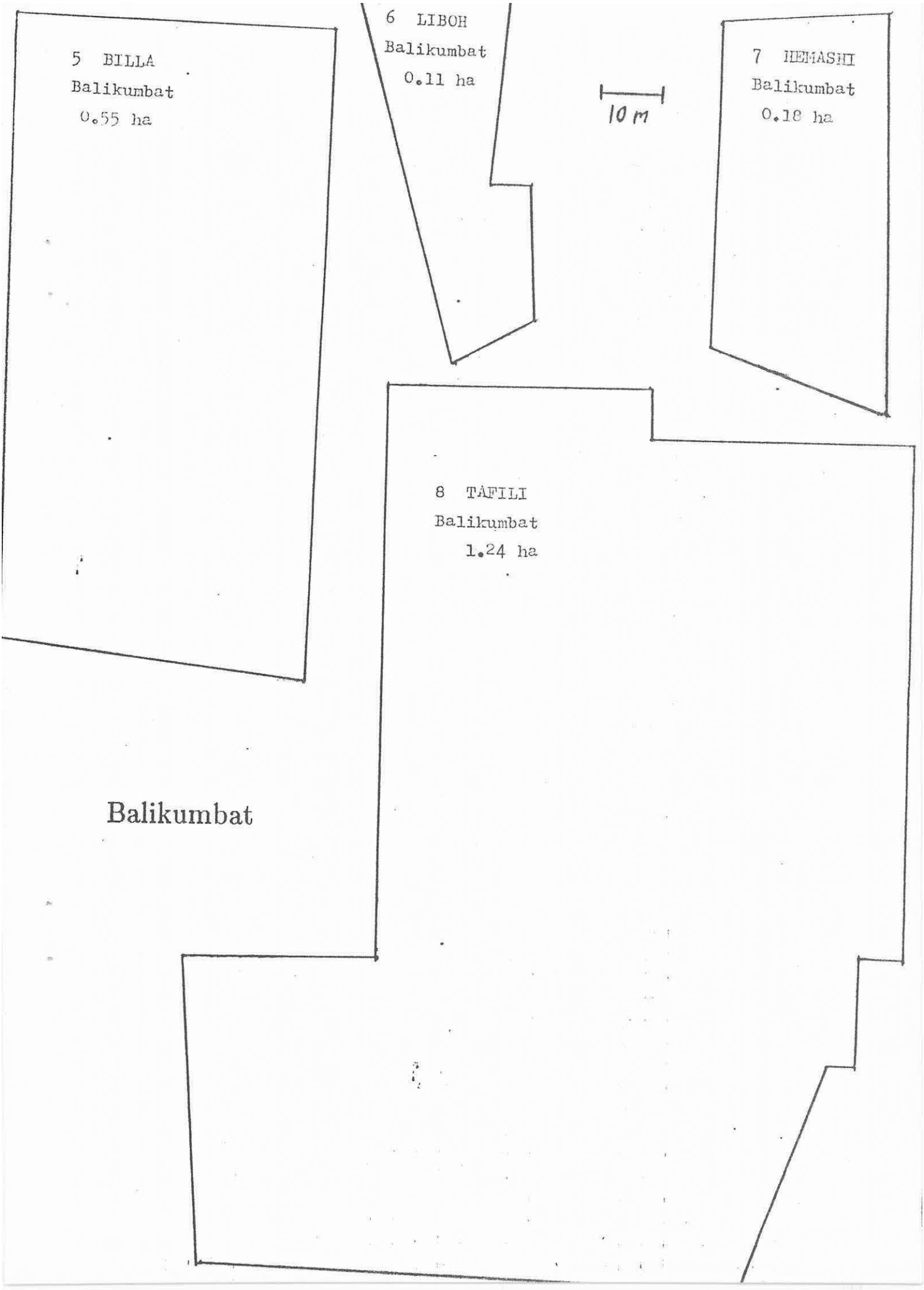
$$x = (c^2 + a^2 - b^2)/2c \quad \text{and} \quad h = \sqrt{a^2 - x^2}$$

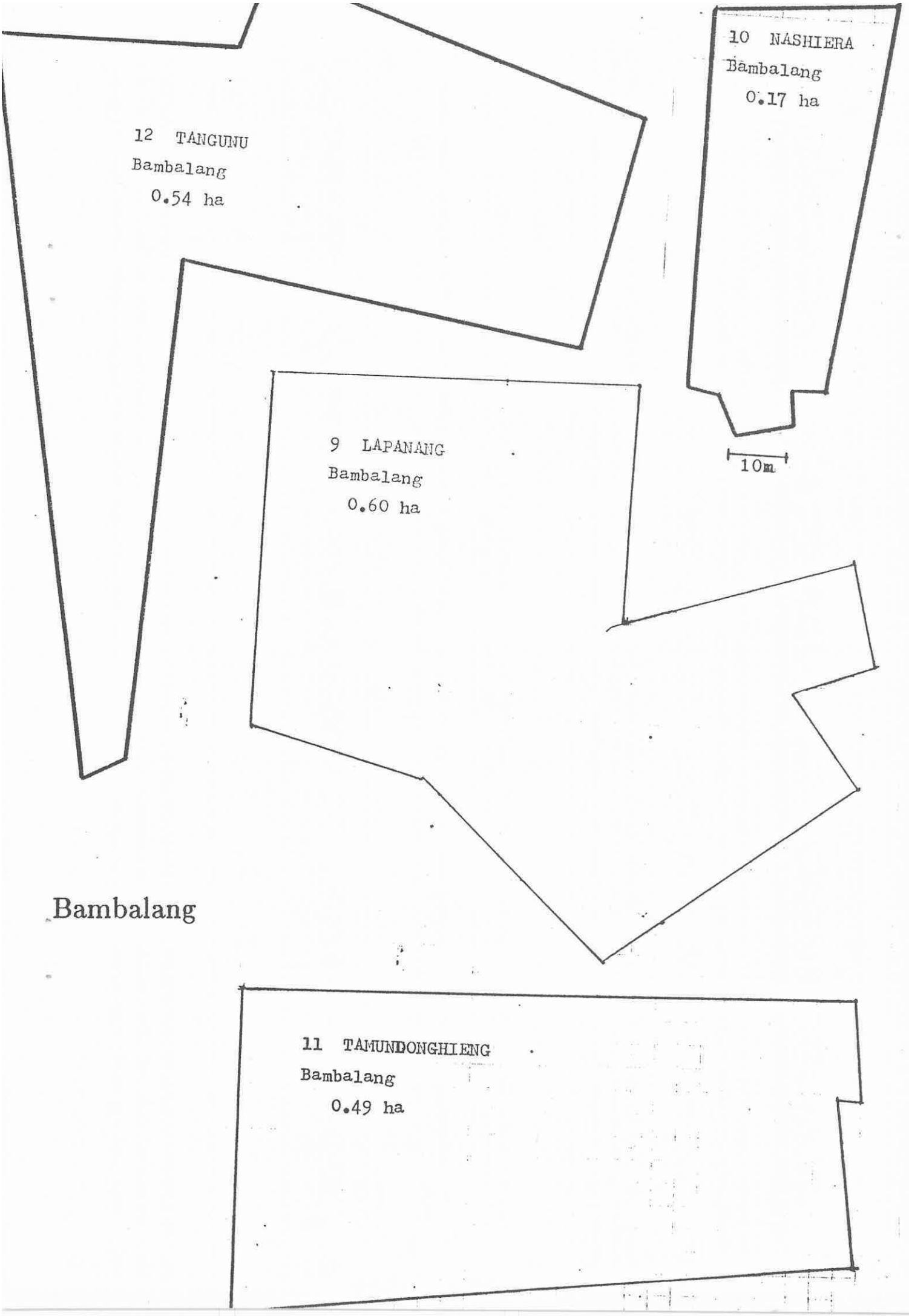
Then the angles can be obtained using a cosine table and the following formulas:

Angle A = arc cosine [(c-x)/b]
Angle B = arc cosine [x/a]
Angle C = 180° - A - B

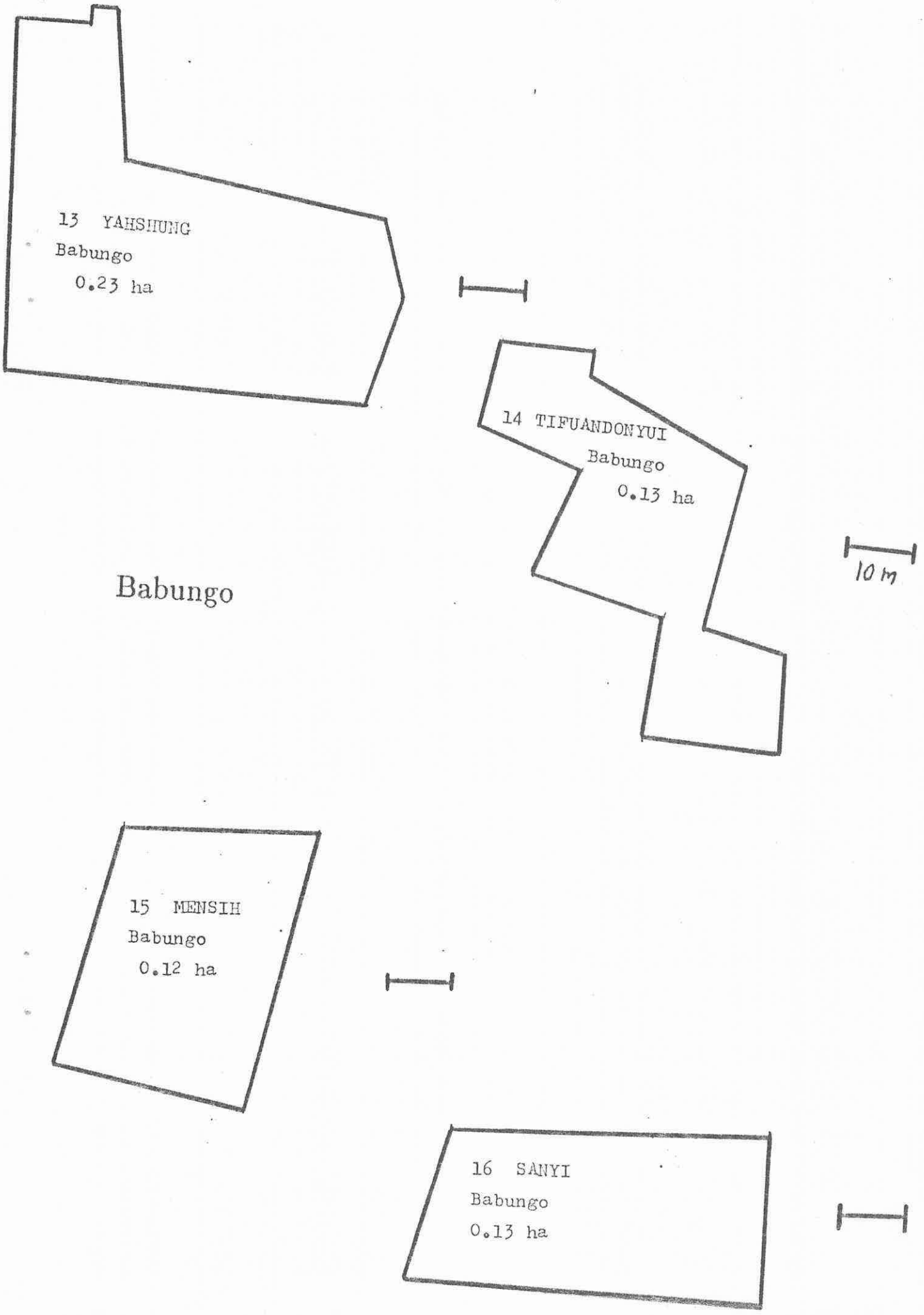
Knowing the angles and sides of the triangles that make up the field, a map of the field can be drawn to scale, using a ruler and protractor.

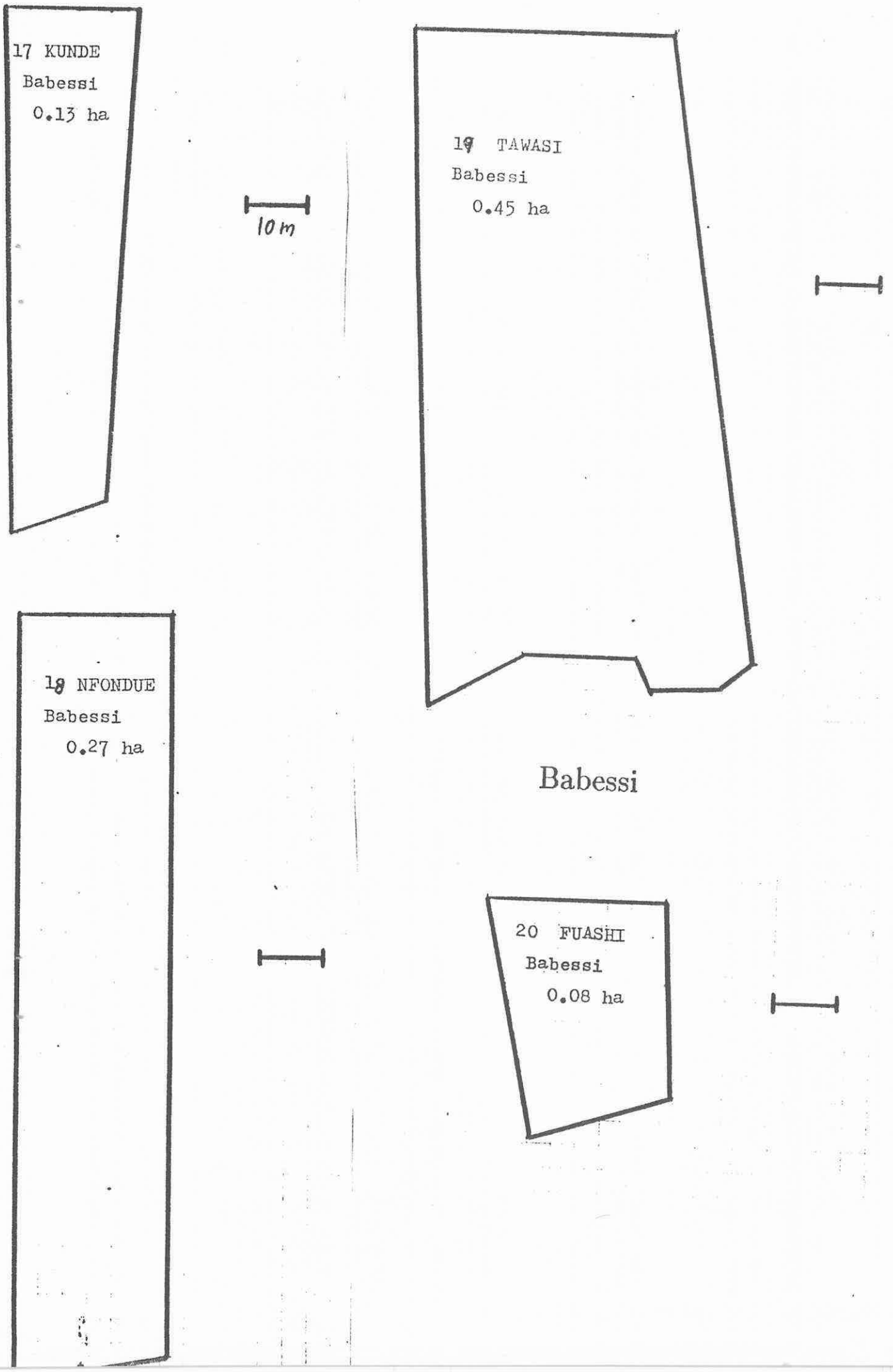

1 NUNA
Kedjom-
Ketinguh
0.17 ha
10 m
2 DJIKANG
Kedjom-
Ketinguh
0.21 ha
3 NCHEFUEA
Kedjom-Ketinguh
0.21 ha
Kedjom – Ketinguh
4 VEKEME
Kedjom-Ketinguh
0.47 ha


5 BILLA
Balikumbat
0.55 ha
6 LIBOH
Balikumbat
0.11 ha
10 m
7 HEMASHI
Balikumbat
0.18 ha
8 TAFILI
Balikumbat
1.24 ha
Balikumbat

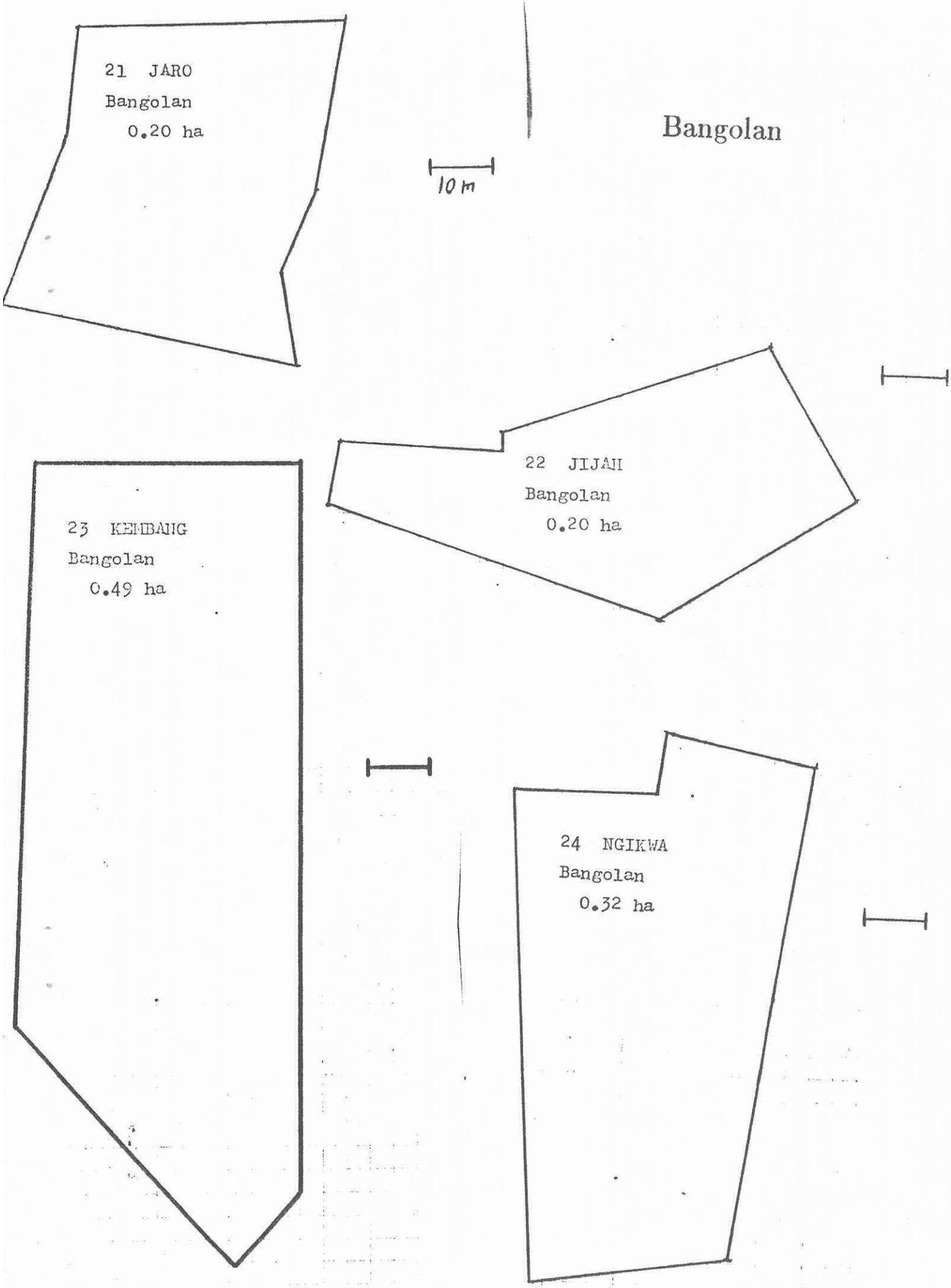

12 TANGUNU
Bambalang
0.54 ha
10 NASHIERA
Bambalang
0.17 ha
9 LAPANANG
Bambalang
0.60 ha
10m
11 TAMUNDONGHIENG
Bambalang
0.49 ha

Bambalang


13 YAHSHUNG
Babungo
0.23 ha
14 TIFUANDONYUI
Babungo
0.13 ha
10 m
Babungo
15 MENSIH
Babungo
0.12 ha
16 SANYI
Babungo
0.13 ha


17 KUNDE
Babessi
0.13 ha
10 m
19 TAWASI
Babessi
0.45 ha
18 NFONDUE
Babessi
0.27 ha
20 FUASHI
Babessi
0.08 ha
Babessi

Bangolan


21 JARO
Bangolan
0.20 ha
10 m
22 JIJAH
Bangolan
0.20 ha
23 KEMBANG
Bangolan
0.49 ha
24 NGIKWA
Bangolan
0.32 ha

APPENDIX D

Soil and Plant Tissue Analyses

and

Crop Associations

D (I) Soil analytical results for monitored fields.

Farmer	Mechanical Analysis Sand	Silt	Clay	pH*	Organic Carbon	Total N	Avail P**	CEC***
	%	%	%		%	%	ppm	meq/100g
Kedjom-Ketinguh								
Nuna	50	30	20	5.3	5.6	0.41	14	28.1
Djikang	56	21	22	5.9	3.8	0.26	10	19.0
Adih	56	17	26	6.1	4.3	0.26	24	22.3
Vekeme	60	21	18	5.2	3.0	0.22	8	20.3
Balikumbat								
Billa	56	17	27	5.9	6.3	0.32	42	21.7
Liboh	54	28	18	5.9	4.7	0.27	13	20.6
Hemashi	50	29	21	5.5	5.6	0.35	11	30.0
Tafili	61	15	24	5.4	5.5	0.31	9	19.0
Bambalang								
Lapanang	64	10	26	5.6	3.7	0.21	6	13.5
Nashiera	58	14	28	5.4	3.6	0.21	6	14.4
Tamundongh.	59	13	28	5.7	3.9	0.25	8	14.7
Tagunu	65	11	24	5.9	3.6	0.22	7	14.8
Babungo								
Janabuh	61	15	24	5.6	4.3	0.25	7	17.2
Tifuandonyui	48	32	20	5.5	5.4	0.41	20	29.8
Mensih	55	21	24	5.8	3.9	0.24	11	25.3
Sanyi	72	13	15	5.9	4.9	0.29	36	12.3
Babessi								
Kunde	70	9	21	5.8	3.0	0.11	9	10.1
Ntobua	56	25	19	5.9	5.8	0.29	22	26.1
Tawase	56	24	20	6.3	4.6	0.30	39	23.6
Fuashi	66	14	20	6.2	4.2	0.18	17	15.1
Bangolan								
Jaro	68	17	15	6.0	6.6	0.33	14	22.0
Jijah	60	27	13	5.6	7.6	0.51	48	30.4
Kembang	66	20	14	5.8	3.8	0.17	18	13.5
Ngikwa	74	9	16	5.7	2.6	0.13	9	9.9

* pH (H_2O) 1 : 2.5

** Bray-2

*** CEC (NH_4 OAc, KCl)

Analyses by the National Soils Centre, Ekona Station, PMB 51 Buea and Dr. Animesh Roy, NCRE Rice Agronomist, IRA-Dschang.

D (I) (continued) Soil analytical results for monitored fields.

Farmer	Base* Saturation	C:N Ratio	Mg^{++}	Ca^{++}	Al^{+++}
	%		meq/100g	meq/100g	meq/100g
Kedjom-Ketinguh					
Nuna	41	14	2.75	7.60	0.40
Djikang	57	15	2.23	7.33	0.00
Adih	62	17	2.38	10.28	0.00
Vekeme	45	13	1.57	6.27	1.61
Balikumbat					
Billa	84	20	3.34	12.95	0.00
Liboh	81	17	2.54	12.72	0.00
Hemashi	72	16	4.14	14.75	0.00
Tafili	44	18	1.51	5.94	0.00
Bambalang					
Lapanang	60	18	1.79	5.81	0.04
Nashiera	49	17	1.38	4.47	0.00
Tamundongh.	62	16	1.71	6.41	0.00
Tagunu	68	16	1.69	7.51	0.00
Babungo					
Janabuh	46	17	2.01	4.56	0.49
Tifuandonyui	32	13	2.87	6.08	0.73
Mensih	59	16	3.71	8.77	0.06
Sanyi	58	17	1.35	5.19	0.00
Babessi					
Kunde	47	27	1.12	2.67	0.35
Ntobua	59	20	3.94	10.02	0.00
Tawase	83	16	5.17	12.14	0.00
Fuashi	65	23	2.16	6.71	0.00
Bangolan					
Jaro	40	20	1.83	5.62	0.00
Jijah	18	15	1.43	3.31	0.15
Kembang	25	22	0.95	2.11	0.51
Ngikwa	16	20	0.41	0.93	0.76

* Total exchangeable bases (TEB) / Cation Exchange Capacity (CEC).

D (II) Maize plant tissue analytical results for monitored fields.

Farmer	N	P	K	Ca	Mg
	%	%	%	%	%
Kedjom-Ketinguh					
Nuna	2.39	0.459	3.84	0.37	0.19
Djikang	2.56	0.382	2.42	0.53	0.26
Adih	1.95	0.186	2.37	0.31	0.30
Vekeme	2.68	0.357	2.40	0.47	0.30
Balikumbat					
Billa	2.35	0.354	3.00	0.50	0.36
Liboh	2.57	0.420	3.23	0.33	0.17
Hemashi	2.34	0.214	2.48	0.35	0.20
Tafili	1,90	0.476	3.74	0.42	0.40
Bambalang					
Lapanang	2.57	0.277	3.65	0.35	0.29
Nashiera	2.22	0.242	2.25	0.29	0.19
Tamundongh.	2.24	0.490	3.45	0.46	0.38
Tagunu	1.75	0.412	3.34	0.51	0.30
Babungo					
Janabuh	2.69	0.420	2.56	0.35	0.21
Tifuandonyui	2.39	0.256	2.54	0.31	0.41
Mensih	2.56	0.382	3.23	0.35	0.25
Sanyi	2.77	0.273	2.38	0.43	0.27
Babessi					
Kunde	2.61	0.354	2.40	0.47	0.23
Ntobua	2.34	0.273	2.45	0.40	0.21
Tawase	1.78	0.238	2.57	0.29	0.34
Fuashi	1.92	0.189	2.40	0.27	0.30
Bangolan					
Jaro	1.83	0.300	3.10	0.27	0.17
Jijah	2.34	0.326	2.28	0.31	0.30
Kembang	2.00	0.186	2.40	0.21	0.18
Ngikwa	----------		No Maize	----------	

Analyses by the National Soils Centre, Ekona Station, PMB 51 Buea

D (III) Observed frequency of selected crops in crop associations on 130 randomly sampled maize fields in the Ndop Plain (1987).

Crop	% of fields in which observed
	(%)
Maize	100
Colocasia	65
Macabo	64
Groundnuts	63
Okra	56
Yams	55
Beans	53
Pumpkin	47
Plantain	44
Egusi melon	43
Cassava	32
Bananas	28
Sweet Potatoes	15
Cowpeas	13
Huckleberry	12
Coffee	12
Raphia Palm	5
Oil Palm	5
Mango	5
Bambara Groundnuts	3
Irish Potatoes	2

Mean number of crops per field = 7.4 (SD = 2.0) (range = 2-14 crops)

APPENDIX E

Labor Utilization Tables

E (I) Mean labor utilization (man-hours ha^{-1}) for the maize-based cropping system, by farm operation.

Farm Operation	n	Mean		SE	Median	
		man-hrs/ha			man-hrs/ha	
Land Clearing	17	207	[11%]	39	203	[12%]
Land Preparation & Planting	22	659	[36%]	71	548	[33%]
Weeding	22	513	[28%]	48	502	[30%]
Fertilizer Applic.	7	24	[1%]	6	20	[1%]
Harvest & transport	21	342	[19%]	49	284	[17%]
(other*)		(93)	[5%]		(118)	[7%]
Total Monitored Field Labor	21	1838	[100%]	158	1675	[100%]

* Thinning maize; earthing up maize & cocoyams; etc.

E (II) Mean total labor utilization (man-hrs) for the monitored farms, by farm enterprise.

Farm Enterprise	Mean		SE	Median	
	man-hrs			man-hrs	
All crops	2283	[84%]	230	2162	[79%]
Monitored field crop	576	(25%)		536	(25%)
All other crops	1707	(75%)		1626	(75%)
Household & off-farm	445	[16%]	-	572	[21%]
Total Farm Labor	2728	[100%]	254	2734	[100%]

E (III) Mean labor utilization (man-hrs ha^{-1}) for the maize-based cropping system, by operation, by labor class.

Labor Class	Land Clearing	Farm Operation: Till & Plant	Weeding	Fert. Applic.	Harvest & Transport	All
		(man - hours per hectare)				
Husband	52	120	73	-	49	299
Wife (ves)	92	320	284	11	151	889
Children*	32	74	77	13	92	334
Other household	25	43	39	-	30	153
Farmer Group	2	28	22	-	10	61
Hired	4	74	18	-	10	102
Total	207	659	513	24	342	1838

* Under 15 years.

E (IV) Distribution of maize-based cropping system labor utilizatio (%), by operation, by labor class.

Labor Class	Land Clearing	Farm Operation: Till & Plant	Weeding	Fert. Applic.	Harvest & Transport	All
	(% of labor contributed by each labor class)					
Husband	25 %	18 %	14 %	0 %	14 %	16 %
--->	(17%)	(40%)	(24%)	(0%)	(16%)	
Wife(ves)	45	49	55	46	44	49
--->	(10)	(36)	(32)	(1)	(17)	
Children*	15	11	15	54	27	18
--->	(10)	(22)	(23)	(4)	(28)	
Other household	12	7	8	0	9	8
--->	(16)	(28)	(25)	(0)	(20)	
Farmer Group	1	4	4	0	3	3
--->	(3)	(46)	(36)	(0)	(16)	
Hired	2	11	4	0	3	6
--->	(4)	(73)	(18)	(0)	(10)	
Total	100 %	100 %	100 %	100 %	100 %	100 %
--->	(11%)	(36%)	(28%)	(1%)	(19%)	

* Under 15 years (for which 2 hours worked = 1 man-hour)

E (V) Mean weekly labor utilization (man-hrs ha^{-1}) for the maize-based cropping system, by operation.

Week of		Land Clearing	Till & Plant	Weeding	Fert. Applic.	Harvest & Transport	Total
			(man - hours	per	hectare)		
Feb	9	15	13	0	0	0	31
	16	74	28	0	0	0	109
	23	19	25	0	0	2	59
Mar	2	26	14	0	0	0	36
	9	10	52	0	0	0	63
	16	4	82	0	0	1	90
	23	1	107	0	0	0	114
	30	0	107	0	0	0	112
Apr	6	0	35	8	0	0	41
	13	0	32	6	0	0	33
	20	0	29	21	0	0	52
	27	0	8	48	0	0	54
May	4	4	6	63	0	0	74
	11	0	2	39	1	0	43
	18	1	2	56	6	0	63
	25	0	1	22	7	0	27
Jun	1	1	1	23	5	1	30
	8	1	2	20	5	0	26
	15	0	1	11	0	1	13
	22	0	1	25	0	3	23
	29	0	0	40	0	4	47
Jul	6	0	0	37	0	0	41
	13	0	0	22	0	0	31
	20	0	0	31	0	2	43
	27	0	0	15	0	19	42
Aug	3	0	0	22	0	55	98
	10	1	0	5	0	20	29
	17	0	0	0	0	40	40
	24	0	0	0	0	34	33
	31	1	12	0	0	51	59
Sep	7	0	14	0	0	48	61
	14	0	1	0	0	13	14
	21	0	6	0	0	16	24
	28	0	4	1	0	5	10
Oct	5	0	13	0	0	1	15
	12	0	8	0	0	2	11
	19	0	15	0	0	0	16
	26	2	5	0	0	0	8
Nov	2	6	7	0	0	2	15
	9	7	2	0	0	1	10
	16	0	1	0	0	1	7
	23	4	0	0	0	0	5
	30	9	1	0	0	1	16
Dec	7	5	5	0	0	2	12
	14	0	6	0	0	1	7
	21	0	4	0	0	2	16
	28	2	2	0	0	10	15
Jan	4	0	2	0	0	0	11
	11	0	0	0	0	1	7
	18	2	1	0	0	0	5
	25	12	2	0	0	1	15
TOTAL		207	659	513	24	342	1838

E (VI) Mean weekly labor utilization (man-hrs) for the monitored farms, by farm enterprise.

Week of		Monitored Field	Other Crops	All Crops		Household & Off-Farm		Total Farm
				(man - hours)				
Feb	9	11	1	12	(80%)	3	(20%)	15
	16	30	20	50	(88%)	7	(12%)	57
	23	22	29	51	(81%)	12	(19%)	63
Mar	2	12	32	44	(86%)	7	(14%)	51
	9	16	28	44	(86%)	7	(14%)	51
	16	24	41	65	(92%)	6	(8%)	71
	23	32	33	65	(90%)	7	(10%)	72
	30	33	19	52	(88%)	7	(12%)	59
Apr	6	18	23	41	(85%)	7	(15%)	48
	13	14	37	51	(93%)	4	(7%)	55
	20	22	27	49	(92%)	4	(8%)	53
	27	18	28	46	(96%)	2	(4%)	48
May	4	21	25	46	(88%)	6	(12%)	52
	11	13	31	44	(92%)	4	(8%)	48
	18	20	26	46	(96%)	2	(4%)	48
	25	12	17	29	(85%)	5	(15%)	34
Jun	1	11	36	47	(92%)	4	(8%)	51
	8	7	37	44	(83%)	9	(17%)	53
	15	5	35	40	(85%)	7	(15%)	47
	22	10	35	45	(88%)	6	(12%)	51
	29	15	29	44	(92%)	4	(8%)	48
Jul	6	14	29	43	(91%)	4	(9%)	47
	13	13	28	41	(87%)	6	(13%)	47
	20	17	26	43	(88%)	6	(12%)	49
	27	14	33	47	(85%)	8	(15%)	55
Aug	3	22	28	50	(72%)	19	(28%)	69
	10	8	38	46	(77%)	14	(23%)	60
	17	13	55	68	(89%)	8	(11%)	76
	24	13	52	65	(92%)	6	(8%)	71
	31	17	53	70	(89%)	9	(11%)	79
Sep	7	18	37	55	(83%)	11	(17%)	66
	14	7	36	43	(78%)	12	(22%)	55
	21	9	33	42	(78%)	12	(22%)	54
	28	6	32	38	(70%)	16	(30%)	54
Oct	5	4	29	33	(70%)	14	(30%)	47
	12	2	30	32	(67%)	16	(33%)	48
	19	5	40	45	(74%)	16	(26%)	61
	26	3	37	40	(75%)	13	(25%)	53
Nov	2	5	43	48	(80%)	12	(20%)	60
	9	3	44	47	(78%)	13	(22%)	60
	16	3	33	36	(69%)	16	(31%)	52
	23	1	29	30	(67%)	15	(33%)	45
	30	4	51	55	(80%)	14	(20%)	69
Dec	7	3	48	51	(81%)	12	(19%)	63
	14	3	52	55	(89%)	7	(11%)	62
	21	3	21	24	(70%)	10	(30%)	34
	28	3	27	30	(70%)	13	(30%)	43
Jan	4	2	35	37	(80%)	9	(20%)	46
	11	3	37	40	(74%)	14	(26%)	54
	18	2	35	37	(68%)	17	(32%)	54
	25	4	34	38	(72%)	15	(28%)	53
TOTAL		576	1707	2283	(84%)	445	(16%)	2728

E (VII) Mean weekly labor utilization (hours worked) for the monitored farms, by labor class (whole farm = all crops, household plus off-farm).

Week of		Husband	Wife(ves)	Children	Other Hshld	Farmer Group	Hired
				(man-hours)			
Feb	9	3	11	1	0	0	0
	16	14	34	4	4	1	1
	23	16	31	5	3	7	0
Mar	2	11	29	4	2	3	2
	9	13	31	4	1	1	1
	16	11	36	14	1	7	2
	23	11	38	12	3	5	2
	30	11	31	8	2	4	4
Apr	6	9	28	5	4	0	2
	13	8	28	6	5	5	4
	20	7	29	4	6	3	2
	27	10	25	4	3	2	4
May	4	11	30	3	3	3	2
	11	10	30	4	4	0	2
	18	6	30	4	4	2	3
	25	7	18	5	3	0	1
Jun	1	10	28	7	4	0	2
	8	13	28	10	1	1	1
	15	11	26	8	3	0	0
	22	10	24	11	2	2	1
	29	9	26	10	2	1	1
Jul	6	9	25	9	1	1	2
	13	7	23	12	1	1	4
	20	8	21	12	2	2	3
	27	10	24	16	3	0	3
Aug	3	11	27	18	8	2	4
	10	7	21	16	5	1	9
	17	10	27	18	5	7	9
	24	12	30	16	8	2	3
	31	13	34	15	8	4	5
Sep	7	13	29	12	6	1	5
	14	12	26	4	5	4	3
	21	14	26	4	4	1	5
	28	14	27	4	3	4	2
Oct	5	14	24	2	4	2	1
	12	14	27	2	3	0	2
	19	17	18	2	5	16	2
	26	15	20	4	3	10	2
Nov	2	15	28	4	3	10	1
	9	12	24	3	4	16	1
	16	14	21	4	4	8	1
	23	14	20	3	6	1	1
	30	12	26	4	4	22	1
Dec	7	12	22	3	4	21	1
	14	12	22	2	6	20	1
	21	10	15	2	4	0	2
	28	12	20	7	2	0	2
Jan	4	12	22	4	4	1	3
	11	14	27	5	5	1	2
	18	12	30	5	4	2	1
	25	13	29	2	6	2	2
TOTAL		575 21%	1323 48%	347 13%	185 7%	212 8%	117 4%

E (VIII) Maize-based cropping system labor utilization (man-hrs ha^{-1}), available family labor (man-hrs $year^{-1}$) and total farm labor utilization (man-hrs) for the individual monitored farms.

Farmer	Maize Crop System	Available* Family Labor	All Crops	Total Farm	% Avail. Lab. Used
	man-hrs/ha	man-hrs/yr	man-hrs	man-hrs	(%)
Kedjom-Ketinguh					
Nuna	5918	6120	4089	4411	(72)
Djikang	3623	9690	2146	2669	(28)
Adih	1830	7650	3071	3252	(42)
Vekeme	2451	9180	3293	3811	(42)
Balikumbat					
Billa	1848	5610	2565	2731	(49)
Liboh	2364	6630	2124	2811	(42)
Hemashi	2750	5100	1614	1691	(33)
Tafili	1557	12750	3634	3943	(31)
Bambalang					
Lapanang	1602	12750	1470	1533	(12)
Nashiera	1675	12240	975	1696	(14)
Tamundongh.	1062	10200	2199	2738	(27)
Tagunu	1947	16830	1838	1975	(12)
Babungo					
Janabuh	750	2040	828	849	(42)
Tifuandonyui	1667	16320	984	1034	(6)
Mensih	1692	8160	1028	1097	(13)
Sanyi	906	11730	842	1172	(10)
Babessi					
Kunde	1096	6630	2210	3668	(55)
Ntobua	1575	6630	2242	3065	(46)
Tawase	1158	20400	2916	3440	(17)
Fuashi	825	9690	1765	3019	(31)
Bangolan					
Jaro	2870	6120	3065	3152	(52)
Jijah	2866	4080	2177	2701	(66)
Kembang	1306	11220	5700	6461	(58)
Ngikwa	969	6120	2021	2570	(42)
Mean	**1838**	**9333**	**2283**	**2728**	**(35)**
SE	158	874	230	254	(4)
CV	9%	9%	10%	9%	(11%)

* Computed as follows:
- family includes husband, wives, children and other household.
- each adult (15 yrs. and above) = 40 hrs/week = 40 man-hrs/week.
- each child (< 15 yrs) = 20 hrs/week = 10 man-hrs/week.

E (IX) Mean monthly hired labor utilization (man-hrs), wage rates (fCFA hr^{-1}) and proportion of farmers (%) using hired labor on the monitored farms.

Month	Mean Total Hired Labor Utilization	Mean Wage	% of Farmers using Hired Labor
	(man-hrs)	(fCFA/hr)	(%)
February '87	1	265	8
March	10	326	29
April	12	189	25
May	7	195	21
June	6	261	25
July	13	200	33
August	27	100	46
September	14	204	33
October	7	200	46
November	4	182	46
December	6	185	38
January '88	7	165	42
Total	114	-	-
Mean	10	206	33
SE	2	16	3
CV	20%	8%	10%
Median	7	198	33

APPENDIX F

Food Crop Commodity Prices

F (I) Mean weekly food crop commodity prices (fCFA kg^{-1}) for six (6) villages in the Ndop Plain* (1987-88).

Week of		Maize Grain	G'nut Grain	Beans	Cocoyam	Rice Local	Rice Imported
Feb	2	72	420	163	53	166	175
	9	69	418	156	51	158	175
	16	69	477	157	49	158	175
	23	72	514	163	49	166	175
Mar	2	78	482	163	52	168	178
	9	73	506	168	52	168	177
	16	75	489	177	52	168	177
	23	78	469	182	51	172	171
	30	81	508	181	52	170	169
Apr	6	82	548	217	53	171	164
	13	82	516	218	52	155	155
	20	87	502	223	52	144	157
	27	91	502	224	54	146	158
May	4	92	503	232	55	147	158
	11	100	530	229	55	147	158
	18	102	549	185	55	151	163
	25	103	493	182	54	151	158
Jun	1	93	524	203	58	147	158
	8	92	499	199	59	144	155
	15	91	529	199	61	140	151
	22	88	532	211	61	136	154
	29	85	479	209	62	135	153
Jul	6	84	538	202	67	134	153
	13	79	541	203	64	134	152
	20	78	543	197	63	130	152
	27	72	491	178	63	134	152
Aug	3	60	517	179	59	137	156
	10	61	459	187	54	131	152
	17	54	431	194	51	135	156
	24	52	458	187	51	137	156
	31	48	472	183	52	140	156
Sep	7	38	402	167	56	142	161
	14	38	406	178	52	140	161
	21	39	401	181	52	138	161
	28	37	390	186	45	143	154
Oct	5	38	389	189	45	141	156
	12	38	381	196	49	148	166
	19	37	373	196	43	152	171
	26	35	374	191	46	154	171
Nov	2	36	392	185	43	158	175
	9	37	349	183	47	155	175
	16	35	378	174	45	155	169
	23	35	379	176	45	157	169
	30	34	366	165	41	153	164
Dec	7	35	349	161	44	157	167
	14	33	380	166	38	160	170
	21	32	326	168	38	155	166
	28	34	255	167	40	155	166
Jan	4	35	268	169	35	154	166
	11	35	306	171	38	142	166
	18	35	313	176	35	150	166
	25	35	316	179	34	150	170

* Kedjom-Ketinguh, Balikumbat, Bambalang, Babungo, Babessi and Bangolan.

APPENDIX G

Monitored Field Crop Yields

and

Farm Produce Sales

G (I) Mean monthly crop yields (kg ha^{-1}), total crop value (fCFA ha^{-1}) and gross returns to labor (fCFA $man\text{-}hr^{-1}$) for the maize-based cropping system.

Month	Maize	Yields G'nuts	Beans	Cocoyam
		(k g / h a)		
February '87	0	0	0	26
March	0	0	0	30
April	0	0	0	0
May	0	0	0	0
June	1	0	4	0
July	133	1	8	0
August	1273	10	14	0
September	566	37	10	0
October	0	5	0	7
November	0	1	0	7
December	0	0	1	2
January '88	0	0	1	5
Mean Total	1973	54	38	77
Median Total	1566	–	–	–

Total Crop Value (fCFA/ha) = 72,999 (70%) + 21,050 (20%) + 7,036 (7%) + 3,402 (3%) = 104,487 (100%)

Gross Return to Labor = 57 fCFA/man-hr
(net of hired labor) = 48 fCFA/man-hr

G (II) Mean monthly farm produce sales* (fCFA), by farm enterprise.

Month	All Crops	Animal Products	Other Goods**	Total Sales
	(f r a n c s C F A)			
February '87	5,695 (91%)	0 (0%)	573 (9%)	6,267
March	818 (22%)	0 (0%)	2,955 (78%)	3,773
April	688 (72%)	0 (0%)	263 (28%)	950
May	925 (35%)	0 (0%)	1,755 (65%)	2,680
June	525 (24%)	100 (5%)	1,520 (71%)	2,145
July	1,918 (75%)	0 (0%)	650 (25%)	2,568
August	3,104 (51%)	75 (1%)	2,868 (47%)	6,046
September	5,829 (71%)	0 (0%)	2,435 (29%)	8,264
October	6,381 (51%)	166 (1%)	6,005 (48%)	12,552
November	6,858 (52%)	1,255 (10%)	5,085 (38%)	13,198
December	28,377 (80%)	1,384 (4%)	5,893 (16%)	35,653
January '88	70,112 (91%)	1,822 (2%)	5,071 (7%)	77,005
Total	131,227 (77%)	4,801 (3%)	35,071 (20%)	171,100
Rice (6 farms)	= 57,527 (34%)			
Coffee (13 farms)	= 33,399 (19%)			
Food Crops (all)	= 40,301 (24%)			

* Net of transportation to market costs.
** Processed foods (egusi pudding, gari, etc.), palm wine, handicrafts (mats, chairs, etc.), etc..